The Practice of
Art and Science

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ARS ELECTRONICA

art & science
european
digital art
and science
network

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Preface

The cultural and intellectual diversity of Europe's countries, regions, and cities is a huge opportunity, since cross-border exchange and collaboration among different disciplines, lands, and cultures are precisely what make innovation flourish. The EU network launched by Ars Electronica in 2014 is dedicated to the exciting symbiosis of media art and science. Seven renowned artistic and cultural institutions as well as leading players in scientific research including CERN, ESO, ESA, and Fraunhofer MEVIS have formed a transcontinental platform in which scientific and artistic issues, methods and visions are interlinked. Artists have the chance to visit some of the world's foremost scientific facilities and gain insights into scientific research practices; the scientists, for their part, are exposed to new perspectives, the focus of which is on the social upheavals triggered by scientific progress. The inspiring results to which such a process of exchange between art and science can lead are demonstrated by this catalog, a compendium of the European Digital Art and Science Network's three-year history.

Enjoy and be amazed!

Thomas Drozda
Federal Minister for Arts and Culture, Constitution and Media

Creative Europe

BUNDESKANZLERAMT ÖSTERREICH

KUNST UND KULTUR

Vorwort

Die kulturelle und intellektuelle Vielfalt in den Ländern, Regionen und Städten Europas ist eine enorme Chance. Gerade im grenzüberschreitenden Austausch und der Zusammenarbeit zwischen unterschiedlichen Disziplinen, Ländern und Kulturen gedeiht Neues. Das 2014 von Ars Electronica initiierte EU-Netzwerk widmet sich der spannenden Symbiose von Medienkunst und Wissenschaft. Sieben renommierte Kunst- und Kultureinrichtungen sowie führende Player im Bereich der Forschung, beispielsweise CERN, ESO, ESA oder Fraunhofer MEVIS, bilden eine europaweite Plattform. Wissenschaftliche und künstlerische Fragestellungen, Methoden und Visionen werden miteinander verknüpft. Künstlerinnen und Künstler haben die Möglichkeit, Leuchttürme der Wissenschaft zu besuchen und Einblick in die wissenschaftliche Forschungspraxis zu bekommen. Die Wissenschaftlerinnen und Wissenschaftler wiederum lernen neue Perspektiven kennen, in deren Mittelpunkt die gesellschaftlichen Umwälzungen im Gefolge der Erkenntnisfortschritte stehen. Zu welch inspirierenden Ergebnissen ein solcher Austausch zwischen Kunst und Wissenschaft führen kann, zeigt der nun vorliegende Katalog, der drei Jahre European Digital Art and Science Network zusammenfasst.

Viel Vergnügen und Staunen beim Lesen!

Thomas Drozda
Bundesminister für Kunst und Kultur, Verfassung und Medien

Creative Europe

BUNDESKANZLERAMT ÖSTERREICH

KUNST UND KULTUR

Gerfried Stocker, Andreas J. Hirsch

Encounters of Great Minds and What is Needed for Them

This book is about the encounters of great minds. *The Practice of Art and Science* looks at the experiences and lessons from the successful work of the European Digital Art and Science Network. In order to enable collaboration of art and science on the highest possible level one could strive for, an alliance was created that brings together leading European science organizations, an array of outstanding cultural institutions in the field of digital art, and Ars Electronica as a kind of "mothership" of the work between art, technology and society.

With support from the European Union this network was able to realize a series of artists' residencies between 2015 and 2017. They took place at such spectacular and groundbreaking research facilities as the European Southern Observatory ESO in Chile, CERN's Large Hadron Collider near Geneva, or in touch with the planetary missions of the European Space Agency ESA. An additional artist-in-residency program in conjunction with the European Digital Art and Science Network was established by Fraunhofer Institute for Medical Image Computing MEVIS and Ars Electronica Linz.

The practice of art and science has been part of the genetic code of Ars Electronica since the beginnings of the Festival in 1979, when it was founded by artist Hubert Bognermayr, scientist Herbert W. Franke, and journalist Hannes Leopoldseder. This "Festival for Art, Technology, and Society" presented art also as a catalyst, which is enabling transformation in those other areas, and thus designed its conferences and exhibitions to allow for ongoing encounters between art and science. In 1996 the growing interest in collaborations between art and science also led to the foundation of two permanent platforms of learning, research, and presentation: Ars Electronica Center as a "Museum of the Future" and Ars Electronica Futurelab as a "Laboratory for Future Innovations." Since then Ars Electronica offers a complete ecosystem for innovation, which actually replicates the entire artistic process from inspiration to experiments on to creation and does so by involving a wide range of disciplines and skills. At Ars Electronica artists, scientists, researchers, designers, and engineers have been collaborating for many years on scientific as well as artistic projects, and presented their results jointly at conferences like "Pixelspaces" or lectured and performed side by side at the annual theme conferences.

Around the turn of the millennium the scope of Ars Electronica widened to Life Sciences and Bio Art, a development that was also reflected in the 1999 Festival *LifeScience* and the 2000 Festival *NEXT SEX*. *Sex in the Age of its Procreative Superfluousness*. With the 2005 Festival *HYBRID—living in paradox,* and the creation of the new Prix Ars Electronica category "Hybrid Art" in 2006/2007, the newly emerging hybrid forms of research and art received additional attention. When in 2011 Ars Electronica Festival, *ORIGIN—how it all begins,* was realized with CERN as a cooperation partner, this was the beginning of a lasting and far-reaching collaboration of Ars Electronica with this leading research organization. From the success of the "Prix Ars Electronica Collide@CERN Award" and the three residencies of its winners at CERN and Ars Electronica Futurelab between 2012 and 2014 finally evolved the plan to open up this axis of collaboration into a network for art and science residencies on a European scale.

The idea behind the European Digital Art and Science Network was to create interesting and successful cases that would stimulate even more dedication in a growing number of science organizations and also to prepare the ground for a rising acceptance within funding bodies to give money for this kind of projects in order to foster the exchange of art and science. From its very start, the project sparked a rapidly growing interest from artists as well as from institutions. As the project went along, the network of partners continued to grow. Probably the best way to value the success of an initiative like this one is the number of similar activities that come up. Also in this respect we may consider the residency program to be successful. In the meantime this increasing attention in facilitating such collaborations even extends to organizations from outside the field of art and science.

Work in the European Digital Art and Science Network turned out to be a learning experience for everybody involved. At the core of this learning process lay something we may call the "art of creating successful encounters of artists and scientists." This kind of expertise is about shaping a set of methods that help facilitate such encounters: find the right partners, prepare the ground for the exchange, and support them along the way. Nurtured by Ars Electronica's eco-system for innovation, this included the entire "production chain" of an artistic project from idea, research, and concept to production and presentation. With the knowledge of Ars Electronica Futurelab from many years of working with artists, and the skillful practice of our cultural partners and of Ars Electronica Festival in presenting digital works of art, this made it possible for the artists to realize projects flowing from the results of their residencies and reach inter-national audiences with them.

The development of methods has in fact been successful in various cases where creativity was employed outside the world of art. The success of "design thinking" for instance is based on a very simple idea and may serve as a good example for this: It is not about telling people who originally do not come from a creative background how to be creative themselves, but about giving them a guideline on how to deal with and work inside creative situations. An approach similar to "design thinking" could lead to a kind of "art and science thinking," and the contours of such new "art and science thinking" are becoming visible through the lessons learned from the European Digital Art and Science Network described here.

Creating successful examples of mutually fruitful encounters of art and science prepares the ground for something that should be the larger goal behind the entire endeavor: To create a new culture of collaboration of art and science that proves useful to society. However, the shared responsibilities of all partners involved can only become productive for society when the process involves the expertise from cultural organizations in facilitating and moderating the encounters and in presenting the results to prepared and informed audiences.

With this perspective towards society in mind, we hope that this publication will serve as a tool that is both effective and useful, which inspires, encourages, and instructs future projects, enabling encounters of art and science—that is, meetings of great minds.

Gerfried Stocker (AT), born 1964, is a media artist and an electronic engineer. Since 1995 he has been a managing and an artistic director of Ars Electronica.

Andreas J. Hirsch (AT), born 1961, is a writer, art curator, and photographic artist. Since 1996 he has been involved with Ars Electronica as curator, juror and artist.

Martin Honzik, Veronika Liebl

Starting the European Digital Art and Science Network

The European Digital Art and Science Network can proudly point to a host of substantial accomplishments—a total of 110 activities showcasing 381 artists from 40+ countries. This project underscores the significance of the European cultural landscape's diversity beginning with project development, through creation & production processes, all the way to presentation and interaction with those partaking of these works. This success is based on three years of close cooperation among curators, producers, and promoters working according to a shared agenda, at the top of which is fostering the collaboration of artists and experts on scientific themes, opening up new areas of activity for artists, and inspiring audiences throughout Europe to behold what these very creative people have done.

Europe's Cultural Landscape in One Project

One of the primary objectives of the European Digital Art and Science Network's concept was selecting an array of partner institutions that mirrors the "essence" of Europe. Europe's cultural diversity and the complexity of its overall geopolitical situation made up the network's qualitative basis as well as the guidelines for the final selection of its members. An essential aspect of this was achieving the greatest possible diversity with regard to individual regional and/or national positioning and the members' respective cultural missions.

The Cultural Partners

- DIG gallery as pioneer of media art in an art-and-science context in Slovakia;
- Kapelica Gallery / Kersnikova Institute in Slovenia as one of the world's longest-established institutions for media art and driving force behind the ongoing redefinition of the avant-garde;
- Center for the Promotion of Science in Serbia as a state institution with an ambitious long-term focus on getting across scientific content;
- LABoral Centro de Arte y Creación Industrial as one of Spain's as well as Europe's largest and most important media art institutions with an educational program focused on its region;
- Zaragoza City of Knowledge Foundation in Spain as a municipal project with remarkable infrastructure in the field of new media and technology that's open to citizens as well as to local and international artists;
- Science Gallery Dublin, Ireland with its qualitatively superb educational programs;
- GV Art in London as the consortium's partner that has done trailblazing work opening up new markets for an artistic genre that is practically nonexistent on the traditional art market;
- Ars Electronica as one of the institutions of longest standing and greatest importance in the media art genre, and which, due to its tripartite orientation as a cultural, educational, and R&D facility, has served as overall project coordinator.

Mutual Benefits

The interaction of small and large cultural institutions is one of the most important factors contributing to successful European collaboration. In projects like the European Digital Art and Science Network, small cultural organizations and initiatives gain access to resources that, in many instances, are essential to their survival, and thereby have the opportunity to make a name for themselves throughout the continent and to establish relationships with renowned cultural protagonists. Large cultural institutions, on the other hand, profit from the dynamics, the innovativeness, and the community orientation of their smaller partners. Europe's future programs to foster culture and creativity have to increasingly take advantage of precisely this diversity and assure that it continues to thrive.

Curatorial Exchange

Instead of organizing individual touring exhibitions or mobility programs, the European Digital Art and Science Network has, from its very inception, accentuated wide-ranging curatorial and intercultural exchange. Particular emphasis has been placed on taking into account the individual backgrounds of the respective project partners as well as considering important regional and/or national networks in the programming process. Four open calls

issued jointly by all network members attracted submissions from 53 countries. Jurors and curators representing all partners met to work on project proposals, nominations, co-productions, and mobile exhibition projects. This is a way to take advantage of synergies, and offer an international showcase to up-and-coming artists in the respective member nations.

Scientific Partners

Whereas diversity was pivotal in the choice of the cultural partners, other criteria applied to the selection of the scientific partners. The task was to identify Europe's leading scientific institutions, cutting-edge innovators that set the global standard for excellence. The network found just the right scientific partners! CERN, ESA, ESO, and Fraunhofer MEVIS each enjoy an international reputation and were gladly willing to provide the selected artists access to internal R&D work, to the unique technical infrastructure available at the respective facilities, and to their staff scientists. The partners succeeded in establishing a form of exchange and a culture of cooperation in accordance with what had already been defined in the network's mission statement and the selection and constellation of the partners themselves. That this goal has indeed been achieved is amply attested to by the results of the residency projects by the participating artists. The point of this cooperation is not to reciprocally enhance the renown of the respective members; rather, it is to pursue shared interests and mutual inspiration, and to blaze new trails in collaboration, production, and presentation. The scientific-artistic work proceeded jointly, with maximum openness and curiosity, on potential solutions at the highest substantive level.

Residencies und Presentations

A specially developed methodology and Ars Electronica's wealth of experience provided the point of departure for this collaboration between art and science within the framework of the European Digital Art and Science Network's six residencies. During a multi-day initial visit to the scientific institution, the particular artist, accompanied by Ars Electronica Futurelab staff experts, presents a concept, delineates precise objectives in discussions with the institution, and selects scientists well suited for collaboration on this project. Following a short pause during which the artist works in his/her own studio to make concrete preparations for the residency, the artist travels to the scientific partner's facility in Chile, Germany, The Netherlands, or Switzerland to spend several weeks engaged in scientific encounter. Finally, the artist works together with Ars Electronica Futurelab's internationally renowned staff of experts in specialized fields such as virtual environments, robotics, media art & creativity, and architecture, as well as Futurelab's leading-edge technical infrastructure. This provides artists with the best possible care and support while they are involved in development processes having to do with digital technologies. Residencies and co-

productions with their relatively high demand for resources and communication are also suitable formats for a calculated effort to spotlight female artists working in the digital art genre, which is why the European Digital Art and Science Network's jury deliberately selected five women and three men for its six residencies at scientific institutions and at Ars Electronica Futurelab.

Targeted Matchmaking

The 815 entries submitted in response to the European Digital Art and Science Network's four open calls illustrate the enormous interest in programs that open doors to bring artists and scientists together. This is a search not only for mentors, but also for protagonists in science and business who desire to collaborate to advance their personal interests. European research subsidy programs such as Horizon 2020 have already recognized the importance of this interface and made possible groundbreaking projects like STARTS and FEAT. And it would be highly desirable for future cultural programs to continue to increase the opportunities for artists to have structured access to interdisciplinary exchange. Meanwhile, essential framework conditions, such as modalities for collaboration and intellectual property rights, have to be defined for such programs.

Cultural Organizations as Intermediaries

Bringing together protagonists from art and science in a way that is sustainable and sensible for all involved entails challenges. It is imperative to develop a common language, to build up mutual respect, and to connect very different worlds. This is precisely the role that has been assumed by the individual members of the European Digital Art and Science Network. As facilitators, they are an integral part of the project's success. Naturally, cultural organizations represent the interests of individual artists. They can open doors to scientific institutions and assure that the collaborations they stage are partnerships of equals. For this decisive intermediary role in the future, however, specifically targeted training & peer education programs will be increasingly important. Accordingly, this should be taken into consideration in future cultural programs.

Educational Programs as Key to the Digital Age

The programs carried out under the aegis of the European Digital Art and Science Network have clearly shown the essential importance of educational programs for the artistic use of digital technologies. It is undisputed that digital technologies open up an unprecedented range of new options for artistic creativity. At the same time, the skills and experience that artists bring with them vary tremendously and constitute in many instances a barrier that prevents them from being admitted to programs like international residencies. This is a reason to foster artists who have ceased thinking in conventional categories, whose

creative work follows an integrative approach, and who have assumed positions as scientists in their own right. To make this step possible, Europe has to improve access to, first and foremost, its cultural subsidy programs and support the financing of practice-oriented training & continuing professional education programs for artists at various points in their career.

The exhibitions conceived and executed as educational platforms within the framework of the European Digital Art and Science Network successfully impart essential scientific content to the visitors who partake of them. And art has long since been integrated into the STEAM educational programs designed to foster creative thinking as well as social, ecological, and economic reflection on the part of kids and young people. Especially in facets of digital media education, which gets far too little attention in traditional school curricula, artists can furnish expertise in the critical application of these media and thus make an important contribution to learning. In this spirit, six cultural partners of the European Digital Art and Science Network have become involved in educational programs for youngsters both in schools and out-of-school learning. The experience gleaned thereby shows that artists can assume an important role in the educational ecosystem, and this simultaneously opens up new fields of activity for them.

New Programs, New Audiences
Moreover, the European Digital Art and Science Network has made it clear that digital technologies and platforms per se aren't all it takes to reach out and connect with new target audiences; the degree of innovation of the programming itself also plays a decisive role. Europe is still far removed from presenting across-the-board cultural programs at the nexus of art and science. As a result, several of the Network's cultural institutions entered into uncharted territory as they had to go about arousing a regional or national audience's interest in their activities to begin with. Thus, the development of a longer-term strategy designed to persuade new target groups to get involved in cultural programs like these calls for a modicum of pioneering.

Cultural Cooperation to Meet Europe's Challenges

Mastering many of the social, ecological, and economic challenges of this day and age will be possible only with creative new approaches. The inclusion of artists and cultural producers in essential social and innovation processes can not only make art accessible to broader segments of the general public, it can also offer artists new areas of activity and provide businesspeople and scientists with new approaches to raising their productivity. An essential factor in this is digitization. Breadth of vision, great insight, and competent application of creativity are ascribed to artists—a set of skills that, in addition to technological and scientific advances, will be necessary to succeed in an age of digital technologies. Cultural projects like the European Digital Art and Science Network illuminate art's role as a catalyst for processes of social renewal in ways that are attractive to audiences.

Martin Honzik (AT) is an artist and Director of Ars Electronica's Festival, Prix, and Exhibitions divisions. He studied Visual Experimental Design at Linz Art University and has an MA in Culture & Media Management from University of Linz and ICCM Salzburg. From 1998 to 2001, he worked at OK Center for Contemporary Art and in 2001, he joined the staff of Ars Electronica Future Lab, where, until 2005, his responsibilities included exhibition design, art in architecture, interface design, event design, and project management. Since 2006, Martin Honzik is director of Ars Electronica Festival and Prix Ars Electronica and is in charge of exhibitions in Ars Electronica Center as well as Ars Electronica's international exhibition projects. His recent achievements, in addition to numerous art projects (e.g. Ganz Linz, Vernichtungsaktion), include co-founding the u19 – CREATE YOUR WORLD festival for young people and serving as head of production and director of the 2012 voestalpine Klangwolke. Martin Honzik was one of the head curators and has been serving as jury member for the European Digital Art and Science Network.

Veronika Liebl (AT) is currently Director of Finance & Organization of Ars Electronica's Festival, Prix, and Exhibitions divisions. She studied Economics and Management Science at Johannes Kepler University in Linz, with study visits at Harvard University (US) and Université de Fribourg (CH). She is currently working on an MBA in Innovation Management at LIMAK Linz—Austrian Business School. Since 2011 she is in charge of cultural management for the Festival/Prix/Exhibitions department at Ars Electronica Linz GmbH, responsible for finances, human resources, public funding, internal operations, and project management. Recently, she is primarily in control of all European collaboration projects under Creative Europe, Horizon 2020, and Erasmus+ and, together with her team, she has carried out numerous EU projects both as project coordinator and as partner, including the European Digital Art and Science Network.

European Digital Art and Science Network

The main idea of the network is to draw a bow between micro- and macro-cosmos of science and digital arts.

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In cooperation with seven artistic and cultural institutions as well as the European Space Agency (ESA), CERN, the European Southern Observatory (ESO), and Fraunhofer MEVIS, Ars Electronica launched the European Digital Art and Science Network, an international initiative offering artists the chance to spend several weeks at CERN, ESO, Fraunhofer Institute for Medical Image Computing MEVIS, and Ars Electronica Futurelab. The network aims to link up scientific aspects and ideas with approaches used in digital art. Fostering interdisciplinary work and intercultural exchange as well as gaining access to new target audiences are among its declared goals. There is also strong emphasis on art's role as a catalyst in processes of social renewal. By creating images and narratives dealing with the potential risks and rewards inherent in technological and scientific development, artists exert an important influence on how our society comes to terms with these innovations.

Co-funded by the
Creative Europe Programme
of the European Union

The European Union Creative Europe program provides half the financing of the European Digital Art and Science Network, the remainder is contributed on an equal basis by the participating institutions. Creative Europe is the European Commission's framework program for the cultural and creative sectors. In cooperation with all the partner organizations, Ars Electronica issued four worldwide open calls for residencies, and besides, Fraunhofer MEVIS and Ars Electronica established an artist-in-residency program in conjunction with the European Digital Art and Science Network. Two calls (fall 2014 and winter 2015) were for residencies at the European Southern Observatory (ESO) in Chile, one (spring 2015) for a residency at CERN in Geneva, Switzerland, one (spring 2016) for a residency at the European Space Agency (ESA), and one residency at Fraunhofer MEVIS in Bremen emerged from a competition by invitation (spring 2017).

From among the entries, the juries of leading experts selected five artists (or artist groups) to take part in the residencies. The artists spent a few weeks at the scientific institutions drawing inspiration from their mentors and their scientific work. Subsequently, they spent an additional residency at Ars Electronica Futurelab, where mentors assisted the artists in the creation and development of new works inspired by their previous scientific residency. The results of the residencies as well as dozens of contextualized artworks have been presented in modular exhibitions and presentations premiering in 2015 and then in 2016 and 2017 at Festival Ars Electronica in Linz and running at the seven artistic and cultural partner institutions.

European Digital Art and Science Network

Partner Network

The basis of the European Digital Art and Science Network is a big manifold network consisting of four scientific mentoring institutions: **CERN, ESO—European Southern Observatory, ESA—European Space Agency**, and **Fraunhofer Institute for Medical Image Computing MEVIS**, representing Europe's finest in scientific research, and offering artists the chance to spend several weeks at their premises and the **Ars Electronica Futurelab**, providing state-of-the-art technical production possibilities in a transdisciplinary discourse, and seven European cultural partners: **Center for the Promotion of Science** (RS), **DIG gallery** (SK), **Zaragoza City of Knowledge Foundation** (ES), **Kapelica Gallery / Kersnikova Institute** (SI), **GV Art London** (UK), **LABoral Centro de Arte y Creación Industrial** (ES), and **Science Gallery Dublin** (IE), which represent strong and diverse European cultural and artistic positions.

Scientific Partners

ESO—European Southern Observatory
Atacama Large Millimeter/submillimeter Array (ALMA)

ESA—European Space Agency
Europe's gateway to space

CERN—the European Organization for Nuclear Research

Fraunhofer Institute for Medical Image Computing MEVIS

Ars Electronica Futurelab

Scientific Partners and Residencies

CERN (CH)

As the cradle of the World Wide Web and home of the Large Hadron Collider that investigates the mysteries of our universe, the European Organization for Nuclear Research (CERN) is an eminent center of digital culture as well as science and technology. As an international center of excellence in these fields it is an inspirational place for artists and designers to explore and extend their research in order to find new artistic approaches. *home.cern*

Arts@CERN is CERN's arts program, designed to make creative connections between the worlds of science, the arts and technology. It is part of CERN's Cultural Policy, agreed in August 2010, which led to the creation of it flagship arts program, Collide@CERN Artists Residencies—Creative Collisions between the Arts and Science, in 2011. The Collide@CERN residency program is already well established and highly regarded, with a proven track record in transdisciplinary artistic excellence and exchange between artists and scientists. *arts.cern/collide*
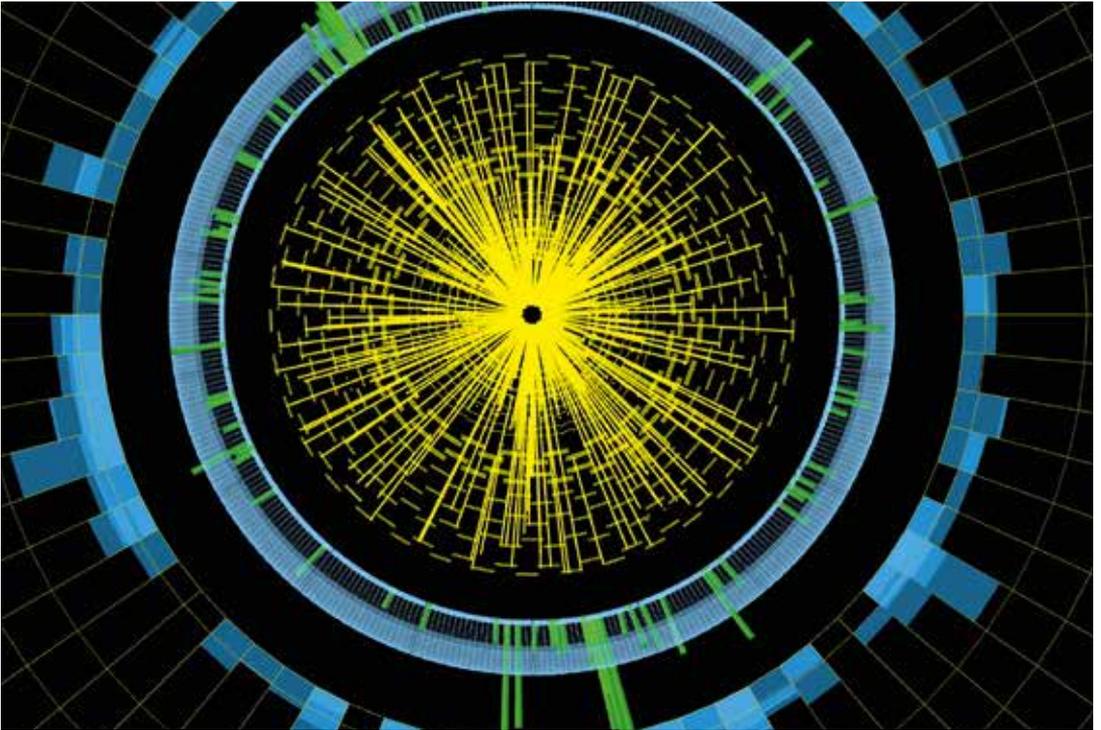

CERN, LHC Large Hadron Collider

Peter Ginter

CERN: Maximilien Brice, CMS Collaboration CERN

CERN, Document Server

CERN / CMS Collaboration

One of the first collisions with "stable beam" at 13 TeV recorded by CMS.

Arts@CERN

The Collide Artists Residency Award is the flagship program of Arts@CERN.

Ariane Koek (UK), an artistic director, cultural producer, cultural policy maker, and strategist, initiated and directed the Collide@CERN program, "working with the transdisciplinary Futurelab team at Ars, the Prix Ars Electronica Arts@CERN Residency Award was created as part of the Collide@CERN—Creative Collisions between the Arts and Science, the artists residency programme initiated and created by CERN in 2010 following a 4-month feasibility study which I carried out." [1]

Rolf-Dieter Heuer, Ariane Koek (both CERN), Gerfried Stocker, Horst Hörtner (both Ars Electronica)

In March 2015 **Mónica Bello** (ES), an independent curator and art critic with expertise in art and science became the new head of Arts@CERN. She served as a jury member for the European Digital Art and Science Network. "For centuries science and art cast together the contour lines of our reality. The way we comprehend our environment, the interactions with other beings, or the understanding of the complex laws of nature, constitute the common drives of art and science through human history. At the current moment, there is a major interest in exploring these hybrid cultures where these two domains of knowledge collide. Today it is possible to imagine a place where artists and scientists can meet and influence each other by using formal strategies and universal imperatives. Far from commenting on scientific facts, illustrating science or communicating advanced technologies, art provides a framework for discussing the complexities that underlie our contemporary scientific culture". [2]

Rolf-Dieter Heuer (DE), a particle physicist, was director general of CERN between 2009 and 2015: "When we launched the Arts@CERN programme little did I know that it would enjoy the great success that it has. In large part, that is due to the partnership we have enjoyed with Ars Electronica, and the quality of the artists who have held the Prix Ars Electronica Collide@CERN. CERN's decision to engage with the arts comes down to a deep-seated conviction that art and science form two aspects of a single culture. The level of heated debate about the so-called 'Two Cultures' is a constant source of bafflement to me. Of course arts and science are linked. Both are about creativity. Both require technical mastery. And both are about exploring the limits of human potential. That's why the motto of the Arts@CERN programme is **'Great art for great science'**." [3]

AEC, rubra

Michael Doser (AT/CH) served several times as a jury member for Prix Ars Electronica's [next idea] category, Collide@CERN Residency Award, and European Digital Art and Science Network and has been working for CERN since 1991, where he is deputy department head of CERN's physics department. He has been working with antimatter since 1983, using it both as a tool and as an object of study, with the goal of understanding the first moments of the universe. In 2002, he was part of the team that made cold atoms of anti-hydrogen for the first time, and he currently leads the Aegis experiment to measure the effect of gravitation of antimatter. He is the author of more than 250 publications related to his work and to the Aegis experiment. He is a CERN Cultural Board Member.

AEC, rubra

1   *TOTAL RECALL, The Evolution of Memory,* Ars Electronica 2013, Hatje Cantz, 2013, p. 307
2   *POST CITY – Habitats for the 21st Century,* Ars Electronica 2015, Hatje Cantz, 2015, p. 181
3   *POST CITY – Habitats for the 21st Century,* Ars Electronica 2015, Hatje Cantz, 2015, p. 181

European Digital Art and Science Network
Artist Residency at CERN

In 2015, the long-term collaboration of Ars Electronica and CERN became part of the European Digital Art and Science Network and was renamed the Collide@CERN Ars Electronica Award. The open call for this award was the great opportunity to realize a new science-inspired project in a fully funded residency for up to two months at CERN, in Geneva, and one month at Ars Electronica Futurelab in Linz.

In early July 2015, the Collide@CERN Ars Electronica Award jury, formed by Monica Bello, Michael Doser (both CERN), Horst Hörtner, Gerfried Stocker (both Ars Electronica), and Mike Stubbs (Fact), met in Linz. A good range of 161 projects from 53 countries was reviewed by the jury, leading to a great debate, discussing what was of value and who would gain most from the opportunity offered by the Collide@CERN Ars Electronica award.

"The winning artists, the British artist duo Semiconductor, demonstrated in previous projects a broad sense of speculation, complexity and wonder, using strategies of analysis and translation of the phenomena into tangible and often beautiful forms. Semiconductor has a long track record of scientific research and previous collaboration with research institutes, e.g. NASA Space Sciences Laboratory in California and the Smithsonian Museum of Natural History. Semiconductor embraces processes that remind us of how our experience of science is framed by tools and artifacts. Their work brings together a deep understanding of materiality, data, and models of natural environments and phenomena. We believe that they will be greatly inspired by their time at CERN and the fundamental physics research being carried out there, and that similarly they will have an impact on the researchers working in the laboratory. In the proposal for their project *A particular kind of conversation* they express a specific interest in exploring quantum phenomena and the subjects of theoretical and experimental practice as carried out at CERN. We foresee multiple outcomes in a variety of media, which we hope will greatly impact the practice and the legacy of science-inspired art."

Statement of the Jury

In fall 2015, the English artist duo started their two-month residency at CERN. During their residency, Jarman and Gerhardt aimed to create a digital artwork elaborating on the nature of the world and our perception of it, including consideration of how scientific instruments and particle physics discoveries influence our perception of nature.

CERN: A Journey Through the World of Science
Text by Ruth Jarman and Joe Gerhardt, Semiconductor

We're in the middle of an intensive journey at CERN, meeting many brilliant minds and bearing witness to incredible dedication, precision and openness at the boundaries of human endeavour. Our time here is precious and we have been cramming in all sorts of visits, meetings and interviews, to see where we may end up.
Much of our time has been taken up talking to theorists and then re-visiting these recorded conversations, not to necessarily learn about particle physics, although that's a nice by-product, but to get a sense of what it is as a language, how the scientists talk about what they do, what it sounds like and how it functions. These talks are really leading the ideas we're developing.
We normally find ourselves looking towards the technology to reveal something about matter that exists beyond our everyday perceptions, but here, it is coming from the theorists. They describe things about the quantum world that shatter our illusions of reality.
We have come to realise that the theorists have access to a kind of extended reality through the models they make and the mathematics they use.

Pictures and illustrations help them, together with CERN physiscist Peter Jenni, to catch a glimpse of what CERN's aims are.

Yes, they do have blackboards at CERN and cosmologist Daniel Figueroa uses them to illustrate what he is talking about.

Michael Doser, expert in Elementary Particle Physics at CERN, gives an overview to this subject matter.

We're interested in continuing this journey and exploring theoretical physics signature on the matter being studied, but at the moment we're struggling with what is real. Beyond the complexities of the quantum we've been delving into other areas of CERN—of which there are many.

The Antimatter factory belongs to one of the first impressions that Semiconductor had during their introduction visit at CERN in October 2015.

Every piece has a number at CERN—and a purpose.

We're interested in exploring how we experience the material nature of particle physics through the lens of science and technology, and this has meant trying to get to the bottom of what the experiments are capturing, how they do it, the materials involved in making it happen, how the data is captured, how it is analysed...

One of the amazing things about CERN is its intriguing history, nearly all these things have been developed on site, and you can often find the people responsible, ready and willing to share their story.

Luis Alvarez-Gaume is the scientific partner at CERN for the artists.

It is a unique hermetic environment that makes for a positive model of people working together to achieve remarkable things. We have been talking to experimenters, software developers, hardware manufacturers, programmers, magnet experts, archivists and visiting workshops, anti-matter factories, control rooms, magnet facilities and networks of tunnels.

Discovering the small pieces of the universe.

We have also begun to film some of the processes we have been observing and are experimenting with ways to visually explore CERNs unique language of science.
Source: *www.aec.at/aeblog/en/2015/08/13/semiconductor/*

Semiconductor

Some of the most exciting treasures are locked in the archives of CERN. Joe Gerhardt and CERN archivist Anita are checking out Bubble Chamber films.

As a result of their residency at CERN and Futurelab, Semiconductor presented their work in the framework of the *Elements of Art and Science* Exhibition at Ars Electronica Festival 2015.
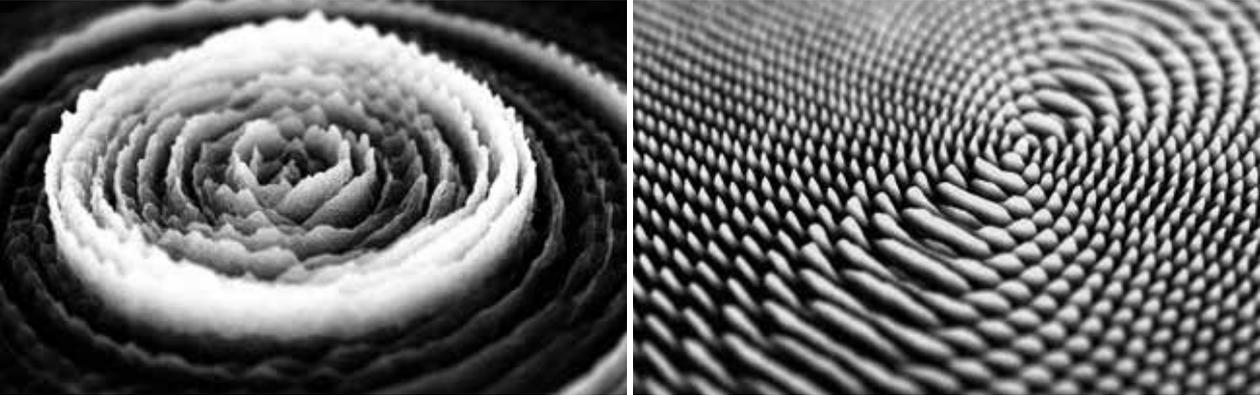
Semiconductor (UK)
A particular kind of conversation

In their art works, the artist duo Semiconductor explores the fundamental material nature of our world and how we experience it through the lens of science and technology, investigating how devices mediate our experiences of nature and position man as an observer of the physical world. They combine methods of filming, animation, sound and dialogue, and re-working and combining actual elements of the scientific language of particle physics (verbal, visual, aural, echnological...) into new forms.

Semiconductor is the UK artist duo Ruth Jarman and Joe Gerhardt. In their artworks they explore the material nature of our world and how we experience it through the lens of science and technology, questioning how they mediate our experiences. Their unique approach has been singled out for recognition with numerous honors and grants. In 2012, they received the Samsung Art+ Prize for new media art, a Smithsonian artist research grant, and a NASA space exploration grant. They have exhibited and screened their works at the House of Electronic Arts in Basel, FACT in Liverpool, the ArtScience Museum in Singapore, the San Francisco Museum of Modern Art, the Royal Academy of Arts in London, the Sundance Film Festival in Utah, and at the Rotterdam Film Festival. Their works *Magnetic Movie* and *Brilliant Noise* are in the permanent collection of the Hirshhorn Museum in Washington DC and the Centre Pompidou in Paris.

ESO – The European Southern Observatory

ESO – The European Southern Observatory (CL) is an intergovernmental organization that has its headquarters in Munich and its observing facilities in Chile. Founded in 1962, today ESO consists of many different observation facilities that helped make a lot of important discoveries in astronomy. ESO has built and operated some of the largest and most technologically advanced telescopes in the world. *www.eso.org/public*
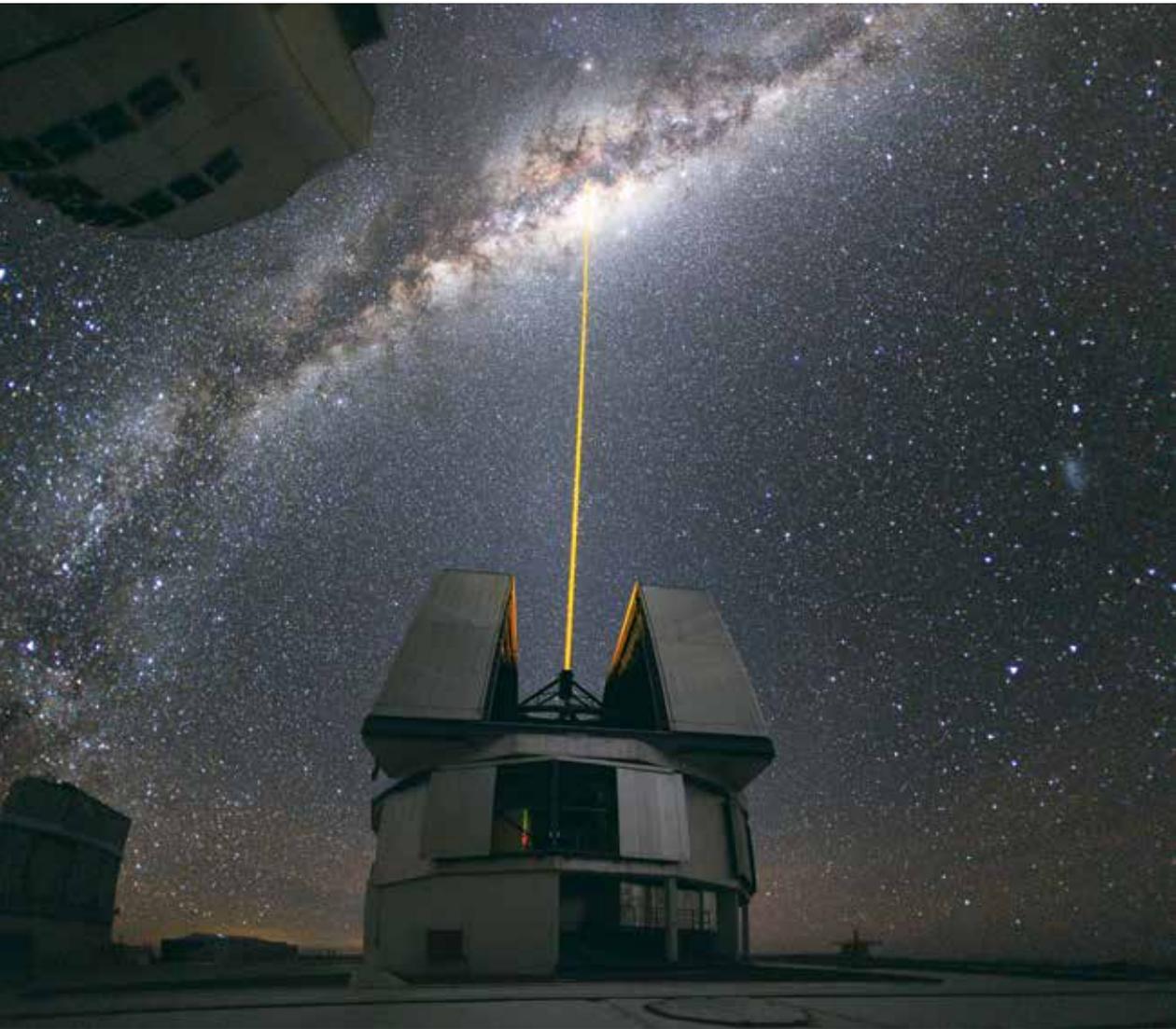
VLT in Paranal

That's how the European Extremely Large Telescope (E-ELT) will look.

La Silla

Atacama Large Millimeter/submillimeter Array (ALMA)

Fernando Comerón, Head of the ESO Representation in Chile: "The residencies at the ESO facilities in Chile, which started in 2015, have given artists the opportunity to visit the observatory of La Silla, the Very Large Telescope (VLT) at Paranal Observatory, and the Atacama Large Millimeter/submillimeter Array (ALMA) on the Chajnantor plain. They also have allowed them to interact with scientists and engineers who work there or who use them for their research projects. The residencies and the works that they inspire provide an example of the strong appeal these special places have not only on the scientists for whom they were built but also on artists, for whom the giant telescopes of the VLT or the antennas of the ALMA acquire a meaning of their own. For the ESO and its personnel working at the observatories, the presence of artists enables a particular dialog where a fresh and enriching perspective is gained, bringing home the fact that science does not talk only to scientists, and that can sometimes reveal unexpected common ground."[1]

Fernando Comerón (CL), PhD, was appointed as head of the ESO Representation in Chile in 2013. Previous to this he was involved in observatory operations for over 15 years and was head of ESO Data Management and Operations Division, located in Garching near Munich. His research interests are in star formation, galactic structure, and young stellar objects at both high and low masses, fields in which he has published over 80 papers in international refereed journals. He was a member of the Jury for the Digital Art and Science Network several times.

1 *RADICAL ATOMS and the alchemists of our time,* Ars Electronica 2016, Hatje Cantz, p. 159

European Digital Art and Science Network
Artist Residency at ESO

The first art and science residency at ESO went to María Ignacia Edwards from Chile. She was selected from among the 140+ applicants from 40 countries who responded to the open call. The decision was reached by a 10-member jury made up of representatives of Ars Electronica, the European Southern Observatory and the seven cultural partner institutions that make up the Art and Science Network. The artist spent the residency at the European Southern Observatory in Chile and subsequently at Ars Electronica Futurelab in Austria.

The jury deliberation took place from 23. – 25.02.2015 in Linz at the Ars Electronica Center. Jury members Gerfried Stocker, Horst Hörtner (both Ars Electronica), Fernando Comerón (ESO), Slobodan Coba Jovanović (Center for the Promotion of Science), Richard Kitta (DIG gallery), Robert Devčić (GV Art London), Jurij Krpan (Kapelica Gallery), Lucía García Rodríguez (LABoral), Diane Mc'Sweeney (Science Gallery Dublin), José Carlos Arnal, Fermín Serrano Sanz (both Zaragoza Foundation) issued the following statement: "The artist works with space, endeavouring to maintain the balance, suspension, lightness, and weightlessness of objects, which are sustained by their own weight and counterweight. The constructions are the result of exquisite prior calculations, mechanisms, solutions, and interventions. María Ignacia Edwards calls these pieces *self-sustainable* because they require no more than their own weight to exist, and the objects tend to rotate constantly around their own axis. The artist invites beholders to observe each object as if they were stars in the firmament. While, at first sight, her approach might seem purely plastic, it transcends science and particularly physics and mathematics, and in the jury's view, it is especially attractive for the potential it offers for the residency. The artist makes a great effort to connect both the inspiration and the outcome of the work to characteristic features of astronomy: isolated objects in weightlessness. The work is thus intended to evoke astronomy-inspired awe. The presentation is very well elaborated and clearly transmits the idea of the project, though it also promises great potential for development in both residency venues."

Statement of the Jury

María Ignacia Edwards
Art and Science: A Cosmic Inspiration

AEC, Claudia Schnugg

Together with Fernando Comerón, the ESO's representative in Chile, and Claudia Schnugg, the artist's mentor at the Ars Electronica Futurelab, María Ignacia Edwards took an inspection tour through Chile in mid-May 2015. The aim of her first journey of inspiration was to reconnoiter potential locations for her residency in Chile and to get to know the scientists and technicians working there as well as the technology behind this huge endeavor.

The "big sky country" of the Atacama Desert about a one-hour drive from Antofagasta in northern Chile is the home of the Very Large Telescope (VLT) and an especially wonderful spot from which to peer into outer space. The VLT in Paranal is the world's most advanced optical instrument. It consists of four unit telescopes with main mirrors 8.2 meters in diameter that can be operated individually or can work together to form a giant interferometer.

Here, the staff gathers data that's indispensible to scientific research on the cosmos. Scientists from all over the world gather in Paranal. Each is the lucky recipient of one of the precious positions on the staff of this high-tech data production machine. Garnering "observing time" is no simple matter, but the potential rewards are tremendous. For example, the oldest star in our Milky Way galaxy was identified with the help of the VLT. And it also took the first picture of a planet outside our solar system.

María Ignacia Edwards visited ALMA, the Atacama Large Millimeter/submillimeter Array. At 5,000 meters above sea level, the world's largest radio telescope has 66 antennas spread out across this arid expanse to scan the sky in all directions.

"ALMA inspires me: There is the power of the desert, the sun, and the illusion of understanding and witnessing the mechanism in action with all those antennas moving at once... the harmony in the accuracy of the movement, which is one of the essential elements that inspire my work."

In the 1960s ESO built the first observatory La Silla. This facility includes several telescopes, which are operated by ESO as well as other institutions.

"The visit to La Silla was overwhelming, I found a place that seems suspended in time and over the clouds, with the beauty and the weight of past time on things, it touched me deeply. I could feel a nostalgia and melancholy for what it used to be and that somehow still is, moving at its own time and rhythm. A place apparently full of stories."

The artist spent a few weeks at the scientific institution and derived inspiration from her mentors and their scientific work. Subsequently, she spent an additional residency at Ars Electronica Futurelab, where mentors assisted the artist in the creation and development of new works that were inspired by her previous residency at ESO.

María Ignacia Edwards and Stefan Mittlböck-Jungwirth-Fohringer at Ars Electronica Futurelab building the swing.

The outcome of the residency, *Encounters,* was then showcased as part of the *Elements of Art and Science* exhibition that premiered at the 2015 Ars Electronica Festival. María Ignacia Edwards conceived her work in such a way that the main portion of the project remained in Linz and other parts could be presented at the other European Art and Science Network member institutions.

Text: Claudia Schnugg, Martin Hieslmair/Ars Electronica
www.aec.at/feature/de/cosmic-inspiration

María Ignacia Edwards

Encounters for Mobile Instrument of String and Air

María Ignacia Edwards works with equilibrium, lightness, and weightlessness of objects that she brings into balance by deploying their own weight or counterweights. Though, at first glance, her works are perceived as purely aesthetic, artistic objects, it soon dawns on those who behold them that these constructions are the result of elaborate mathematical and physical calculations. Based on her experience at the ESO observatories La Silla and ALMA, María created a *Mobile Instrument* that is able to capture the movement of pieces located at distant places by a mechanism as a reference to time and the motion of the universe.

María Ignacia Edwards (CL), born 1982, is an artist from Santiago, Chile. After getting her Arts bachelor degree from Finis Terrae University in Santiago and her Diploma in Cinema, Art Direction and Photography from the University of Chile, she lived and worked in New York City from 2009 to 2012. During this time she also did an artistic residency at the School of Visual Arts and in the Lower East Side Printshop. In 2012, she received an invitation from the Arts Cultural Center in Mexico, Reinosa/Tamaulipas, to perform an individual exhibition, *In Between,* within the Tamaulipas International Arts Festival. The artworks of María Edwards were also exhibited in Chile, Spain, USA, Argentina, Peru, and Mexico. She has participated in international fairs: Pinta Art Fair in New York, ArteBA in Buenos Aires, Art Lima in Peru, and ChaCo in Chile. She was awarded the honor prize Art for Science, granted by the National Commission for Scientific and Technological Research (CONICYT) in Santiago, Chile. María I. Edwards was the first artist in residency in the framework of the European Art and Science Network. *www.aec.at/artandscience*

European Digital Art and Science Network
Artist Residency at ESO

Following María Ignacia Edwards' residency at ESO in 2015, the members of the Quadrature artists' collective, Jan Bernstein, Juliane Götz, and Sebastian Neitsch (all DE), were the next recipients of the European Digital Art and Science Network residency at the European Southern Observatory in 2016.

After 2 days of Jury deliberations (22. – 23.02.2016) the members of the jury, Gerfried Stocker, Horst Hörtner, Martin Honzik (all Ars Electronica), Slobodan Coba Jovanovic (CPN), Richard Kitta (DIG gallery), Fernando Comerón (ESO), Robert Devčić (GV Art London), Jurij Krpan (Kapelica Gallery), Lucía García Rodríguez (LABoral), Lynn Scarff (Science Gallery Dublin), and Fermin Serrano Sanz (Zaragoza City of Knowledge Foundation) issued the following statement: "Quadrature are not new to the exploration of space; their previous work has tracked the movement of the Voyager space probe and given it a physical, kinetic manifestation here on Earth. This making the unseen visible was an exciting proposition of their proposal for the ESO residency. As a collective, their practice is already embedded in the processes of collaborative practice that are critical to the success of an art science residency of this nature. Their proposal addressed questions around how their work would develop and manifest in a physical exhibition space like Ars Electronica and offer a compelling experience to visitors, enabling them to sense the unseen, to momentarily lift off and experience deep space. Their intimate knowledge of the constraints and possibilities of the technology at ESO demonstrated a body of knowledge and work that sets the scene for exciting outputs. In summary, the members of the jury are assured that Quadrature's residency at the ESO in Chile and at the Ars Electronica Futurelab in Linz has significant artistic potential and innovation within the art science space."

Statement of the Jury

A Trip Close to Outer Space

In 2013, Jan Bernstein, Juliane Götz, and Sebastian Neitsch, who met at art school founded the artists collective Quadrature in which each of them contributes his/her own skills and focal-point topics. The artists, not only bring to the table tremendous interest in and prior knowledge about ESO's locations in Chile; two of their previous projects—*Voyager* and *Satellites*—dealt with very similar topics. Finally in late May 2016 they departed for Chile to get a close-up look at the European Southern Observatory's locations there and get acquainted with scientists on site. As Sebastian Neitsch put it "We won't soon be taking another trip so close to outer space!"

Sebastian Neitsch

The first stop on the itinerary was ESO's headquarters in Santiago, where the artists had their first meeting with the organization's scientists and astronomers. After this round of socializing with lots of new names and faces, things calmed down considerably and the artists headed into the huge expanses of the desert landscape. On the access road to Cerro Paranal, a mountain about 12 kilometers from the Chilean coast, a sense of joyful anticipation took hold of them. The Paranal Observatory is perched at an altitude of about 2,600 meters above sea level; its telescopes are visible from afar.
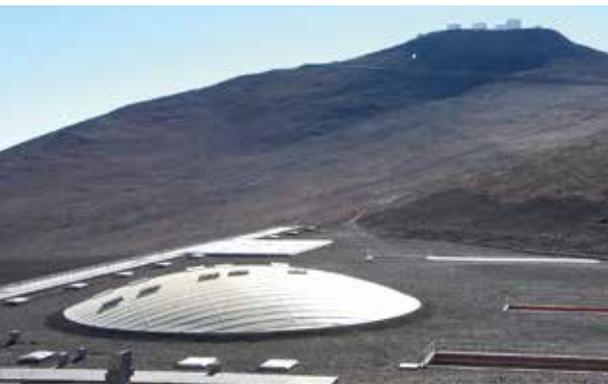
Just like its bigger associates, the little UT5's roof slides back to let you get a good look into the endless expanses of the cosmos.

Four huge telescopes are ensconced in Paranal. They're named Antu, Kueyen, Melipal and Yepun, and are so-called unit telescopes (UT1 to UT4) that make up ESO's Very Large Telescope (VLT).

Quadrature at the VLT platform: Fernando Comerón personally explains to the three artists how the VLT works, how the giant telescope can rotate, what calibrations are necessary, and the functions of the reflectors and lasers.
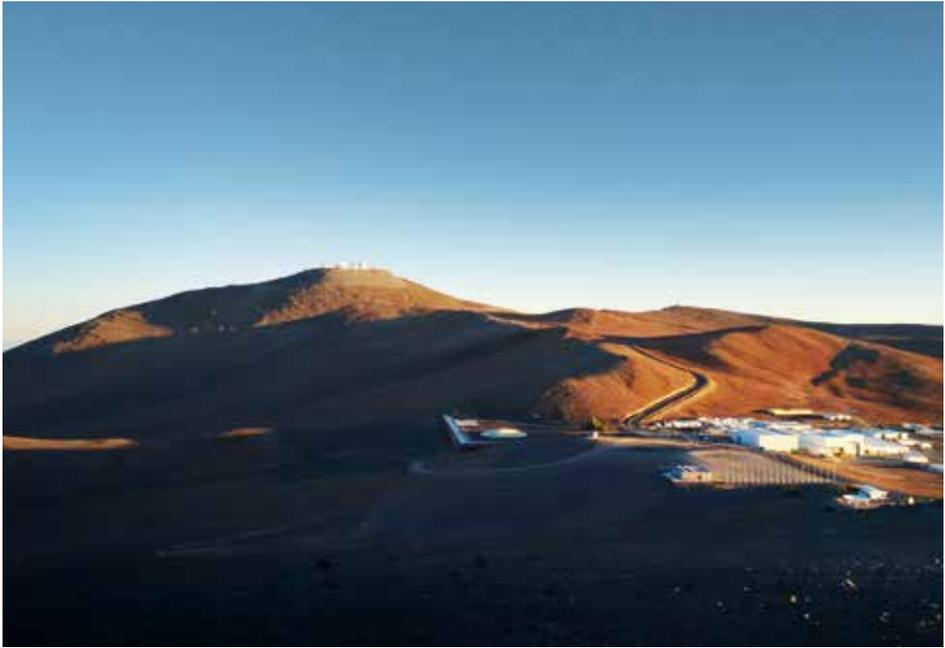
The next stop on the tour of Paranal is ESO's coating area, where the reflectors used in the telescopes are recoated with aluminum.

Since the reflector's reflective coating deteriorates over time—due to oxidation or wear and tear—these sensitive elements have to be recoated every few years.

At some locations in Paranal, shoes need to be covered up too for the sake of the delicate devices.
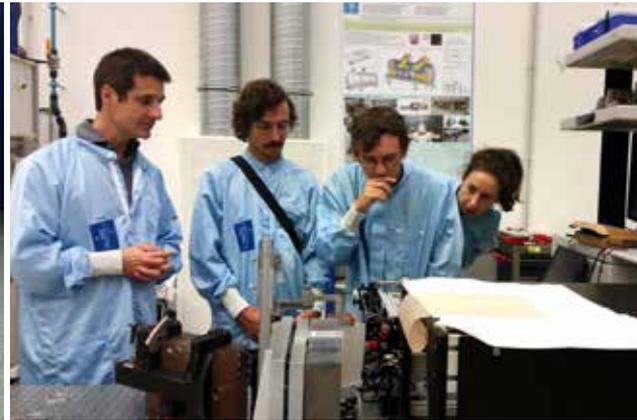
Shortly before the end of this leg of their protracted journey, the artists dropped in on the Integration Lab, where Samuel Leveque described tests being performed there.

Samuel Leveque

Fernando Comerón (ESO Chile), Claudia Schnugg (Ars Electronica Futurelab), Jan Bernstein, Juliane Götz, and Sebastian Neitsch (Quadrature)

Text: Martin Hieslmair
Source: *www.aec.at/feature/de/esoexpedition*

The next stop on Quadrature's itinerary was Ars Electronica Futurelab in Linz, where, in September 2016 at the Ars Electronica Festival *RADICAL ATOMS and the alchemists of our time,* the audience could see what the artists' collective had made out of their Residency.

Quadrature (DE)
STONES
Storage **T**echnology for **O**bserved **N**earby **E**xtraterrestrial **S**helters

Astronomical research is very much subject to the human tendency to observe and evaluate any findings within the context of our own culture. Yet the truth of scientific results goes far beyond the duration of our current civilizations. Just the detection of exoplanets* in the habitable zone already constitutes a scientific milestone. Detached from any contemporary interpretation, the work archives pure knowledge for the coming millennia. In a notation that requires no previous cultural education but can be deciphered based on logic and scientific observation, the knowledge itself is the main message.

* A planet outside our solar system, orbiting its parent star in a particular area so that water may be present on its surface in liquid form. This is regarded as a prerequisite for the emergence of life. So far, 42 such objects have been identified. (Source: Planetary Habitability Laboratory, UPR Arecibo.)

AEC, Tom Mesic

AEC, Florian Voggeneder

Quadrature (DE)
MASSES
Motors **a**nd **S**tones **S**earching for **E**quilibrium **S**tate

We place two stones on top of a balanced steel plate. The aim of the machine is to position the stones so that the system is perfectly balanced. In an incessant process, continuous efforts repeatedly briefly avert the constant threat of divergence, only for it to appear elsewhere a moment later. Instead of the desired state of well-adjusted stability, the work achieves a permanent state of incessant motion—a fragile but constant situation between falling and floating. As the precision of modern research instruments advances, so their vulnerability increases, and with it the need to compensate for even the smallest disturbing influences. Supported by a machinery of sensors and people, the apparatus performs an endless sequence of observation and calibration.

ESA – The European Space Agency

ESA-Anneke Le Floc'h

ESTEC, aerial view

In 2016 ESA joined the project as a new scientific partner. ESA—the European Space Agency—is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world. ESA is an international organization with 22 Member States. ESA's job is to draw up the European space program and carry it through. ESA's programs are designed to find out more about Earth, its immediate space environment, our Solar System, and the Universe, as well as to develop satellite-based technologies and services, and to promote European industries. ESA also works closely with space organizations outside Europe. *www.esa.int*

This residency at ESA offers artists an extraordinary opportunity to visit the European Space Research and Technology Centre (ESTEC) in Noordwijk, the Netherlands. ESTEC, the largest of ESA's establishments, is the incubator of the European space effort, where most ESA projects are born and where they are guided through the various phases of development. There, artists can view ESA's environmental test centre for spacecraft and visit other laboratories specialised in systems engineering, components, and materials. During the residency, artists can get acquainted with all aspects of ESA's Space Science Programme, comprising a fleet of space telescopes performing astronomical observations across the electromagnetic spectrum and space probes exploring a variety of Solar System bodies. The residency also offers the unique chance to experience one-of-a-kind events, such as the arrival of the ExoMars mission at Mars, in October 2016, at ESA's European Space Operations Centre (ESOC) in Darmstadt, Germany.

The ESA Residency program is co-curated by Claudia Mignone and Karen O'Flaherty, and was initiated by Mark McCaughrean " ... Investigating our cosmic origins is a major theme in the Space Science Programme of the European Space Agency (ESA), which operates a fleet of missions that allow European scientists to be at the frontier of astrophysics, planetary science, solar and fundamental physics. It's sometimes easy to forget, while caught up in the daily duties of scientific research, that space science tackles questions that spark curiosity at a deeper, more fundamentally human level. These questions concern the very essence of our existence on this planet—not as mere individuals but as part of a cosmic tale that started eons before us and that will continue long after we are gone. These questions do not pertain exclusively to science, but are central to many other domains of culture and research, and in particular to the arts. In recent years, in our role as communicators of ESA's Space Science Programme to the broader public, we have met and interacted with a number of artists who had been inspired by ESA missions, by their results, and by the vision that brought them about. These artists wanted to learn more, to probe the scientific and technological processes that enable the spirit of enquiry to leave Earth's gravitational pull to research the Universe from space. During these interactions, we appreciated the variety of perspectives that artists have on the scientific endeavour and were intrigued by how their curiosity is triggered by aspects that may differ from those pursued by scientists. These perspectives often provide refreshing insights into the science of the cosmos. So we were honoured when Ars Electronica invited ESA to join an exciting collaboration, researching the common ground between art and space science through an artistic residency, to be spent partly at ESA's European Space Research and Technology Centre (ESTEC) in the Netherlands, and partly with the creative team at Futurelab in Austria. (...)[1]

Mark McCaughrean (UK) works for the European Space Agency, where he is the Senior Advisor for Science & Exploration and is active in communicating the scientific results from ESA's astronomy, heliophysics, planetary, and fundamental physics missions. Following his PhD from the University of Edinburgh in 1988, he has worked in the UK, the US, Germany, and the Netherlands. His personal research involves observational studies of the formation of stars and their planetary systems using state-of-the-art ground- and space-based telescopes. He is an Interdisciplinary Scientist on the Science Working Group for the NASA/ESA/CSA James Webb Space Telescope.

Claudia Mignone (IT), (Vitrociset Belgium for ESA – European Space Agency), is an astrophysicist, science writer, and communicator. After studying Astronomy at the University of Bologna and obtaining a PhD in Cosmology at the University of Heidelberg, she decided to embrace a full-time career in the public outreach of science, and has been working as a science writer for ESA since 2010. Together with Karen O'Flaherty she has served as a jury member, representing ESA, for the European Digital Art and Science Network.

Karen O'Flaherty (IE), (EJR-Quartz for ESA – European Space Agency), is a scientist, editor, and writer. A graduate of University College Dublin, she has worked at the European Space Agency (ESA) since obtaining her PhD in Astrophysics. During her time at ESA she has specialized in outreach to different audiences and has been involved in many innovative communication initiatives for ESA's science missions. She is currently chief editor for ESA's Science & Technology and Robotic Exploration of Mars websites. Together with Claudia Mignone she has served as a jury member, representing ESA, for the European Digital Art and Science Network.

1   Claudia Mignone, Karen O'Flaherty, and Mark McCaughrean, "When Art and Space Science meet" in *RADICAL ATOMS and the alchemists of our time,* Ars Electronica 2016, Hatje Cantz, p. 162

European Digital Art and Science Network
Artist Residency at the European Space Agency

The recipient of the first art&science@ESA residency, is Aoife van Linden Tol. Her winning proposal was selected from 139 submitted projects by an international jury including representatives from ESA, Ars Electronica, and members of the European Digital Art and Science Network.

The Jury meeting was held at Ars Electronica in Linz from 08.07. – 09.07.2016 and the Jury included Gerfried Stocker, Horst Hörtner (both Ars Electronica), Claudia Mignone and Karen O'Flaherty (both representing the European Space Agency), Dobrivoje Lale Eric (Center for the Promotion of Science), Richard Kitta (DIG gallery), Karin Ohlenschläger (LABoral), and Jurij Krpan (Kapelica Gallery). In their statement they gave their reasons:

"Aoife van Linden Tol is a multidisciplinary artist working primarily with explosive media and inspired by different scientific disciplines like chemistry, physics, and cosmology. By using explosions as a creative way to explore not only concepts of time, density, and matter but also deep human emotions, she is able to create beautiful and poetic as well as strong and devastating moments and experiences in art. With her project *Star Storm*, which tackles the life-cycle of stars and the physical processes of stellar formation and evolution across the Universe, she was able to convince the jury that she is the right artist for this first opportunity of a residency at the ESA's European Space Research and Technology Centre. What impressed the jury the most was her individual approach in asking and exploring fundamental questions about our Universe".

Statement of the Jury

art&science@ESA residency

For the art&science@ESA residency, Aoife proposed *Star Storm,* a spectacular performance inspired by the physical processes that characterize the life of stars. Asked to explain the connection between the theme of explosions and the Universe in her performance, the artist explains: "From the Big Bang to solar mass ejections and supernovae, the spacescape is alive with explosions. With *Star Storm* I plan to use explosives to describe some of the physics of the stars and of our Sun in particular. I have an instinct about how I will do this but actually the design will come directly from the research at ESA. For example, one of my interests is the journey that light and other particles from stars take in their lifetime, traveling across the Universe and then interacting with our atmosphere and the Earth. I wonder if I can describe this journey as one of the performances."

Aoife van Linden Tol experimenting at Ars Electronica Futurelab

Questioned on her plans for the residency at ESTEC and at Ars Electronica Futurelab, Aoife van Linden Tol replied: "ESTEC is very much about learning for me. Absorbing information, asking lots and lots and lots of questions. I am a little worried that I am going to drive them crazy! All the research will help to design a new body of work including the explosive performances for Ars Electronica 2017. Futurelab will very much be about experimenting. I will need to test all the techniques I have designed, which is quite a process. I would also like to discover new ways to trigger the explosions. I am very interested in how a tipping point is reached for a reaction to start. Perhaps the audience can create the electrical current needed for example."¬

Source: *https://www.aec.at/aeblog/en/2016/08/03/aoife-van-linden-tol*

Aoife van Linden Tol (IE)
Star Storm

Star Storm, a spectacular, site-specific explosive performance inspired by the processes of the stars, was presented at Ars Electronica Festival 2017 *ARTIFICIAL INTELLIGENCE – The Other I* in Linz. Using research from the European Space Agency on the composition, life cycle, magnetic behavior, and light production within stars, including our Sun, the artist designed a powerful and beautifully poetic experience. Taken on an emotional and physical journey, the audience witnessed a series of explosive and pyrotechnic events, each of which represented a specific phenomenon taking place every moment in stars all across the Universe. Each section of the performance is varied and distinct—creating a wonderful contrast of energy and experience from exciting to meditative, from durational to instant, from order to chaos, reflecting the Universe we live in and the discoveries we have made about it. The work incorporates cutting-edge technology, allowing the audience to trigger the electrical charge needed to initiate the explosive chain reaction, highlighting the tipping point at which equilibrium is instantaneously and irreversibly transformed. *Star Storm* aims to create a unique and lasting experience which gives audiences insights into the very nature of our universe and their own place within it.

Aoife van Linden Tol (IE). Beginning in 2000, Aoife van Linden Tol's work with explosives fused her interests in nature, cosmology, chemistry, and physics. A multi-disciplinary artist, her practice spans sculpture, installation, drawing, photography, film, and performance. She creates abstract works that often examine concepts of time, density, and matter as well as deep human emotions and motivations. She has exhibited internationally including at the ICA, London, the San Francisco MOMA, and the NGBK Berlin. Aoife has recently worked with Imperial College London, researching light spectra for a series in neon, and was invited by Disney to design a limited edition model Star Wars BB-8 robot that was auctioned by Force for Change charity, benefiting Great Ormond Street Hospital, London.

European Digital Art and Science Network
Artist Residency at Fraunhofer MEVIS

Fraunhofer MEVIS

Embedded in a worldwide network of clinical and academic partners, Fraunhofer MEVIS develops real-world software solutions for image-supported early detection, diagnosis, and therapy. Strong focus is placed on cancer as well as diseases of the circulatory system, brain, breast, liver, and lung. The goal is to detect diseases earlier and more reliably, tailor treatments to each individual, and make therapeutic success more measurable. In addition, Fraunhofer MEVIS is committed to raising awareness about how computerization influences health care and to inspiring the young to consider career pathways in science by showing new ideas, approaches, and possibilities that emerge from innovative R&D. The aim is to foster the engagement with, and ownership of future technology. *www.mevis.fraunhofer.de*

Fraunhofer MEVIS and Ars Electronica established an artist-in-residency program in conjunction with the European Digital Art and Science Network. Bianka Hofmann, Head of Corporate Communication at Fraunhofer Institute for Medical Image Computing MEVIS, explains the potential she sees in connecting art and science: "We need a new avant-garde that feeds on the fusion of natural and social sciences, technology and art, and develops societal utopias—neither dystopias nor promises of technological salvation. People cannot comprehend or constructively deal with complex questions in 20-minute presentations or 140 characters. Expert knowledge, time, devotion, and understanding are needed. What we are capable of though is socially and accessibly incorporating and acknowledging this expertise as well as possible. Nerdy is the new awesome! Media-cultural developments such as the sitcom Silicon Valley are just one expression of this. Research, development, and art do not exist in a societal vacuum, and are usually not devised by isolated geniuses. What ideas for the future, sustainable beyond our own lifetime, do we want to carry forward? How do we want to talk about new possibilities in medical technology and describe their development? Every view of the world, including the scientific view, is also a choice of perspective, a specific door to enter. Remembering or even realizing this is an important step towards acknowledging and exploring other perspectives such as art."[1]

Bianka Hofmann (DE) inspires people with new ideas in science, research, and art and the possible impacts of future technology. To encourage people to engage with and create their own experiences, she focuses on innovative communication concepts. She works at the Fraunhofer Institute for Medical Image Computing MEVIS, where she developed the institute's strategic press and media work and science communication and is now the Head of Corporate Communication. Before she worked at the University of Bremen on transferring new knowledge from the universities into schools. She studied Comparative Religion and Biology and is a qualified communication coach.

1   Source: *https://www.aec.at/aeblog/en/2017/01/30/steam-imaging*
     Bianka Hofmann in an interview with Martin Hieslmair, Ars Electronica, March 1, 2017

STEAM Imaging
An artist-in-residency program focusing on links between art and science

The Fraunhofer Institute for Medical Image Computing MEVIS has established an exciting artist-in-residency program that focuses on links between art and science. It is also integrating pupils into this experiment. Educators have been aware of the need to promote the STEM subjects Science, Technology, Engineering, and Mathematics for decades now, and measures have been prescribed for elementary school classroom instruction in order to ensure an early start and pave the way to an innovative society.

In the meantime, the acronym has acquired an additional letter. The "A" that now makes STEAM stands for Arts. Accordingly, Fraunhofer MEVIS has launched STEAM Imaging, which gives an artist the opportunity to spend a residency of several weeks working closely together with staff researchers at Fraunhofer MEVIS in Bremen, Germany, and co-developed and held a STEAM workshop for pupils. Then, she spent several weeks at Ars Electronica, Linz, which hosted another STEAM workshop. The artistic outcome of these encounters was presented at Ars Electronica Festival, September 2017 in Linz within the framework of the European Digital Art and Science Network.

Yen Tzu Chang (TW), the recipient of the residency STEAM Imaging, jointly hosted by Fraunhofer Institute for Medical Image Computing (MEVIS) and Ars Electronica, had the unique opportunity to work closely together with the Institute's research staff. The Taiwanese media artist, whose previous works have included experimental sound performances, specializes in creating customized electronic instruments. Yen Tzu Chang also agreed, together with the scientists, to lead workshops for pupils in the 7th to 9th grades in Bremen and Linz in cooperation with the International Fraunhofer Talent School Bremen in March and June 2017. Following her residency, the outcome of this encounter of art and science in the field of medical imaging, *Whose scalpel,* was featured at Ars Electronica Festival *ARTIFICIAL INTELLIGENCE – The Other I* in September 2017.

https://www.aec.at/artandscience/en/artists/yen-tzu-chang

The medical imaging and sound art concert

AEC, Martin Hieslmair

Hands-on projects for the next generation that focus on STEM topics as mathematics, informatics, and physics have a long tradition at Fraunhofer MEVIS. By expanding the proven workshop practices to an artistic level Fraunhofer MEVIS enters new territory. STEAM Imaging includes the explicit assignment for the artist to carry out school workshops. The Taiwanese artist Yen Tzu Chang working with young students.

Yen Tzu Chang
Whose scalpel

Whose scalpel is a sound performance combined with visual and 3D printed installation, realized with an application framework for medical image processing. Mixing several methods from art and science, it is an imagination of the future and presents the issues of the relationship between human and machine during heart surgery. The concept is developed from three different areas—the application of sound in medical science, coronary artery bypass surgery, and machine learning. The background story of the performance is based on the assumption that in the near future a surgeon works with the machine that can give advice during surgery. Sound is chosen as the media of the performance because it helps to create a scene and atmosphere. On the other hand, sound plays an important role in medicine. For instance, it is well known that the heart pumps blood through the whole human body with a regular frequency, which can be used to help diagnosis. Another famous application of sound in medicine is the stethoscope, which was

invented in the 19th century for auscultation and allows listening to the internal sound of organs in the chest such as lungs and heart. Another state of the art example is the video from the Fraunhofer MEVIS YouTube channel, *Auditory guidance prototype for navigated liver surgery*[1]. The video shows that if the scalpel deviates from the correct cutting path, the device will make a different sound to notify the surgeon.

The heart as one of the most important human organs—both from the perspective of biology or symbolism in the society is the focus of the surgery. The heart is an installation, which is built according to the performer's real heart from MRI scans, but is larger than its actual size. It is printed out by a 3D printer and surrounded by aluminum structures. To make the heart installation like a musical instrument, the inner part of it is equipped with Arduino, LED, and electronic components and the surface is covered with silicon and transparent vessels. It is designed to interact when the performer plugs in audio cables and bridges connections, similar to the method of coronary artery bypass surgery. Coronary artery bypass surgery is a type of heart surgery used for treating coronary artery disease, caused by the inner wall of arteries becoming blocked by fat. To supply enough oxygenated blood to the heart muscle, the doctor takes the blood vessels (or grafts) from the patient's leg, chest, or wrist and places it above and below the end of the blocked area so that the blood can go through the new grafts to reach the heart muscle.[2] This method enables blood to flow through the new path, and it is a similar approach with operating a modular synthesizer to some extent, which is about letting the signal go through one modular to the other to produce the sound. In the heart installation, plugging in the cables, as a similar act, triggers the sound from Pure Data.

The AI is another character in the performance. It is created according to the technology trend. Since Alan Turing, an English computer scientist, submitted his article "Computing Machinery and Intelligence,"[3] a new era began and the question: "Can machines think?" was raised. One large topic in artificial intelligence is machine learning, which, according to American pioneer Arthur Samuel means, "giving computers the ability to learn without being explicitly programmed".[4] The theory of it is, by designing algorithms to analyze portions of data, insights may be discovered and predictions may be made. Machine learning has been applied in many fields. In the medical field, machine learning is applied in diagnosis. According to Fraunhofer's 2016 press publication, it can help physicians to distinguish tumors from CT and MRI scans.[5]

In the performance, an artistically imagined AI will be in charge of more important medical tasks such as analyzing the patient's body condition and giving doctors suggestions with sound and visuals in future surgery. The storyline is led by the sound and the mixed video of medical images and live performance from the webcam. The goal of the performer as a surgeon during surgery is to cure the heart, which symbolizes human consciousness and faith. The AI, which is regarded as a perfect model, gives instruction to the performer. Maybe the question "If machines can reason even better than humans, will we as humans lose some abilities and not even believe ourselves anymore?" is worth thinking about since the issue is already present.

1   Christian Hansen, David Black, Christoph Lange, Fabian Rieber, Wolfram Lamadé, Marchello Donati, Karl J. Oldhafer, and Horst K. Hahn. Auditory guidance prototype for navigated liver surgery. Computer Support for Image-Based Medicine, Fraunhofer Institute for Medical Image Computing MEVIS. URL: *https://youtu.be/gCg5nJSl2pY* [accessed 2017-02-07].
2   Johns Hopkins Medicine, Health Library, Coronary Artery Bypass Graft Surgery. URL: *http://www.hopkinsmedicine.org/healthlibrary/test_procedures/cardiovascular/ coronary_artery_bypass_graft_surgery_cabg_92,P07967/* [accessed 2017-07-02].
3   Turing, Alan M. "Computing machinery and intelligence." Mind 59.236 (1950): 433-460.
4   Munoz, Andres. "Machine Learning and Optimization." *URL: https://www. cims. nyu. edu/~ munoz/files/ml_optimization. Pdf* [accessed 2016-03-02][WebCite Cache ID 6fiLfZvnG] (2014).
5   Fraunhofer. Machine learning to help physicians. URL: *https://www.fraunhofer.de/en/press/ research-news/2016/november/machine-learning-to-help-physicians.html* [accessed 2017-07-02].

Yen Tzu Chang (TW) is a Taiwanese media artist who has lived and studied in Linz, Austria since 2014. She has a BA from the new media art department at Taipei National University of Art. Since 2011, she has been working in various fields, including interdisciplinary art and experimental performances based on sound installation. Her early works were audio-visual and installation mixed with video art. *One kind of language*... was like a science video about an incredibly long millipede walking through two screens. She gradually became interested in making installations, which combine her experience on stage. She began to develop her own electronic instruments. The *Time Travel* and *Self-luminous* series are the most successful light installations in her art career.

Andreas J. Hirsch

The Practice of Art and Science

Experiences and Lessons
from the European Digital Art
and Science Network

I. ENTERING NEW GROUND

Building an Extraordinary Network for Art and Science Encounters

Encounters of art and science, or, more precisely, of artists and scientists, have enjoyed rapidly growing interest and attention in recent years. The romance of art and science has a long history, albeit a mixed one. Leonardo da Vinci (1452–1519), the artist and polymath active in the Florence of the Renaissance, still serves as the prominent example for the enormous creative potential flowing from the interactions of art and science. Since then science has been splitting up into numerous paths of ever deeper specialization, seeking knowledge within reductionist paradigms, and has largely abandoned free science in favor of research inside large organizations able to afford and maintain the ever larger and more refined instruments needed for it. Art—at the price of the mainly precarious existence of many artists—still offers more degrees of freedom, but the system of art displays its various agents like art institutions, curators, universities, galleries, critics, and the artists fighting for survival in an ever more pressurized and economy-driven environment.

What has also emerged since the days of Leonardo is—due to the advent of Modern Science and the Industrial Age[1]—this opposition of the distinct, seemingly incompatible roles of the artist and the scientist, which turned the figure of the polymath into more of an element of mythology. Mathematics having become the lingua franca of most of the sciences has added an almost impenetrable language barrier to this scenario. So the preconditions for seeking anew the encounter of art and science would—at first glance—seem not too good. But from the seedbed of mathematics sprang a universal tool, which quickly became the key instrument used by scientists and artists alike—the digital computer. This tool, together with ubiquitous communication networks and the internet as a medium of collaboration, prepared the ground for new encounters.

The Prologue for a New Phase in Encounters of Art and Science

As this new digital world was about to unfold, a new kind of artist started to appear on the scene, who worked with all kinds of media, even before they turned digital. In this emerging field of media art an institution of a new kind—bearing a name that seemed to reference back in history even further than the Renaissance—came to life in 1979: Ars Electronica. From its visionary inception onwards, Ars Electronica contributed at the nexus of art, technology and society to what would then turn into a Digital Revolution, and kept reflecting its impact on society. Over the years the list of topics embraced and challenged by Ars Electronica included an increasing number of new sciences and the corresponding new fields of artistic creation like Nanotech, Bio-Art, etc. The expertise from this long track record of Ars Electronica's work with scientists active in those new disciplines and with artists pioneering new artforms helped prepare for the logical next steps in the encounter of art and science.

Since its very foundation in 1996, Ars Electronica Futurelab—the research arm of Ars Electronica—has been receiving guest artists as well as guest researchers, a practice that in the following years developed into the more formal format of the Ars Electronica Residency Network. With the category [the next idea][2] in 2009, a new selection modality—through a competition and an international jury—for winning residencies at Ars Electronica Futurelab was implemented. Prix Ars Electronica—the international award for media and digital art introduced in 1987—has been constantly evolving its pattern of artistic categories in line with the latest developments in art, technology and society. In 2007 the category Hybrid Art was added, which is specifically dedicated to transdisciplinary projects and "transcending the boundaries between art and research."[3] So through the different activities of Ars Electronica, the ground was prepared, a rich body of experience accumulated, and far reaching international networks woven that would prove valuable when bringing the encounters of art and science to the next level.

Each emerging new development—be it in art, science, technology or in societies—has its driving forces behind it. Large-scale structural change results in new forms of art, breakthroughs in discovery, the introduction of new media, or different conditions and modalities of living together. But all such development also has its midwives, people who turn out to be the right person in a key position at a crucial time. So the development that led up to the European Digital Art and Science Network was also influenced and driven by a number of individuals with the vision and the persistence to create new forms of encounters of art and science. They came from all different areas of expertise involved: artists, curators, and scientists.

"You have to find the institutions and the people who are interested in this kind of exchange. The excitement is then primarily about the joy of collaboration and exchange."

Gerfried Stocker, Ars Electronica[4]

The media artist Gerfried Stocker, born 1964 in Austria, became artistic director of Ars Electronica in 1995. Under his direction, the new Ars Electronica Center as a space for presentation and interaction was opened in 1996 and expanded in 2009. In his strictly interdisciplinary work he combines an engineering background with artistic curation and strategic vision. Designing the annual topics of Ars Electronica Festival means preparing the "proving ground" for new artistic tendencies, emerging technological trends, and seismic shifts in societies. This includes detecting metatrends like the one that flowed into the theme of the 2005 Ars Electronica Festival, *HYBRID—living in paradox,* and the creation of the already mentioned Prix Ars Electronica category Hybrid Art. Stocker is also the chief architect of the European Digital Art and Science Network.

"If science gets accessible, it will most likely be through the arts."

Horst Hörtner, Ars Electronica Futurelab[5]

An expert in human computer interaction, the media artist and researcher Horst Hörtner—born 1965 in Austria—is a founding member and the director of Ars Electronica Futurelab since 1996. The Futurelab comprises constant evolvement and renewal in its genetic code and nurtures a culture of embracing new perspectives coming into the lab through new members of its team as well as visiting artists and researchers. One of its more recent developments under Hörtner's lead is the project *Spaxels, Pixels in Space,* a spatial display that shows signs of becoming a new medium of expression.

"The central goal is to actively work on blurring the dividing line of the 'Two Cultures' and help usher in a new culture that is overdue—a culture of creative thinkers from the arts and sciences who join together to combine their knowledge and skills to come up with innovations, collaborations and most of all, new ways to help heal this planet."

Victoria Vesna, UCLA Art|Sci Center[6]

In developing and directing the Art|Sci Program at UCLA in California since 2005 and numerous interdisciplinary programs that preceded it, the artist, curator, and academic teacher Victoria Vesna, born 1959 in the US, has become one of the experts in the encounters of art and science. In her work she strongly advocated for the opening of mindsets in an academic context and facilitating exchange between the disciplines. This led also to her long lasting cooperation with Ars Electronica, including speaking at the 1997 Festival, FleshFactor, and her work as juror of the Hybrid Art category and moderator of the Prix Forum for Hybrid Art.

"Being attracted by the ultimate questions—who we are, where we come from, and where we are going as humankind, artists and scientists are sharing the same field of metaphysical interest, but the ways they approach these ultimate questions are intrinsically different."

Jurij Krpan, Kapelica Gallery[7]

For more than 20 years a gallery in Slovenia has been a hot spot for media art and a platform for different forms of transdisciplinary exchange. The founder of Kapelica Gallery for Contemporary Investigative Arts in Ljubljana and its director since 1995, curator Jurij Krpan, born 1961, has been doing pioneering work in the field of art and science. For Ars Electronica Festival in 2008 he curated the Featured Art Scene exhibition at LENTOS Art Museum, presenting the lively Art & Science Scene from Slovenia. He repeatedly served as juror for the Hybrid Art category of Prix Ars Electronica, and Kapelica Gallery has become an important partner of Ars Electronica in networking projects in a European context.

"As more techniques are standardized, they get used across disciplines. When tools are democratized, agency becomes distributed."

Jens Hauser, curator[8]

The Media Studies scholar and art curator Jens Hauser, born 1969 in Germany, has gained international standing as an expert in the field of Bio Art. From a first encounter with Ars Electronica at the 1999 Festival, Life Sciences, flowed his later involvement in the newly created Prix Ars Electronica category Hybrid Art in 2007. His scientific work at the intersection of media studies, art history, and epistemology led to his development of a theory of biomediality. His curatorial work focuses on the interactions between art and technology, trans-genre and hybrid aesthetics.

"For science and for art you need an open atmosphere in society. We need freedom to perform, to think and to express. Both science and art need freedom, openness and trust. Tim Berners-Lee, for instance, had the freedom and trust to develop something. That freedom was given to him by the institute he worked for, and what he did was every bit as creative as a work of art. He could have developed anything. What he did develop was the World Wide Web."

Rolf-Dieter Heuer, CERN[9]

The German physicist Rolf-Dieter Heuer, born 1948, served as Director-General of CERN from 2009 to 2015, one of the longest terms of the directors of this institution so far. In his time as Director-General, the discovery of the Higgs boson in 2012, for which researchers had been looking for almost fifty years, was made at CERN. Also during his time in office, Heuer, who sees himself as an enabler of research constantly testing new ground, entered a cooperation of Ars Electronica and CERN based on the newly implemented Collide@CERN residency program developed by Ariane Koek at CERN. This cooperation resulted in the pioneering Prix Ars Electronica Collide@CERN residency award program, which in fact served as an "ice-breaker" for further encounters of artists and scientists at the largest particle laboratory in the world.

"These residencies are about something that is usually outside of the experience of both groups interacting with each other: science and art in the making. It is not so much about the finished product, a scientific discovery or an artwork. I see this as one of the most valuable experiences."

Fernando Comerón, European Southern Observatory[10]

The astrophysicist Fernando Comerón, born 1965 in Spain, has been Head Representative of the European Southern Observatory in Chile since 2013. His research interests in star formation, galactic structure, and young stellar objects flow into his work at this leading European international organization for observational astronomy. His openness to the encounter with the arts led to his deep involvement in the selection processes for the ESO residencies, and his prudent care of the visiting artists allowed for successful encounters at the spectacular sites of the ESO observatories in Chile.

Finally the efforts and the knowledge of those and numerous other pioneers in art and science worldwide would converge in what evolved into the European Digital Art and Science Network in 2014. But the creation of that network was preceded by an axis of cooperation that turned out to be highly significant and fruitful for the entire renaissance of the conversation between art and science. When Ars Electronica and The European Organisation for Nuclear Research, better known as CERN, joined forces, the impact of this collaboration provided valuable experiences as well as the public attention necessary for further development.

A Different Kind of Overture: Prix Ars Electronica Collide@CERN

The Prix Ars Electronica Collide@CERN residency program, running from 2012 until 2014, was designed as an international competition for digital artists to win a residency at CERN, the facilities of this international research organization, founded in 1954. The largest particle physics laboratory in the world works with the biggest man made machine ever built—the Large Hadron Collider, which resides in a circular tunnel 27 km in circumference, located 100 meters underground the countryside near Geneva in Switzerland and France. CERN provides the particle accelerators for high-energy physics research.

The idea behind the cooperation of Ars Electronica and CERN was to "take digital creativity to new dimensions by colliding the minds of scientists with the imaginations of artists"[11] and thus seeking "to accelerate innovation across culture." The architecture of the program already included elements that would later feed into the conception of the European Digital Art and Science Network. An international jury, which convened in the context of the Prix Ars Electronica jury process, selected the winning artists. The residencies were split into two parts: A two-month period at CERN, where the artist had a specially dedicated science mentor, dubbed "inspirational partner," at their side, was followed by a month at Ars Electronica Futurelab in Linz with all the options of collaborating with the transdisciplinary team there and making use of its long experience in receiving visiting artists. So good care was taken in facilitating and moderating the entire process of encounters between artists and scientists. Showcases of the results from the residencies at both partnering institutions—the Globe of Science and Innovation at CERN in Geneva and at Ars Electronica Festival in Linz—completed the program.

"This is the beauty of science: You learn something and you open a door. Then you stand in front of new doors, which you would not have seen without the knowledge that allowed you to open the first door. There you realize that you can ask more detailed questions. I believe that this is very similar for artists: They realize they can do something and when they have done it, they can see how to improve it and how to go in another direction."

Rolf-Dieter Heuer, CERN[12]

In the actual realization of the program, Prix Ars Electronica Collide@CERN brought three artists from highly different backgrounds and three different generations to CERN. In 2012 the German artist Julius von Bismarck was the first winner of such a residency and he in fact fulfilled, as Rolf-Dieter Heuer describes it[13] the role of the "ice-breaker" for the entire program. Bismarck, who was born in 1983, was the youngest of the three, and had won the Golden Nica of Prix Ars Electronica in the category Interactive Art in 2008. As a result of his residency at CERN, he created the piece *Versuch unter Kreisen* and presented it at the 2012 Ars Electronica Festival. The piece contains lights hanging from the ceiling which "turn in their separate orbits out of synch, driven by real data, but on the 78th turn strangely come into synch together for one complete circle."[14] The piece then became the setting for a dance piece titled *Quantum,* developed also at CERN by the choreographer Gilles Jobin.

"The visit to CERN was inspiring and renewing. It put me back in touch with myself. Being at CERN and having these conversations and then intensely listening and recording was like going on a spiritual retreat."

Bill Fontana, artist[15]

The composer and sound-artist Bill Fontana, born 1947 in the US, arrived for his residency at CERN in 2013. Fontana, who had studied with John Cage and gained fame with his large scale sound sculptures for institutions including the Whitney Museum of American Art in New York City, the San Francisco Museum of Modern Art, and Tate Modern in London. In 2009 he won the Golden Nica of Prix Ars Electronica in the category Digital Music & Sound

Art for his piece *Speeds of Time*. While at CERN, he turned the Large Hadron Collider (LHC) into the world's largest acoustic instrument and created the piece *Acoustic Time Travel*. Fontana is strongly interested in revealing hidden sounds in unlikely places and explored places like the CERN proton source, where the particles begin their journey into the 27-km accelerator ring. Ultimately he played the sound of the LHC back to itself in its cavities 100 meters below ground, thus evoking strong, positive, emotional reactions from the scientists and engineers present.

The electronic composer and visual artist Ryōji Ikeda, born in 1966 in Japan, "has gained a reputation as one of the few international artists working convincingly across both visual and sonic media."[16] He repeatedly performed at Ars Electronica Festival and in 2001 won the Golden Nica of Prix Ars Electronica in the category Digital Musics & Sound Art. Inspired by his dialogue with the artists at CERN in 2014, he based his pieces *the planck universe [micro]* and *the planck universe [macro]* on principles of particle physics and cosmology, striving to visualize the different scales and magnitudes of the universe.

Bringing the European Digital Art and Science Network to Life

Together with seven renowned artistic and cultural institutions Ars Electronica joined forces with some of the leading scientific institutions in creating the European Digital Art and Science Network. First scientific partners in what would turn out to be a network of superlatives were: CERN, together with which the Prix Ars Electronica Collide@CERN residency program—practically the "overture" to the network—had been designed and realized; ESO, the European Southern Observatory that was created in 1962 and has built and operates some of the largest and most advanced telescopes on earth, among them the Very Large Telescope (VLT) in Chile; The European Space Agency (ESA), Europe's gateway to space, developing Europe's space capability and drawing up and realizing the European space program, and with a recent partner, the Fraunhofer Institute for Medical Image Computing (MEVIS), the network continues to grow in new directions.

The European Digital Art and Science Network was financed by the European Union program Creative Europe, which contributed half of the budget, and the participating institutions, which equally shared the other half. Creative Europe is the European Commission's framework program for the cultural and creative sectors.

The superlatives of the network are not limited to the partner's impressive research facilities and spectacular discoveries. The research at those organizations also relates to some of the most fundamental questions of mankind. They represent a substantial part of humankind's efforts to push ever further the horizons of our knowledge about the world.

"All of mankind's hopes and curiosity are so much brought to one spot in those huge machines like the Large Hadron Collider at CERN or the Very Large Telescope at the observatories of ESO in the Atacama desert. This is telling so much more about us and our societies and the way our science works."

Horst Hörtner, Ars Electronica Futurelab[17]

Scientists at CERN deal with the cornerstones of quantum physics and have found some of the smallest particles known so far. In 2012 they announced the discovery of a new particle, identified as the so-called "Higgs boson," whose existence had first been suggested by Nobel Prize Winner Peter Higgs in 1964. Researchers at CERN have also been successful in creating antimatter and maintaining antihydrogen for over 15 minutes in 2011. Their research draws close to the singularity, the so-called "Big Bang" in the prevailing cosmological model for the universe. CERN is also the birthplace of the World Wide Web.

The sites of the European Southern Observatory (ESO)—some of them at the Atacama desert in Chile at altitudes as high as 5,000 meters above sea level—are among the most surreal on earth. This gigantic eye to the universe—built from numerous different instruments—looks deep into space and far back in time, determining the age of the universe and finding evidence for a black hole at the center of the Milky Way. The successful search for exoplanets conducted there is ultimately the search for extraterrestrial life.

The European Space Agency (ESA)—with facilities scattered across Europe and a spaceport at Kourou in French Guiana—conducts missions as spectacular as landing the spacecraft Rosetta's lander module Philae on the comet 67P/Churyumov–Gerasimenko, which had a two-year rendezvous studying the comet. The ExoMars program sends spacecraft to Mars with the aim of finding out whether life has ever existed there.

The Fraunhofer Institute for Medical Image Computing (MEVIS) in Bremen in Germany develops applications for the clinical routine. Its research and development directly address matters of reliable diagnosis, safe treatment planning, and measurable therapeutic success for severe diseases such as cancer.

However, the network includes not only big players in the world of science, but a number of influential cultural institutions across Europe, which are active in the areas of Media Art, Bio Art, etc. High-profile institutions with a long standing in the emerging Media Arts like LABoral in Spain, Kapelica Gallery / Kersnikova in Slovenia, Science Gallery Dublin, DIG gallery in Slovakia, GV Art London, Center for the Promotion of Science in Serbia and Zaragoza City of Knowledge Foundation in Spain belong to this cultural side of the network. It is this cultural element in the network, that—together with Ars Electronica's own capabilities—brings cultural know-how into the project and endows the art and science encounters with due visibility in the art world.

Together with the institutions on board in The European Digital Art and Science Network, Ars Electronica developed a residency program to allow artists to go to the research facilities and engage in encounters with the scientists there. Those residencies from the outset included not only time at the facilities of one of the partners, but also time at Ars Electronica Futurelab and presentations at Ars Electronica Festival and across the various cultural partner institutions of the network.

"The nature and the structure of the science organizations involved are also important for the selection and curation process. In the beginning we tended to say: This is a great science institution, let's look for artists who want to go there! So we were mainly looking at the artistic quality of the proposal. Together with the representatives from the institutions we gradually learned how important it is to think of the matchmaking between artists and scientists in terms of working style and accessibility."

Gerfried Stocker, Ars Electronica[18]

The artists selected for the first rounds of residencies come from a number of different countries and cultures and they represent a broad variety of artistic approaches and working styles. Artists working on their own are present here as well as artist groups or collectives, artists with extensive experience with residencies as well as those entirely new to this kind of opportunity.

"I would like to go into deeper research on the philosophical connection posed by Plato and Pythagoras about the notion that music, mathematic and astronomy were essentially different science and disciplines, but with a common principle of origin."

María Ignacia Edwards, artist [19]

María Ignacia Edwards from Chile first went to the ESO observatories La Silla and ALMA located in her home country and then travelled to a residency at Ars Electronica Futurelab in Linz to complete her piece titled *Encounters for Mobile Instrument of String and Air*. The *Mobile Instrument* she created is able to capture the movement of 11 swings located at distant places as a reference to time and the motion of the universe. The swings, installed at the cultural partners of the network, fed back into musical notes played on a piano at Ars Electronica Center in Linz. In her art she works with equilibrium, using the lightness and weightlessness of objects that she brings into balance by deploying their own weight or counterweights. At first glance her works may be perceived as purely aesthetic objects, while in fact the constructions are the result of elaborate mathematical and physical calculations.

"It's always quite daunting stepping into any environment that has a distinct language and culture that is new to you. Through our previous experiences in science labs we have learnt to embrace the challenges that this type of journey presents. As a result we have developed a confidence in our line of enquiry, and learnt how to enjoy the intensity of the experience."

Ruth Jarman, artist duo Semiconductor [20]

The English artist duo Semiconductor—Ruth Jarman and Joe Gerhardt—spent a two-month residency at CERN. In their work—and a number of previous residencies at research institutions—they strive to "explore the material nature of our world and how we experience it through the lens of science and technology, questioning how these devices mediate our experiences."[21] For them the field of particle physics offered the missing link in their work: "Having previously explored the make-up of matter on astronomical and geological scales we have been waiting for the right opportunity to engage with matter on a quantum scale (...)."[22] The title of their piece *A particular kind of conversation* somehow—on a metaphorical level—seems to anticipate the encounters with the scientists at CERN.

"Actually, we feel a bit like explorers ourselves, like we're trailblazers who are being permitted to penetrate a remote, inaccessible region to obtain insights into another world."

Juliane Götz, artists collective Quadrature [23]

Quadrature is an artists collective from Berlin, Germany, formed by Juliane Götz, Sebastian Neitsch, and Jan Bernstein, who have been collaborating since the year 2009. To their residency at ESO they brought the experience from previous projects of theirs like *Voyager* and *Satelliten,* which in 2015 had earned them an Honorary Mention in the Interactive Art category of Prix Ars Electronica. Dealing with the methods humans employ to explore the cosmos, they often focus on the contradictions between knowledge and comprehension. In addition to being acquainted with the exploration of space they also could build upon their practice in collective processes that proved valuable in the encounter with the scientists. Their piece *MASSES—Motors And Stones Searching Equilibrium State* displays a permanent state of incessant motion, which they describe as "a fragile but constant situation between fall and float, an endless dance of observation and calibration."[24] The piece clearly relates to one of the deepest impressions from their visit to the observatories: the process of self-calibration of the huge telescopes before the next night of observation begins.

"Even with the explosives I work with there is a hidden order which reveals itself when used in particular ways, and it's all about being able to see this underlying, mathematical order. The same applies to the methodologies used in scientific research."

Aoife van Linden Tol, artist[25]

The Irish artist Aoife van Linden Tol primarily works with explosive media, inspired by different scientific disciplines like chemistry, physics, and cosmology. To her residency at the European Space Agency she brought plans for her project *Star Storm* which tackles the life cycle of stars and the physical processes of stellar formation and evolution across the Universe. Her approach to fundamental questions relating to the universe includes looking at nature's explosions as creative scenarios. Her residency was initiated by a brief visit to

the European Space Operations Centre at Darmstadt in Germany for the arrival at Mars of the ExoMars mission, followed by a two-part residency at the facilities of the European Space Research and Technology Centre (ESTEC) in the Netherlands. With her own work being highly multidisciplinary, she embarked on encounters with the scientists by involving them in different participatory projects, clearly and creatively going beyond the usual type of art and science conversations.

"As an artist, my approach is strongly connected to science. Because art is not only a way to express personal aesthetic, it can also bring out critical thought."

Yen Tzu Chang, artist[26]

The Taiwanese artist Yen Tzu Chang spent her residency at the Fraunhofer Institute for Medical Image Computing (MEVIS) and at Ars Electronica Futurelab. She sees art and science as a cycle system in her art, with both elements being mutually beneficial to her interdisciplinary performances and installations. The residency also enabled her to take the step from working with science to directly working with scientists. With her project *Whose scalpel* she realizes a sound performance inspired by an *Auditory guidance prototype for navigated liver surgery* developed by Fraunhofer MEVIS. Different aspects of this tool have inspired the creation of her performance piece, where she interprets the relationship between surgeons and the medical machine as a kind of struggle between humanity and technology.[27]

"I see the institutions as platforms where different stakeholders meet: engineers, scientists, artists, mediators, curators. As a curator I can share the intimate experiences of how artworks grow, which the artists do not share among themselves. We also need to create an opportunity for the artists that their work is understood properly. If we presented an artist, even an internationally renowned one, in a context that is not socially and publicly prepared for it, we would miss our goal."

Jurij Krpan, Kapelica Gallery[28]

The projects that flowed from those residencies in the European Digital Art and Science Network were presented in a number of exhibitions, conferences, and workshops among the cultural partner organizations of the network. Different formats and thematic focal points were applied. The exhibition *Materia Prima* at LABoral Centro de Arte y Creación Industrial in Gijón in Spain looked at new alliances between art and science while reflecting the role of computer code as the *materia prima* the participating artists work with. At Ars Electronica Center the exhibition *The Alchemists of Art and Science* included speculative, futuristic visions that have emerged from the amalgamation of artistic and scientific approaches.

Those presentations served as an important part of the network's activities to complement the residencies with key elements of the full artistic production chain—from inspiration and concept to production, presentation, and critical discourse on an international scale.

"This shared learning process and the building up of competence in the European Digital Art and Science Network included developing new ways to present the outcome. At cultural institutions like LABoral for instance, we presented not only the outcome from the residencies, but also other examples of art and science collaborations. For this we developed a kind of hybrid between exhibition and laboratory, which has not been done before in that way and was extremely interesting also for the audience. Such mutual benefit comes only with a networked project like this one."

Gerfried Stocker, Ars Electronica[29]

II. EXPERIENCES AND LESSONS

How to Enjoy the Learning Curve of Art and Science Residencies

Residency programs like the one conducted by the European Digital Art and Science Network are first and foremost learning experiences—clearly for the individual artists and scientists involved in the encounters, but also for the institutions, both scientific and cultural. Based on the amount of previous experience with the format of the residency, the learning curve can be more or less steep. There are good reasons for that, since basically the residencies are about facilitating the meeting of two different cultures. Mastering the art of turning this into fruitful experiences for both sides can prove quite challenging.

”Curiosity is one thing, but in order to find something new, creativity and ingenuity are necessary. In this respect, the mindsets of artists and scientists are very similar to a large extent. Some of the artists that came to CERN made a choice early in their careers between science and art, so it's nice to see that circle being closed through the arts programme.”

Rolf-Dieter Heuer, CERN[30]

“You are selecting both the quality of the art and the mindset of the person.”

Michael Doser, CERN[31]

"We should understand the curatorial process for art and science residencies according to the original Latin source 'curare'—the humble attitude of 'taking care of'. The goal is to find those science- and technology-literate artists, who will really challenge the scientists."

Jens Hauser, curator [32]

The learning process starts with the task of selecting the right artists for the right receiving institutions. While a curated selection process may easily lean towards the more established artists already in the loop of the art world and with recognition in the art and science circles, an open call will lead to a broader dissemination of information about the residency program as well as a broader and more diverse set of submissions. The selection by a jury with experts from media arts plus representatives from the receiving institutions had to identify the key criteria for a successful residency. Whereas in juries awarding an art prize, the artistic quality and consistency of the submitted work would get most attention, in this case additional aspects come into consideration. The challenge with art and science residencies is to select artists who also bring with them the communicative skills and an appropriate mindset for adapting to a situation presumably alien to them and for engaging in a lasting conversation with all different kinds of scientists at the facility.

"Recommendation for science institutions: Curate the residencies. Provide the artists with contacts, legitimacy, ask them to showcase their thoughts and work. Select artists like you would select a science project: insist on coherence and depth and quality of the proposal and then allow them to go where the work takes them."

Michael Doser, CERN[33]

The submissions can also pose another problem. Some artists will submit an elaborate concept of what they are planning to do as a result of the residency, some will be more vague about this, and some even resist submitting such information in favor of a completely open process. As it turns out, it may be important to also consider an open ending to be acceptable, since the whole endeavor of art and science is about entering new territory in many respects. Still, this involves a fair amount of risk for all sides involved. After all, there is no art and no science without the risk of failure.

Fernando Comerón from the European Southern Observatory gives this description of his own learning process during the selection of the artists: "One of the first things that surprised me when going through the applications at the Ars Electronica jury, was how inconcrete the artists were about the results they wanted to achieve. Then I realized that this was reflecting a methodological difference. When I write a scientific proposal to have access to the telescopes, I need to provide a scientific justification, what I want to achieve, what are the expected results and if we do not get those results, what do we learn from not getting them. In the case of the artists I discovered that this was not only not expected, but that it was even considered counterproductive. It would close the road of artistic discovery."[34]

For the science partners in this network, the vague or missing description of the goals of a submitted art project may be more unusual than for art curators. Scientists from early on in their careers are trained to describe their projects in such an elaborate way, whereas artists are usually far less often subject to such submissions of their concepts when they apply for grants, awards, or residencies at art institutions. This structural difference between the working conditions for art and science points to a whole set of differences that Claudia Mignone[35] reflects.

"Regarding the two cultures I see the differences more in the way of working and the way that careers are framed in institutions, rather than in the individuals. When they start their training, scientists have very similar questions, curiosity, and spirit as artists have. But when you finish your training, there is no such thing as an 'independent' scientist. So the focus is shifted more on the results, rather than on the process of research itself." Claudia Mignone, Vitrociset Belgium for ESA—European Space Agency [36]

Such differences become apparent when it comes to avoiding some of the most famous misconceptions about the work of scientists and artists today. The daily work of scientists is far from being a series of spectacular discoveries or eureka moments, but rather a long stretch of relatively boring office work. Even at facilities like the European Southern Observatory, the astronomers would sit in a control room all night and not in the cupola of one of the telescopes. The actual work with the data from the observations would take place much later in the scientists' offices. Scientists today work mainly in larger institutions and are exposed to all the load of communication, documentation, and administration that comes with any larger structure.

"It has to be a win-win-situation. A win for the scientist is of course to explain their work to artists, who may not have much scientific knowledge, in a way that they can use and transform into an art project. In that process you see whether the artist has grasped the main sense of the science. A win for the artist is to create a work that stands alone as a piece of art, but that contains the scientific inspiration for anyone who wants to look for it."

Rolf-Dieter Heuer, CERN[37]

On the other hand, artists today—unless they are truly successful—work mostly under precarious conditions that force them to constantly look for new opportunities to fund their art and sustain themselves. They will not be part of any organization but will be collaborating in a highly networked mode with others in order to realize their projects. With any arts bordering on different kinds of technology and research and involving a broad set of skills, this turns out to be increasingly so. The image of the lone genius in her or his studio is clearly a thing of the past, or rather an echo from a constructed mythology out of romantic times.

"We need to seriously look into the question, what is the real benefit, the real outcome. In the end it is the artists and the scientists who devote a substantial amount of their work time and an essential part of their career path to this collaboration."

Gerfried Stocker, Ars Electronica[38]

The scientists whom an artist may meet during a residency are far from being a homogenous group. It is extremely useful to be aware of the different sub-groups and the different structural conditions under which they work at a certain facility, since these may strongly influence their encounter with the artists. Senior scientists are generally considered more easily accessible to visiting artists as they have less pressure on them to pursue their career paths. Scientists engaged in basic research may also be easier to involve in a conversation than astronomers making use of limited telescope time assigned to their research project. Staff scientists in an organization will have lots of additional duties that do not burden visiting scientists who come and go as the artists-in-residence do.

"What most inspired me about them was their level of sensitivity and huge commitment to their work."

María Ignacia Edwards, artist[39]

Very probably the most difficult group to engage in encounters with artists are the younger scientists with maximum pressure on them to work on several projects at the same time and to create a significant output of published papers. Still, that group should not be left out of the game, since they belong to a new generation of scientists who may be increasingly open to an exchange with the arts. Michael Doser of CERN recommends artists to simply follow those younger scientists around their day and find a kind of "embedded mode" with their research.

"What matters
is the chemistry between people."

Rolf-Dieter Heuer, CERN[40]

"With the residency, everybody had
to leave their comfort zone."

Bianka Hofmann, Fraunhofer MEVIS[41]

Some artists also opened a dialog with the engineers, who often form a larger group than the scientists at a facility. They are responsible for maintaining the functioning of the different instruments and thus provide the foundations for the actual research done. They will be able to provide a lot of understanding of the facility itself, they see the instruments as "their" instruments and the scientists as their users. Thus they may also express different views on the overall topics of the research than the scientists.

"A basic knowledge of the environment, and what is actually done there, is quite important. There were some artists who expected to see a scientific discovery, who wanted to participate in the mind of the scientist at a time when the eureka moment happens. But this is something that does not happen at the observatory, this is not the place to expect it. We wanted to avoid that the artist gets disappointed. Artists wanted to work with the data as they come, but there is very limited use of the data as they come. You don't get spectacular images or even very informative images. You need more time to work with the data and this will not happen at the observatory."

Fernando Comerón, European Southern Observatory[42]

Preparation is another key to the success of a residency. Of course artists should come well prepared, even if they strive to arrive as open-minded as possible. Information about the facility and the different areas of research done there is essential to navigate through the enormous amount of information and the strong wave of experiences awaiting the artist on site. In some cases an initial short visit for orientation and planning turned out to be effective, something that of course is not always possible—especially with such remote locations as Chile's Atacama Desert.

But the receiving institution should also be prepared. Given some pre-information about the artists from the selection process, they can think of doing a certain amount of pre-filtering of the scientists who would be initially interested in meeting the artists. It seems essential to ask the artists in the early stages of their residency to give a presentation of their work and their ideas for the residency. This will be useful in making the artists visible inside the organization, but also helps to avoid misconceptions about more contemporary forms of art some of the scientists may not be familiar with. Media artists are mainly used to situations where their work is not immediately understood as it does not follow traditional paradigms, namely, lingering concepts of "beauty."

"Most of the successful art and science residencies take place in those institutions who work in sciences that have a proximity to spiritual as well as fundamental ethical questions. Maybe people who work in those areas are more sensitive to the need to open up their thinking and take care of public opinion. For many publicly funded institutions it is important to contribute to a better understanding of their service to society. That is a legitimate motivation to enter art and science collaborations."
Gerfried Stocker, Ars Electronica[43]

Preparing the organization should also include prior information for their staff about the motivations for the institution to participate in this art and science residency program. Claudia Mignone (Vitrociset Belgium for ESA) compares this to scientist's perception of science communication: "There is a similar discussion going on regarding the engagement of scientists in the context of public outreach and science communication. Many of them like to be involved in these activities, but often find it challenging to balance the time and efforts spent away from the core functions of their research work. Some have suggested a formal acknowledgement or reward system to make this part of the work more relevant and visible, especially for early-career scientists, so that they can feel comfortable spending a certain amount of time engaging with the public.
I believe something like that could also be applied to the interaction with artists in a broader cultural context."[44]

"Acceptance in the organization came through the quality of the artists, the enthusiasm of the inspirational partners at CERN, and the reactions of the public who came to the events. Then people came to me and said 'What a nice program!' This happened relatively fast."

Rolf-Dieter Heuer, CERN[45]

One of the lessons from the residencies is the need to allocate the resources of one person being available to take care of the artists for the entire duration of the residency. Support only in the initial phase will not be sufficient, since it is not only about logistical support for the artists but also about moderating the entire process. It is only through the allocation of such human resources that the institutional learning effects can be secured and made productive.

"You will need time and resources throughout the entire stay of the artist. Consider at least one person on site to spend a substantial amount of their time taking care not only of the logistics, but also of mentoring in order to pair the visiting artist with the right people on site."

Claudia Mignone, Vitrociset Belgium for ESA—European Space Agency[46]

There are different philosophies about the appropriate duration of a residency. While there is no one rule befitting all kinds of facilities and all kinds of artists, certain aspects become clear. A minimum time of around three to four weeks seems necessary to manage the first orientation and to get below the "glossy surfaces." The maximum time will rather be defined by the available budget for the residency, the resources of the organization, and the working schedule and other obligations of the artists. The more internationally renowned an artist is, the shorter the individual visits will very probably be. Splitting the residency into two or more shorter segments can be useful, especially with respect to the aspect of human relationships.

"One to three months is a good time window for residencies. If the residency is shorter than one month, the artist comes in and is overwhelmed and has no time to start asking interesting questions. If it is longer than three months, then the artist wants to become a scientist. Then the discrepancy between what they would want to do here and what they would be able to do, becomes too large."

Michael Doser, CERN[47]

Art and Science: The Human Factor

Across all residencies in this network it became clear that time is of the essence for the building up of human relationships between artists and scientists. Although we may strive to cast a primarily structural view on the prerequisites for a successful residency, we will have to acknowledge the human factor in this encounter.

Reflecting on the experience of the residency at the European Space Agency, Claudia Mignone drew a parallel with ESA's Rosetta mission and its extended "rendezvous" with a comet as opposed to the "fly-by" approach of previous space missions. For such an extended "rendezvous" of artists and scientists, a human relationship is the necessary foundation, which in itself takes time to develop and grow. The willingness of scientists in a busy research schedule to engage in a long-term exchange will grow once they personally know the artists, have been exposed to their way of working, could connect with the artistic approaches, begin to enjoy the exchange, and maybe even start seeing beneficial effects for their own work.

"Recommendation for visiting artists: be prepared, have an idea and a plan, but be ready to change it entirely. Be focused but also as open as possible. Expect to be surprised. Be ready to change route. This is the essence of exploration."

Claudia Mignone, Vitrociset Belgium for ESA—European Space Agency [48]

Not all artists in the context of a residency will go as far as Aoife van Linden Tol at ESTEC, the European Space Research and Technology Centre and ESA's technical heart, in conceiving and offering different formats for involving the scientists in participatory activities like mini-workshops, brainstorming sessions, or collective artworks. But inspiration can be taken from such a highly communicative and creative approach to facilitating the encounters. The initiative for new formats of exchange can come from the artists, but could also be offered and managed by the institution.

"Art and science residencies are about introducing different systems to each other. Therefore highly practical methods can be very helpful, if you want to develop this beyond a small group of very dedicated and already experienced individuals on both sides."

Gerfried Stocker, Ars Electronica [49]

Innovative formats of exchange can also help tackling the problems of a language barrier that exist despite all efforts of popular science. Good or bad school experiences with mathematics or physics are strong suspects for determining later readiness to approach scientific concepts expressed in mathematical terms or for scientific concepts and thinking remaining alien to a person. In its concepts and languages modern science has moved quite far away from everyday understanding. We are basically still conducting our every-day lives in a world that appears to be well-defined by the laws that Sir Isaac Newton (1642–1726) formulated three hundred years ago. Around a century ago, the Theory of Relativity and the findings of Quantum Physics have greatly expanded Newton's world and, more broadly, the realm of classical physics, but we happily continue to live as if Newton's view of the world remained unharmed. This profound gap points to the numerous chasms that separate our common understanding of the world around us from the knowledge about it that science provides today.

"On the one hand, we wished to open up the institution—the knowledge, the methodologies, and everything that is developed here—to another group of researchers, the artists. On the other hand, we had the expectation of bringing complementary views from the side of the humanities into the everyday working of a scientific institution."
Claudia Mignone, Vitrociset Belgium for ESA—European Space Agency[50]

"The transparent bug-fixing mentality at our organization was also lived within the residency—the artist and the participating scientists could take part in every conversation in a transparent way."
Bianka Hofmann, Fraunhofer MEVIS[51]

The art of engaging scientists in a conversation has more to do with passions shared by scientists and artists than with asking them "scientific" questions. Looking at shared passions does not imply to cover up existing differences, but is rather a step towards one of the secrets of successful residen-cies. First, there is the profound and mutual respect for the passion and dedica-tion with which the other side is doing their research or their art. Next comes the discovery that the underlying questions of a lot of the research that is being done in this network are among the most existential questions asked by humankind, which is followed by the realization that also non-scientists can have a lifelong passion for astronomy, cosmology, or space travel.

"Artists should think of the scientists they encounter as open-minded persons at least as curious as themselves."

Jens Hauser, curator [52]

"Recommendation for visiting artists: Interact with the scientists, ask them about their dreams, hopes, fears (and a little bit about their work). Ask them to draw their work, watch their hands as they talk."

Michael Doser, CERN [53]

Growing up with science fiction and popular culture plays an important role in this field of powerful passions and far-reaching imagination. The enthusiasm for science fiction feeds back into a lasting interest in the science in the stories. Having seen the first landing on the moon on television as a child remains a key experience for an entire generation. Having followed the *Star Trek* television series may have kindled interest also in the physics behind it. [54]

"We grew up with stories and images of our universe, both real-life accounts and utopian ones. Rockets, time travel, space stations, life on Mars, aliens ... Scientists aren't the only ones for whom the cosmos and space exploration provide a virtually inexhaustible source of inspiration."

Sebastian Neitsch, artists collective Quadrature [55]

Science fiction may also provide a common set of stories and metaphors that artists and scientists can share and use as an agent of initiating their collaboration. This does not mean that the collaboration would then be about science fiction instead of the actual science, but that sci-fi serves as a kind of common ground to open up the conversation. Even if the role of science fiction does not reach that far in a certain encounter, it might still be part of the motivational background that led some artists to an art that closely relates to science.

"It is valuable to use the enthusiasm we see in artists for space science, particle physics or genetic engineering, and other spiritually or ethically loaded scientific research in order to draw experiences and models that are also applicable to other areas. The power of art could be of great benefit to other areas of society. These residencies are prototyping examples with the aim to see how—in a larger scenario—art can gain a more influential role in society. The overall vision from our side is to see how art can engage in as many different areas of society as possible."

Gerfried Stocker, Ars Electronica[56]

Popular culture does contribute to shaping the public image, especially of the more visible and prominent research institutions, a fact that does not always turn out to be helpful to those institutions in their effort to communicate what their research is actually about. CERN is a good example of productively handling this. In the book *Angels & Demons,* published in 2000 by US-writer Dan Brown, there are references to CERN and to the topic of antimatter. In a scene set at CERN, two fictional characters, CERN director Maximilan Kohler and Harvard Professor Robert Langdon appear:

"Kohler took a sharp left and entered a wide hallway adorned with awards and commendations. A particularly large plaque dominated the entry. Langdon slowed to read the engraved bronze as they passed.

ARS ELECTRONICA AWARD
For Cultural Innovation in the Digital Age
Awarded to Tim Berners Lee and CERN
for the invention of the
WORLDWIDE WEB"[57]

In a kind of memetic Möbius strip this scene connects popular culture's myths about the science practiced at CERN back with Prix Ars Electronica's actual awarding of Tim Berners-Lee with an Honorary Golden Nica in 1995 for the concept of Hypertext. In reaction to the book and the subsequent movie *Angels & Demons,* directed by Ron Howard and starring Tom Hanks as Robert Langdon, CERN set up a website[58] where explanation and clarification about research at CERN and scientific knowledge about antimatter are offered.

How to Avoid the "Scylla and Charybdis" of Art and Science

Wrong expectations from both sides can also hamper the exchange in the framework of a residency. Some of these are specially complex and difficult to avoid. They present, as Michael Doser of CERN[59] put it, the "Scylla and Charybdis" of art and science encounters. Like the two monsters from Homer's *Odyssey* at opposing shores of what may have been the Strait of Messina, two specially dangerous pitfalls await those involving themselves in art and science residency programs. Their danger lies in turning those encounters into one-sided affairs with one partner cannabalizing the other.

"The expectation that art helps to communicate science better is legitimate, as long as you don't instrumentalize the artist. Art can be a welcome addition to a scientific project, but it should never be something that you, as a scientist, demand from the artist. The chance of success is highest if you don't demand anything, but simply seek to inspire. You already break a large part of the barrier between science and society when you show that you are open."

Rolf-Dieter Heuer, CERN[60]

Scientific institutions often tend to see the visiting artists in the context of their own communications efforts. Art is then understood primarily in visual and aesthetic terms and thus the expectation comes for the artists to provide a "visualization" of the science. Such expectations are legitimate insofar as they result from the evident need to communicate the results from research and the experience of a rising public awareness of certain—more spectacular—achievements of science. But although art is essentially communication, artists are not necessarily the better communicators, as Gerfried Stocker[61] points out. But if they want to engage with sciences, artists will need to consider these kinds of expectations. And science institutions will wisely make their expectations clear from the outset and openly discuss what they may expect and what not.

> "If we are looking for a symmetrical relation-ship between artists and scientists, we should look for a relationship where the work of both is mutually inspirational."
>
> Jurij Krpan, Kapelica Gallery[62]

On the other side, artists may see the scientists they meet solely as sources of information and inspiration without any readiness on their part to give something back. That "something" will certainly not need to be pre-defined and can simply consist of the quality of a conversation that is interesting and inspiring for both sides. It is more about the attitude than about the actual outcome. An important aspect in that context is to make clear that the artists should be put under no obligation to produce an art project, that is to deliver a "result" from the residency. Some institutions, like CERN, already made that part of their policy for art residencies.

> "The artists who come here are under no obligation to produce anything. There is no expectation that art comes out of the residency. The important thing is the discovery, the process, the opening of minds, if we are lucky, or the change in direction that can then propagate through future work."
>
> Michael Doser, CERN[63]

The real danger of this "Scylla and Charybdis" situation is that such scenarios, if not addressed early on and in a transparent way, can backfire and stand in the way of actually establishing a sustainable conversation and mutual exchange between artists and scientist in the residency format.

> "The presence of the artist during the residency allowed for more openness."
>
> Bianka Hofmann, Fraunhofer MEVIS[64]

In most cases artists used their residency at a facility mainly for getting input. Only later did they go into the actual conception phase of an art project and then arrived at Ars Electronica Futurelab to bring their project to production. However, there is no single formula for defining the stages of a project for everybody.

"We knew from the start that the time of the artists at the research institutions would be consumed by getting knowledge, absorbing inspiration, doing some reflection, and getting feedback from the scientists. Then in order to best help the artists to produce the outcome of their residencies, we used the entire production chain available: Time at the Ars Electronica Futurelab to produce and Ars Electronica Festival as a presentation platform."

Gerfried Stocker, Ars Electronica[65]

"Laboratories like the Ars Electronica Futurelab in Linz, the MIT Media Lab in Cambridge or Art+Com in Berlin have a permanent team in place from different disciplines. In the tradition of a laboratory to experiment and to prove a theory it always was very important to work cross disciplines. These places are something like a role model for having additional trans-disciplinary approaches. Here artists and scientist can meet on a platform where crossing disciplines is a daily practice."

Horst Hörtner, Ars Electronica Futurelab[66]

Some may come already with a concept to the residency and then merely enrich and refine it. For some the conceptualizing work would start during the residency to be finalized at Ars Electronica Futurelab. Some—like Quadrature at ESO—would spend some extra time by themselves in the country after their time at the observatories and there start the conceptualizing process in their group. In all the various scenarios, the second part of the residency at Ars Electronica Futurelab proved very valuable, since the team there could adapt to the different needs of the artists—from entering into a dialogue on a conceptual level to hands-on technical solutions for the final art piece.

"How do you get your work recognized? There is a clear parallel in what is frustrating about the two systems of science and of art. Both would like to do things that are not commercial and not easy to be accepted. These networks of art and science provide a framework of credibility."

Fernando Comerón, European Southern Observatory[67]

Even though a finished art project was not an obligation, most of the artists came up with a project and made good use of the many opportunities to make their works seen at Ars Electronica Festival and in different presentation formats at the partner institutions across this European Network for Digital Art and Science. And even though such art and science residencies are basically about the process and the interaction and not about a specific result, the goal of an art piece to be exhibited or performed helped guide the process and gave all sides a more concrete understanding of the content and the direction of their encounter. So it turned out to be very useful that the residency program was designed with the entire artistic production chain in mind and that it offered support and a platform for each step on the way.

III. CULTURES, PLACES, AND AGENTS

Opening New Perspectives
on Art and Science Collaborations

The encounters of artists and scientists open a new strand of conversations. The situation may seem remindful of a huge room full of remarkable people, who in that very room—as the artist James Lee Byars once envisioned[68]—would ask each other the questions they usually pose only to themselves. They may belong to very different cultures of insight, but they clearly share an extraordinary curiosity and passion for those questions that fill the room once the conversation has started.

"Intelligent questions asked by an artist are not questions about the science. We do not ask the artists to become physicists. It is more about their conceptual questions, fundamental questions going beyond the superficial. Questions about what it means to be doing science and what it means to understand the universe. Questions that launch reflection in the scientist. Then it becomes a dialogue. That's what you are really looking for."

Michael Doser, CERN[69]

This is a conversation that has been resumed after it paused through most of the Industrial Age, and it will not stop so easily again. It is gaining momentum and increasing in urgency in the light of two unsettling developments: the critical conditions of the survival of the ecosphere and of freedom in open societies as well as a backlash of religious and ideological fundamentalism, a regression in human development behind everything that modern science and modern art stand for.

"Science, its insights or its methods, are, for us, inalienably connected to art. Both are seeking answers, seeking not-yet-posed questions, seeking new possibilities."
Sebastian Neitsch, artists collective Quadrature [70]

Only through conversations like this, may both the sciences and the arts hope to overcome their own restricting paradigms and structural limitations. So the expectations are high and the drive for evermore far reaching encounters is getting stronger and stronger on both sides. The hoped-for "quantum leap" from art and science encounters to actual collaborations cannot be forced, but the conditions for it to happen can be prepared. The lessons learned from residency programs like the one initiated and enabled by the European Digital Art and Science Network should serve as a useful resource of knowledge in facilitating further encounters.

"Certainly there is want for collaboration and for understanding. The scientist looks for description and understanding, while the artist is looking for meaning. It is the process in which the scientist can learn more from the artist. The open mind and the methodology of the artist is something that can be enriching for the scientist."
Fernando Comerón, European Southern Observatory [71]

When that quantum leap will happen, chances are good for a new kind of "third culture" to develop. The ideas of authors such as C. P. Snow and John Brockman [72], who propagated a third culture beyond the old opposition of conventional scientists and literary intellectuals, will then be carried forward to new scenarios of collaborative research involving scientists and artists, and of the cultural mediators facilitating the process.

"Buckminster Fuller inspired me. He said that the reason why he loves working with artists is because they are the only ones who are taught to be comprehensive, to break rules, and to look for something new. Most disciplines are taught to be specialized and reductionist. So when you talk to an artist, it is kind of a natural thing that she / he would be exploring and thinking about how things connect—artists play a really important role in society."

Victoria Vesna, UCLA Art|Sci Center [73]

While the facilities of scientific research—logically and organically—provided the stage for the encounters during the residencies, other places may come into the picture. The "return visit" of scientists at the artists' studio is still a rare occasion, mainly reserved to those cases where a long-term relationship of exchange resulted from the residency.

"Not primarily for the sake of art or for the sake of science, but for the sake of society the chance for an actual collaboration between artists and scientists is important. If the collaboration allows both partners to participate in the outcome, then both sides gain a lot of experience that they can take back to their own work in their disciplines."

Horst Hörtner, Ars Electronica Futurelab[74]

For future collaborations that take place over longer periods of time, there may be the need for a "third place," a space of free and open exchange beyond—and in addition to—the facilities of the science institutions and the artists' studios with all their structural constraints. This would be a kind of "art and science lab," whose working prototypes can be found at pioneering institutions like Ars Electronica Center and Futurelab in Linz or at the UCLA Art|Sci Center in California.

"Art studios and laboratories should not be separate."

Victoria Vesna, UCLA Art|Sci Center[75]

"We would need to create opportunities for artists and scientists to meet on a regular basis. We would need to create a kind of oasis for them, without pushing them in a certain direction."

Jurij Krpan, Kapelica Gallery[76]

Legend has it that at the entrance of the Platonic Academy the words "Let None But Geometers Enter Here" were inscribed. As new generations of artists and scientists come into the conversation, more and more "digital natives" are part of this exchange on both sides. The places of art and science encounters will, however, require in addition to that a new kind of literacy enabling this very art and science exchange to flow into collaborative projects our societies and our planet are very much in need of. We will recognize the emerging future agents of art and science collaboration by exactly this type of literacy. To help in this very process is what projects like the European Digital Art and Science Network are actually here for.

"Artists are able to create the stories and the images that society needs, not to understand how science works, but to understand what science and technology mean to us. This is one of the very promising and interesting aspects of these art and science encounters: To create messages that are telling us how science and technology are changing our lives. This is maybe even a responsibility of art."

Gerfried Stocker, Ars Electronica[77]
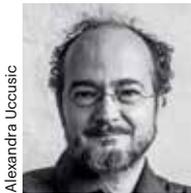
Alexandra Uccusic

Andreas J. Hirsch (AT). Born 1961 in Vienna, Austria, Andreas J. Hirsch lives and works there as a writer, art curator, and photographic artist. He obtained his PhD in Law from the University of Vienna in 1986. His writings include books on Pablo Picasso, Tina Modotti, Friedensreich Hundertwasser, and HR Giger as well as the children's book *Florian Featherlight and the Quest for the Magic Pearl*. As curator of KUNST HAUS WIEN from 2009 until 2014, he was responsible for large monographic exhibitions of photography including René Burri, Henri Cartier-Bresson, and Linda McCartney. He has worked with artists as diverse as Franz West, Bill Fontana, Scott S. Snibbe, and HR Giger. His involvement with Ars Electronica started in 1996 with the concept for the SKY Media Loft of the new Ars Electronica Center. From 2004 until 2007 he served on the jury of Prix Ars Electronica for the category *Digital Communities,* which he had helped to create. He curated the conference *Open Source Life* at Ars Electronica Festival 2010 with speakers including Saskia Sassen, Joichi Ito, Derrick de Kerckhove, and John Thackara. When the Swiss artist HR Giger became "Featured Artist" of Ars Electronica Festival 2013, he curated the exhibition *HR Giger – The Art of Biomechanics* at LENTOS Art Museum and the project *HR Giger's World* for Deep Space at Ars Electronica Center. He participated in the 2015 Festival, *POST CITY,* with his photographic piece *Re-Reading the City,* inspired by situationist ideas and psychogeographic strategies.

1 See also: Victoria Vesna, "Art & Science, Relationships and Emergence," in: *POST CITY, Habitats for the 21st Century,* Ars Electronica 2015, Hatje Cantz p. 184

2 Full title of the category: [the next idea] voestalpine Art and Technology Grant

3 https://www.aec.at/prix/en/kategorien/hybrid-art/

4 Gerfried Stocker, AEC, in a conversation with the author, June 20, 2017.

5 Horst Hörtner, Ars Electronica Futurelab, in a conversation with the author, July 18, 2017.

6 Victoria Vesna, "Our Mission," in: *RETRO / SPECTIVE, A Decade of Intersections,* Art|Sci, Los Angeles, 2015, p. 1
http://artsci.ucla.edu/sites/artsci.ucla.edu/files/retrospective/01/mobile/index.html#p=4

7 Jurij Krpan, "Art & Science, The relationship that is not existing but yet it's functioning," in: *POST CITY, Habitats for the 21st Century,* Ars Electronica 2015, Hatje Cantz p. 185

8 Jens Hauser, in a conversation with the author, June 28, 2017.

9 Rolf-Dieter Heuer, CERN, in a conversation with the author on July 17, 2017.

10 Fernando Comerón, ESO, in a conversation with the author, June 15, 2017.

11 https://www.aec.at/prix/en/collide/

12 Rolf-Dieter Heuer, CERN, in a conversation with the author on July 17, 2017.

13 Rolf-Dieter Heuer, CERN, in a conversation with the author on July 17, 2017.

14 http://arts.cern/julius-von-bismarck

15 http://arts.cern/bill-fontana

16 http://arts.cern/news/2014/japanese-artist-ryoji-ikeda-wins-third-prix-ars-electronica-collidecern

17 Horst Hörtner, Ars Electronica Futurelab, in a conversation with the author, July 18, 2017.

18 Gerfried Stocker, AEC, in a conversation with the author, June 20, 2017.

19 Interview with María Ignacia Edwards by Magdalena Sick-Leitner, March 10, 2015, https://www.aec.at/aeblog/en/2015/03/10/verbindung-von-poesie-und-mathematik/

20 Interview with Semiconductor by Magdalena Sick-Leitner, August 13, 2015, https://www.aec.at/aeblog/en/2015/08/13/semiconductor

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22 https://www.aec.at/aeblog/en/2015/08/13/semiconductor

23 Interview with Quadrature by Martin Hieslmair, March 15, 2016, https://www.aec.at/aeblog/en/2016/03/15/artandscience-quadrature/

24 https://vimeo.com/188180250

25 Interview with Aoife van Linden Tol by Claudia Mignone, March 2017, http://blogs.esa.int/artscience/2017/03/24/stellar-start-for-aoife-van-linden-tol-s-residency/

26 Interview with Yen Tzu Chang by Martin Hieslmair, March 20, 2017, https://www.aec.at/aeblog/en/2017/03/20/yen-tzu-chang/

27 Interview with Yen Tzu Chang by Martin Hieslmair, March 20, 2017, https://www.aec.at/aeblog/en/2017/03/20/yen-tzu-chang/

28 Jurij Krpan, in a conversation with the author, June 26, 2017.

29 Gerfried Stocker, AEC, in a conversation with the author, June 20, 2017.

30 Rolf-Dieter Heuer, CERN, in a conversation with the author on July 17, 2017.

31 Michael Doser, CERN, in a conversation with the author, June 21, 2017.

32 Jens Hauser, in a conversation with the author, June 28, 2017.

33 Michael Doser, CERN, in a conversation with the author, June 21, 2017.

34 Fernando Comerón, ESO, in a conversation with the author, June 15, 2017.

35 Claudia Mignone, Vitrociset Belgium for ESA, has co-curated the residencies together with Karen O'Flaherty, EJR-Quartz for ESA. The initiator at ESA was Mark McCaughrean, Senior Advisor for Science & Exploration, ESA

36 Claudia Mignone, Vitrociset Belgium for ESA, in a conversation with the author, June 19, 2017.

37 Rolf-Dieter Heuer, CERN, in a conversation with the author on July 17, 2017.

38 Gerfried Stocker, AEC, in a conversation with the author, June 20, 2017.

39 Interview with María Ignacia Edwards by Magdalena Sick-Leitner, March 10, 2015, https://www.aec.at/aeblog/en/2015/03/10/verbindung-von-poesie-und-mathematik/
40 Rolf-Dieter Heuer, CERN, in a conversation with the author on July 17, 2017.
41 Bianka Hofmann, Fraunhofer MEVIS, in a conversation with the author, June 22, 2017.
42 Fernando Comerón, ESO, in a conversation with the author, June 15, 2017.
43 Gerfried Stocker, AEC, in a conversation with the author, June 20, 2017.
44 Claudia Mignone, Vitrociset Belgium for ESA, in a conversation with the author, June 19, 2017.
45 Rolf-Dieter Heuer, CERN, in a conversation with the author on July 17, 2017.
46 Claudia Mignone, Vitrociset Belgium for ESA, in a conversation with the author, June 23, 2017.
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48 Claudia Mignone, Vitrociset Belgium for ESA, in a conversation with the author, June 23, 2017.
49 Gerfried Stocker, AEC, in a conversation with the author, June 20, 2017.
50 Claudia Mignone, Vitrociset Belgium for ESA, in a conversation with the author, June 19, 2017.
51 Bianka Hofmann, Fraunhofer MEVIS, in a conversation with the author, June 22, 2017.
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57 Dan Brown, *Angels and Demons,* New York, 2000, p. 17
58 http://angelsanddemons.web.cern.ch/
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60 Rolf-Dieter Heuer, CERN, in a conversation with the author on July 17, 2017.
61 Gerfried Stocker, AEC, in a conversation with the author, June 20, 2017.
62 Jurij Krpan, "Art & Science, The relationship that is not existing but yet it's functioning," in: *POST CITY, Habitats for the 21st Century,* Ars Electronica 2015, Hatje Cantz, p. 185
63 Michael Doser, CERN, in a conversation with the author, June 21, 2017.
64 Bianka Hofmann, Fraunhofer MEVIS, in a conversation with the author, June 22, 2017.
65 Gerfried Stocker, AEC, in a conversation with the author, June 20th 2017.
66 Horst Hörtner, Ars Electronica Futurelab, in a conversation with the author, July 18, 2017.
67 Fernando Comerón, ESO, in a conversation with the author, June 15, 2017.
68 As quoted by John Brockman in the preface to his book *What We Believe But Cannot Prove: Today's Leading Thinkers on Science in the Age of Certainty,* New York, 2006: "To arrive at the edge of the world's knowledge, seek out the most complex and interesting minds, put them in a room together, and have them ask each other the questions they are asking themselves."
69 Michael Doser, CERN, in a conversation with the author, June 21, 2017.
70 Interview with Quadrature by Martin Hieslmair, March 15, 2016, https://www.aec.at/aeblog/en/2016/03/15/artandscience-quadrature/
71 Fernando Comerón, ESO, in a conversation with the author, June 15, 2017.
72 C. P. Snow, *The Two Cultures,* 1959. John Brockmann, *The Third Culture,* 1995.
73 Victoria Vesna, UCLA Art|Sci Center, in a conversation with the author, June 22, 2017.
74 Horst Hörtner, Ars Electronica Futurelab, in a conversation with the author, July 18, 2017.
75 Victoria Vesna, UCLA Art|Sci Center, in a conversation with the author, June 22, 2017.
76 Jurij Krpan, in a conversation with the author, June 26, 2017.
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Jurij Krpan

Art&Science
The relationship that is not existing but yet it's functioning

The subtitle is taken from the notorious J. Lacan seminar: *Encore,* 1972–1973, where he introduced the non-biological, denaturalized sexual difference between a woman and a man and formalized it in the scandalous one-liner: "There is no sexual relationship." Being inspired with theoretizations of the relationship between two genders, where theoretical psychoanalysis created the gap between the sexes to be able to depict the inherent out-of-sync between something that is apparent to everyone as being contingent.

With this inspirational quote in mind, I want to emphasize that the Art&Science which is taken for granted and objectifies anything in arts that is related to media, electronics, and other contemporary technology, is not a solid praxis where art and science merge, but rather a dichotomy where one struggles with the other. Conceptual difference between science as production of knowledge and art as production of meaning, plus structural discrepancy between linear thinking in science and non-linear (synchronous) comprehension, are leading us to a number of possible approaches and intersections between the two which may be tried out one by one or all together at the same time.

Being attracted by the ultimate questions—who we are, where we come from, and where are we going as humankind, artists and scientists are sharing the same field of metaphysical interest, but the way they approach these ultimate questions are intrinsically different. If we are looking for a symmetrical relationship between artists and scientists, we should look for a relationship where the work of both are mutually inspirational. There are some mundane examples where scientists can be inspired by artworks and artists can be inspired by the scientific findings (sometimes still just concepts), but such inspirational premises are never really smooth and uni-directional. There might be a case of negative inspiration as well and also just an unscrupulous transposition of a scientific experiment into a gallery or another art context.

The relationships between Art&Science might be asymmetrical and abusive where artists are merely using knowledge, expertise, and tools that scientists can provide them with for an art project, while scientists, on the other side, can instrumentalize artists to draw and design visualizations of their findings to communicate their complex scientific results better. In the art projects where artists are problematizing and criticizing the effects of scientific findings and technological applications on society, the science figures only as a relational field. Artists are using materials, tools, and protocols that are typical for the phenomena caused by scientific agents, in order to be more precise in their thematizations. If I put it simply, artists can't use the oil on canvas technique when arguing about the effect that biotechnologies are having on the consumeristic ideology that proposes to design life as a product.

I might go on forever with descriptions of possible types of relationships between artists and scientists, but the format of this short text enables me to extend the whole discourse just inside this one-page essay. However, I believe, it is enough to underline the impossibility of the Art&Science term, since there is nothing that you can "point your finger at" and determine what Art&Science precisely is. If I wrap up, there is no such thing as Art&Science, but yet it is clear, that that dichotomy is producing extremely fruitful tensions. Exactly like theoretical psychoanalysis enables us to understand the functioning of non-existing relationships between the sexes, we should understand the dynamic intersections between arts and science and shouldn't be frustrated because we see how "out-of-sync" the two practices are. The whole axiomatic statement "There is no sexual relationship" has its rhetorical follow-up: "But yet it's functioning."

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Jurij Krpan (SI), born in Postojna in 1961, lives and works in Ljubljana, Slovenia. At the initiative of the Student Organization of the University of Ljubljana, he conceived the Kapelica Gallery – Gallery for Contemporary Investigative Arts, which he has been running since it was established in 1995. As a curator and selector he has contributed to various domestic and international festivals. In 2014 he co-curated the Designing Life section for the Biennial of Design in Ljubljana and curated the Slovenian pavilion at the Venice Biennale of Architecture. He started the year 2015 as an appointed curator of the Freies Museum Berlin. Jurij Krpan lectures about the artistic profile of the Kapelica Gallery in Slovenia as well as abroad.

Victoria Vesna

Anticipatory Art Science: Networks to NanoSystems

Individual / Collective / Micro / Macro

"The further art advances
the closer it approaches science...
and the further science advances
the closer it approaches art."

Leonardo da Vinci, quoted in R. Buckminster Fuller,
Nine Chains to the Moon, 1963

Things have sped up, everything is moving ever faster and what we would have deemed impossible even 20 years ago is happening now. We are in the midst of a major paradigm shift and are bound to land in a whole different world sooner than we think. At this particular juncture, there is an urgency that is collectively shared as reductionist models of science collapse, the established art world caters to the wealthy few, and we are at a brink of an ecological disaster. There is some hope however as we see more and more artists, scientists, and many others seeking to blur the traditional disciplinary boundaries, and our youth are rightfully demanding this in their education. The young Leonardos who will inherit this planet need support and the tools to work with so they can survive and prosper. Educational institutions around the world—for the arts, sciences, and humanities—are leftovers from the Industrial Age mindset and the remaining crystalized structures are difficult to shift. But we have no time to perpetuate the old models as our world is on the brink of a collapse and we urgently need minds from every discipline to come together and envision alternatives.

Divisions of people and disciplines inevitably lead to the creation of stereotypes that contribute to perpetuating their separation, whether intentionally or not. The current educational system is set up to develop these roles and, if one is successful in understanding the archetypical image that is being summoned and shapes him/herself accordingly, it strengthens the possibility of success in that particular field. The problem of course is that gender and race cannot be shape-shifted and so we have large segments of the creative population who do not fit into the established stereotypic mold of the art and/or science worlds.

Bad Math Teacher / Bad Art Teacher

When I teach my *Introduction to Art & Science* course[1], we always start by sharing stories going back to the intersection on our educational path where we had to make the decision—at the fork of two cultures. Science students often tell stories of how they loved art or music but their parents would have never let them pursue this as a serious study. Or, worse, an art teacher told them that they do not have the talent for art. For many artists, including myself, there would be stories about the awful chemistry or math classes. But, inevitably in everyone's case there was at least one good teacher who passed on his or her passion for a subject and helped determine the path. From both sides, although we often try to fill the educational gap, many give up and never cross over to the "other side." We see this now in the growth of the DIY movements and the growing number of workshops outside of academia offering what is missing—mixing up the science lab, art, and music studio practice. Add to that social media and "how to" online courses and it is apparent that educational patterns are changing outside of academic walls. A new generation of teachers will hopefully have the willpower to create the environment that will prepare the youth for contemporary complexity.

At UCLA (University of California, Los Angeles), the large campus is clearly divided geographically between the north side (arts and humanities) and the south (engineering and science). Institutional divide is further amplified by the distances, and students have to travel with their schedules jam-packed—even the most energetic, more often than not, end up giving up. Students who attempt interdisciplinary majors also have no roadmap and end up having to do twice the work, if persistence prevails.

Traveling around the world and visiting many academic and research institutions as well as art festivals and events, I have witnessed this same divide everywhere. For instance, I was recently a guest professor at the Interface Culture program[2] of Linz University of Art and Design, teaching a lighter version of the *Introduction to Art & Science* class to masters students. After everyone shared their stories, I asked where the scientists in the University of Linz are and the response was: "Across the river, at Kepler University." This was so obviously symbolic that the next day we packed up and crossed the river to enter the sciences and also visit one of the student's friends who works there in a mechatronic lab. They were all amazed at how similar their interests are but it was clear that, at this stage, it is still difficult to collaborate.

For many years, I separated my artwork from my parallel interest in science. I produced and directed an award winning documentary, *Unfolding the Pyramids of Egypt Using Modern Physics* (1988), conducted interviews with Nobel Laureates such as Murray Gellman and Glenn Seaborg about their creative process (1989), and directed a CD-ROM production of *Life in the Universe with Stephen Hawking* (1996).[3] I did not consider this part of my artwork and only started connecting the two worlds in 2001 when I finally met a scientist who was going to collaborate in earnest and not expect me to visualize his / her work. Here I tell about a sequence of events that led me to pursue with passion art & science in my work as well as in education. I elaborate on how a large exhibition, *NANO*, determined my path and also was a precursor to the work that followed in my own practice as an artist and educator.

Networks to Nanosystems

"I am quite sure we are going to get research and development laboratories of education where the faculty will become producers of extraordinary moving-picture documentaries. That is going to be the big, new educational trend."

R. Buckminster Fuller, *Education Automation, 1962*

During my PhD studies, I was fortunate enough to meet Allegra Snyder-Fuller who gave me access to the Buckminster Fuller archives, auspiciously situated in Santa Barbara at the time. After our first meeting she sent me a copy of *Education Automation: Comprehensive Learning for Emergent Humanity,* a book written by her father who was a passionate believer in the influence of information technology on education.[4] The short book is a transcript of a 22 April 1961 lecture, and preceded J. C. R. Licklider's famed memos on computer networks in 1962. As I delved further into his work, I learned about the discovery of the third allotrope carbon, C60, and was particularly fascinated with the story of how this molecule came to be named Buckminsterfullerene.[5]

Soon after 9/11, in November 2001, I organized a symposium entitled *Networks to NanoSystems: art, science & technology in times of crisis,* in coordination with my colleagues in the UC system[6] and Roy Ascott's Planetary Collegium PhD student meeting and residency at UCLA[7].

It was important for me to have at least one scientist who worked on nanotechnology in the symposium and I had trouble finding someone who would be interested in real dialogue. Luckily, a colleague and fan of Bucky Fuller, Maroon Tabbal, told me about a scientist who had just arrived to campus from IBM Zurich Research Laboratory—James Gimzewski. I sent him an email and was surprised to get a quick and enthusiastic response. During his lecture I was thrilled to find out that the IBM Zurich Lab he came from actually developed the Scanning Tunneling Microscope (STM)[8]. But even though he worked with bucky-

balls, he did not know who Buckminster Fuller was or the story of the naming of the C60, so this became the basis of our productive exchanges. We arrived at the same point from the opposite sides of the pendulum—I was learning about the science and he about the cultural background. After a year of sharing our ideas and discussing philosophically, the pros and cons of this new science and the manipulation of the molecular realm, *zero@wavefunction: dreams and nightmares* was created.[9] The project premiered at BEAP, Perth in 2002 and gave me an opportunity to visit the SymbioticA art lab being set up in the biology department at the University of Western Australia. It was inspiring to see artists, humanists, and scientists sharing the same space exploring biotechnology.

NANO

Due to the successful buckyball installation, we were given a unique opportunity by Los Angeles County Museum of Art (LACMA) to create an "experimental space" or laboratory at the Boone's Children's Gallery. The museum was confronted with a programming vacuum when a radical renovation proposed by Rem Koolhaas fell through. Ironically, we enacted what he envisioned with the *NANO* exhibition. In 2001, this is how his team described their proposal: "Once, all continents formed a single whole. Then they drifted apart. We propose to undo LACMA's "continental" separation. Imagine an almost utopian condition where the history of the arts can be told as a single and simultaneous narrative showing moments of chronological coincidence, autonomy, influence, and convergence. After decades where accommodating the "modern" led to a situation of glut and fatigue, the idea of the all-embracing has a new appeal."[10]

The chances of a museum allowing the kind of experimental exhibition and series of events we staged with *NANO* in such a large space for close to a year are to this day almost nonexistent. Usually their calendar is set years in advance, and established names or topics are what are to be expected. But we found ourselves in-between space and time and the opening became an inspiration to develop a conceptual framework that would address the impact of nanotechnology on culture and society. I set out to imagine a series of interconnected installations that would play with scale and be activated by the audience's presence and interaction. Gimzewski and I worked closely together on imagining the experiences and we invited theorist Katherine Hayles to join us. We had art, science, and humanities working together and envisioning an interactive experience based on scale, dreams, and nightmares of nanotechnology.

Retreats, Residencies, Social Events

With a tight time frame and budget, we had to envisage and realize a conceptual framework that would inspire others to join us. The three of us organized a series of "Sinaptic Blow-out" brainstorming meetings which included our brightest graduate students. The retreats took place at a house on the Malibu Point

Dume State Beach with no agenda, and very quickly those who wanted a structured plan backed off. After a few sessions, the group that was left was composed of people who really wanted to be there and got along on a human level. Professors, students, photographers, and friends were having fun envisioning installations while discussing at length social and cultural implications of this new science.

These retreats were purposely outside the academic or gallery context and were definitely the most productive way to initiate and develop such large interdisciplinary projects. To this day, I organize those kind of social gatherings when an ambitious project is about to come together. In collaborations that span disciplines and different languages and methodologies, the human connection is the most important creative glue. Inspiration is clear of disciplinary programming.

During the year, we involved architects, theorists, designers, musicians, choreographers, dancers, and engineers in the development of the exhibition. Students from all areas were involved and it was like conducting an orchestra to bring all the different sides together. Architects Johnston Marklee worked with us to develop large structures based on Buckminster Fuller's model of the Dymaxion map. Using shapes that resemble molecular nanostructures, the folded three-dimensional surfaces created interlocking layers of enclosed and semi-enclosed "cells" and "sense spaces." The entire space was designed to play with scale and disturb our usual relationship to the material realm with unexpected behavioral responses. At the entrance, the audience was confronted with many surveillance cameras that captured their images and added into a growing number of projected hexagons over the ten months that the exhibition lasted. Entering the center cell, one could manipulate buckyballs with ones shadows and the floor consisted of a hexagonal projection that was responsive to the movements of people walking as well as large robotic spheres that were being manipulated by the audience remotely. This resembled the graphene single atomic layer before it was discovered in 2010.[11] People walked through a "quantum tunnel," where two identical mirrored spaces bounced granulated images and sound and when another visitor passed through the tunnel connecting the two rooms, seemingly non-sensical reflections and disturbances were created. Moving further, one would enter a room with a bed of sand with a projection of a sand mandala which evolved in scale from the molecular structure of a single grain to the recognizable image of a Chakrasamvara mandala created by Tibetan monks in another part of the museum.

NANO was open for a period of ten months and become a fertile space for collaborations and experimentation. Katherine Hayles edited a book, *Nanoculture: Implications of the New Technoscience,* written by her students who participated in the process of the installation, wrote about the subject in it, and contributed text to the exhibition.[12] Dance PhD student Nora Zuniga-Shaw together with choreographer Marianne M. Kim worked with master performers. Harmony Bench choreographed a performance within the installations with dancers wearing white clothes designed by fashion design students from Otis

design school under the eminent NY fashion designer Isabel Toledo.[13] This allowed the models to play with the installation projections and meld into the environment. Together with Bucky aficionado Maroon Tabbal, we organized public educational workshops at the museum that connected to the installations, including a few evenings with DJs and parties around the installations. Hayles and her students selected scientific, art, and sci-fi books related to the exhibition theme and made them available to the public. Media arts, dance, fashion, music nanotechnology, engineering, and humanities graduate students worked together helping with the creation and installation where they learned through experience while making strong peer connections. Anne Niemetz, an MFA student working with me, staged within the installation her MFA project together with PhD student Andrew Pelling in Gimzewski's lab.[14]

NANO evolved as an emergent system as the outcome of a directed self-organizational process and I started really believing in the importance of this form of collective/collaborative work. It at once challenged the way both art and science museums operate.

The experience of directing these collaborative artworks changed my perception of what an artist working with large interactive installations can offer in addition to the exhibition. It became a space where graduate students worked together in the process of creation and also staged their own work, undergraduates helped with the installation, learning in the process, and the public was taught about the scientific concepts by the professor and students. But, most of all, the children experienced all of the above without the art or science being dumbed down. This was my prime motivation for envisioning the Art|Sci Center in 2005 and two years later I designed the curriculum for the *NanoLab Summer Institute* for high school students.

What do the Scientists get out of it?

This *NANO* exhibition was a major commitment for Gimzewski and his students, taking a lot of time and energy. However he noted that those who participated later went on to produce more publications and adopted a creative side in their scientific research. Indeed, in later projects we collaborated on publications that arose out of the synergetic relationship with the artwork.[15] This did not go unnoticed by other scientists on campus who started being more open and engaging in dialogues with artists visiting the Art|Sci Center, inviting them to their labs, and even delving into deeper collaborations. Today, we see this trend having significant momentum in many science and art programs becoming official and funding programs like the National Science Foundation (NSF) in the US and the STARTS program established with the EU. This is all very encouraging but still has to be approached cautiously as it can at times be artificial in the connections made or superficial when not enough time is given to allow the work to emerge naturally. Arranged marriages sometimes work but generally lack the passion and dynamics of a relationship based on natural attraction—and there is no formula for this, you just have to allow it to happen.

It is particularly encouraging to witness a new breed of young scientists who have embraced art science collaborations early in their education. When a senior professor encourages the students in their labs to be open to working with artists and the center further promotes the work, we see comprehensive, creative scientists emerging. Another example is Takashi Ikegami, a physicist from Tokyo University who I currently collaborate with on a highly interdisciplinary and complex project initiated by evolutionary biologist Charles Taylor[16]. Ikegami went a step further and invited sound art and philosophy students to join his lab. He rightfully believes that this gives him a wider view on his research into artificial life and other complex systems that do not operate successfully in a sterile reductionist environment. Combined with institutions such as Ars Electronica that promote and celebrate this approach, is clearly a positive sign for the future. But most of all, we have to pay attention and encourage the really young art scientists who are about to enter university. There is still no solid curriculum that promotes art and science intersections and unfortunately much still has to happen on the fringes in between and outside of academia.

Sci|Art NanoLab

"There are children playing in the streets who could solve some of my top problems in physics, because they have modes of sensory perception that I lost long ago."

J. Robert Oppenheimer, 1967

By the time students are accepted into college, their expectations of what academia offers as an educational environment has been set. *NanoLab* program was designed for students at the intersection of the two cultures—just at this critical point that determines their future educational path, recognizing that it will take some time to change the academic structures. Our goal is to show the students all the possibilities of how to navigate different disciplinary boundaries and how to push the limitations of the existing system.

The teenage phase of life often involves risk seeking and irrational behavior. This is an ideal time to focus that wild energy and include them in new areas of exploration. I have experienced this first hand with my two daughters who participated in many art installations and who particularly loved *NANO*. Looking for suitable high school summer programs for them gave me the idea to conceive a new program for students about to enter college. While developing the curriculum, I had two honest and tough beta testers and I eventually developed a program that this summer is celebrating its tenth year. We contacted some of the many students who went through our program to find out where they eventually landed. Many went on to the medical professions, one is working for Space X, and another is forming his own nanotechnology company. There is no doubt that catching them early and showing them the possibilities of having a

wide angle lens and a divergent view while pursuing their studies in a research university provides a key advantage later in life—no matter what path they decide upon.

NanoLab is an intensive two-week program based on a college level class that is normally taught in ten weeks. This means non-stop immersion in a broad, comprehensive study that is not dumbed down, and students get college credits that are transferable. Once established in 2007, Adam Stieg, who was at the time a graduate student in Gimzewski's lab and an active participant in *NANO,* became the director.[17] I continue to be involved with the planning and recruiting students from Design Media Arts and Gimzewski and Stieg brought in graduate students from the sciences. We team art and science graduate students and guide them in developing their classes and workshops. This provides them with an opportunity to learn from each other and it has strongly contributed to lasting collaborations and the emergence of some great projects. Undergraduate students are also called to task as counselors and helpers with their assignments. This way they learn about various topics and how to take responsibility in the running of the program.

"Students everywhere are confronted with yesterday's science fiction operating as today's fact."

R. Buckminster Fuller, *I Seem to Be a Verb*, 1970

NanoLab takes place at the California NanoSystems Institute and the day begins at the auditorium with a lecture about a particular topic, typically commencing with nanotechnology. This is followed by a hands-on workshop where students build their own optical microscope using cheap webcams, and they also learn about different imaging systems. After lunch, they go to visit various imaging laboratories and see how scientists work with the Scanning Tunneling Microscope (STM), Scanning Electron Microscope (SEM), and related research tools including advance optical microscopes. After that, they hear a lecture of a visiting artist who works with imaging technologies and are given a hands-on demo. After dinner, they watch a sci-fi movie related to the same topic and write about their impressions. Throughout the two weeks, science, art, music, movie, and literature are interspersed and they very quickly understand that only the methodology of development is what really separates these disciplines. We take them out to museums, the beach, and the LA river to test the water quality and encourage their curiosity about their environment. After a week of this kind of immersion, they are asked to self-organize into small groups and develop project prototypes and proposals based on the science they learned about and we ask them to imagine the "impossible." Once their final projects are presented, we tell them that they successfully created an "artwork" and if they want to commit the time to make it a reality, they will be doing "science." To achieve this, they have to essentially invent their own methodology that is peculiar to their vision rather than what is typically taught in science classes. The methodology we teach is "Anything goes."[18]

Face the Future now

The generation of youth growing up today is inheriting a world we are not even able to imagine, so how do we prepare them for the uncertain future?

If we take a 100-year marker and briefly rewind our film back to 1917, literacy was just 23%—today it is 80%, WW1 was raging, the Russian revolution was in full swing, Kazimir Malevich presented the controversial white on white painting, Marcel Duchamp exhibited the urinal as sculpture. Those works to this day resonate and inform the art world. D'Arcy Thomson wrote *Growth and Form*—a book still influential to biologists and artists alike; Einstein wrote his famous paper that predicted stimulated emissions (beam of a laser) and we know the massive applications in all walks of life; Freud came up with his ideas of the unconscious—think of the subsequent advances in brain / consciousness research. War technology was making fast progress through use of airplanes and even gas attacks—now we have drone attacks and much more. In 1917, women were fighting for the right to vote, only 6% of Americans graduated from high school, now we are arguing whether artists should do a PhD. We had 1,9 billion people on the planet, today it is 7,9 billion. It took three grueling months of travel from London to New York, now we complain when the plane is an hour late. Ford Motor Company was in full speed with the newly introduced idea of mass assembly line production ushering in the car as transportation available to the middle classes. Today electrical cars are finally hitting the road in large numbers.

In parallel to all this creative innovative art, science and technology, multiple political events occurred in 1917. Europe's Great War was transformed into the First World War, America entered the stage, Asia was mobilized, Mahatma Gandhi and his followers established the first experiment in self-rule, and with Lenin's coup, an entirely new ideological politics and geopolitical order emerged. The overthrow of the tsar in Russia triggered a wave of sympathy around the world and this year had a moment of democratic, not socialist, excitement.[19]

Growing up with a father who was a diplomat for former Yugoslavia, I was bounced around from Washington D.C. to Belgrade, to Jakarta to New York City by the time I was twelve. At each location I was taught a different version of World War II history and quickly realized that these were stories told from differ-ent global and political perspectives. But, one thing is for sure—no one could have predicted how the world changed and the direction we collectively took over the course of the last hundred years. We first saw our planet from a distance in 1969—that is not that long ago. That same year we made the first network connection from UCLA to UCSB and Stanford with the first message "LO," starting the process of communication across the globe and slowly becoming world citizens.

We feel something brewing, we are in the midst of a paradigm shift and the wave is already sweeping us along. The icebergs are melting and many are ignoring the alarm sounds of the scientific community predicting environmental disasters upon us, or the potential dangers of artificial intelligence. All of us are anticipating a new era with CRISPR/Cas9 gene editing technology promising

to reprogram life as we know it. New developments in artificial intelligence, artificial life, robotics, sensors, networks, synthetic biology, materials science, space exploration, and more knowledge about our brain, mind, and consciousness appear every day. However, every great proposition has an equally great opposition and the world is polarized more than ever on a global level.

Many of the things we discuss when it comes to education and academia are not even an issue with today's youth. We can see this happening all over with an ever growing number of workshops and DIY meet ups offered by young artists and scientists and the new generation that grew up around art, science, and technology. A good example is seen in the children growing up in Linz who are exposed to cutting edge art installations and science through Ars Electronica. One example is the young artist, Lisa Buttinger (born 1997), who received the Golden Nica of Prix Ars Electronica u19 category and the STARTS Prize Honorary Mention this year. Seemingly effortlessly she combined her knowledge of natural sciences with an artistic output and created a work that is surprisingly mature. Seeing these young Leonardos working on creative projects gives us hope for the future as we can anticipate the third culture truly emerging with no disciplinary separation as we know it. The main challenge is to avoid having them caught up in the de-geniusing machines of yesterday.

Neuroscientists agree that we use around 5% of our brain and that most of what we do is actually unconscious, although some even believe it's closer to 1–2%. Regardless, it is clear that scientists are faced with increasing complexity that cannot be addressed with traditional methodologies. This is the important role that artists can play as the few that are trained to think in comprehensive ways. As Anticipatory Design / Art Scientists, we can put up what John Cage calls our "antennae to the future" and present to the world alternate visions, counter to what is being fed through our media daily. It is an exciting time, it is a dangerous time, certainly unpredictable but we can anticipate and prepare ourselves. Dramatic shifts can happen in a nanosecond—this is the nature of self-organized criticality.[20]

Victoria Vesna (US) is an artist and a professor at the UCLA Department of Design Media Arts and Director of the UCLA Art|Sci Center. With her installations she investigates how communication technologies affect collective behavior and perceptions of identity shift in relation to scientific innovation (PhD, University of Wales, 2000). Her work involves long-term collaborations with composers, nano-scientists, neuroscientists, and evolutionary biologists, and she brings this experience to students. Since 1997, she is a speaker at Ars Electronica symposia, has served as a juror several times, and in 2017 she showed *Bird Song Diamond* at Deep Space and curated the Campus Exhibition.

1. Introduction to Art & Science in the UCLA Department of Design Media Arts course started as a large General Education lecture course in 2006 and gradually shifted to an online hybrid class. Students from every discipline imaginable take this class and participate in the events organized by the Art|Sci Center giving them an opportunity to meet in a more relaxed social environment. Because of its wide outreach, I consider this course an important aspect of shifting away from the two-culture divide on campus.

2. The Interface Culture program at University of Art and Design Linz, Department of Media was founded in 2004 by Christa Sommerer and Laurent Mignonneau. Sommerer received her PhD from Ascott's Planetary Collegium in 2002.

3. In parallel to exhibiting my artwork, I was making a living as a video producer and focused on scientific content for a period of 10 years—1987-97. *Life in the Universe with Stephen Hawking* CD-ROM—art direction and production, UC Santa Barbara in collaboration with MetaTools Inc. 1996, (unpublished); *The Internal Language of the Brain Translated into Music*. Video (produced and edited) Xiadong Leng and Gordon Shaw, University of California Irvine, 1993, (unpublished); *System for Aneutronic Fusion Energy* (S.A.F.E.). UCI / Advanced Physics Corp, 1992 (unpublished); *Discovery of Strangeness*. Dr. Murray Gell-Mann, Nobel Laureate, 1989, (unpublished); *The Science of Preventing Wars.*The Physicist Who Changed Gorbachev's Mind (unpublished); *Biochemistry of Emotions*. Norman Cousins, 1989, (unpublished); *Unfolding the Pyramids' Secrets Using Modern Physics,* directed by Victoria Vesna and awarded a CINE Golden Eagle for Best Science Documentary, 1988, (unpublished). Produced by the Tesla foundation.

4. "Education Automation on Spaceship Earth: Buckminster Fuller's Vision. More Relevant than Ever." Allegra Fuller Snyder and Victoria Vesna. In *Leonardo, Vol. 31, No. 4* (1998), pp. 289-292, MIT Press.

5. Buckminsterfullerene discovered by Harold Kroto, James Heath, and Richard Smalley in 1985. One of his designs of a geodesic dome structure bears great resemblance to C60; as a result, the discoverers of the allotrope named the newfound molecule after him. The general public, however, sometimes refers to buckminsterfullerene, and even Fuller's dome structure, as buckyballs. See "Naming of Buckminsterfullerene by E.J. Applewhite," in *The Chemical Intelligencer,* July, 1995 (Vol. 1, No. 3)

6. UC DARNET – University of California Digital Arts Research Network was a collective of media artists and professors in the UC system – UC Berkeley, Santa Cruz, Davis, Los Angeles, Irvine, Riverside and Sand Diego (1997-2009).

7. The Planetary Collegium was first established as the Centre for Advanced Inquiry in the Interactive Arts (CAiiA) by Roy Ascott in 1994 at what is now the University of Wales, Newport. I was one of the first five PhD students along with Jill Scott, Bill Seaman, Miroslaw Rogala, and Joseph Nechvatal (1996-2000). In 2003, Ascott relocated the platform to Plymouth University, renaming it the Planetary Collegium, where it is now located in the Faculty of Arts and Humanities. Over 80 doctoral candidates have graduated.

8. A Scanning Tunneling Microscope (STM) is an instrument for imaging surfaces at the atomic level. Its development in 1981 earned its inventors, Gerd Binnig and Heinrich Rohrer at IBM Zurich, the Nobel Prize in Physics in 1986. Gimzewski pioneered research on mechanical and electrical contacts with single atoms and molecules using scanning tunneling microscopy (STM) and was one of the first persons to image molecules with STM.

9. *Zero@wavefunction* as described in 2001 in the exhibition catalog at BEAP festival in Perth, Australia: "Zerowave explores the dreams, nightmares and visions in a manner similar to quantum mechanics. The particle that penetrates the quantum wall has a probability to reflect to transmit through the barrier with a zillion possible outcomes in between. To the artist and the scientist this becomes the magnetic realm worthy of exploration. It is a set of wave functions of human existence, of technology and science woven together in a dynamically transforming landscape with probabilities of Being and Non-Being, of Time and No time. The project represents an exploration of the unpredictable where both artist and scientist are willing to be conceptually changed in their vision, hopes and fears."

10. OMA office work website: *http://oma.eu/projects/lacma-extension*

11. Andre Geim and Konstantin Novoselov received a Nobel Prize in Physics for their discovery of a thin flake of ordinary carbon, just one atom thick. They have shown that carbon in such a flat form has exceptional properties that originate from the remarkable world of quantum physics.

12. Hayles, Katherine, ed. *Nanoculture: Implications of the New Technoscience*. Intellect books, UK, 2004.

13. I was invited to work together with fashion designer Isabel Toledo as part of the mentorship program in the Otis School of Design in Los Angeles. The dresses produced by students were part of the NANO exhibition as well as an annual fashion show at the Beverly Hilton hotel. *https://www.otis.edu/fashion-design/past-mentors*

14. *Dark Side of the Cell* premiered at the LACMA as part of the NANO installation and was Anne Niemetz's final MFA project. It was based on Gimzewski's research showing that yeast cells oscillate at the nanoscale. Andrew Pelling, PhD student in his lab, amplified the oscillations making them audible and Anne created an installation inspired by the cellular tensile structures. *http://www.darksideofcell.info/about.html*

15. Co-authored with Gimzewski in relation to the exhibition: "The Nanomeme Syndrome: Blurring of fact and fiction in the construction of new science." *Technoetic Arts* journal, May, 2003 "NANO: An Exhibition of Scale and Senses." *Leonardo Vol. 38, Issue 4,* August 2005.

16. *Mapping the Acoustic Network of Birds* is a research project that was funded by the National Science Foundation and the art project that emerged is *Bird Song Diamond*. The leaders of this large and complex collaborations are evolutionary biologist Charles Taylor, artist Victoria Vesna, physicist Takashi Ikegami, and engineer Hiroo Iwata. *http://birdsongdiamond.com*

17. Adam Stieg directed the program until 2015 when he assumed additional research responsibilities at California NanoSystems Institute (CNSI). He is still involved in an advisory role.

18. "Anything goes"—I refer here to Feyerabend's *Against Method: Outline of an Anarchistic Theory of Knowledge* in which he defends the idea that there are no methodological rules always used by scientists. In his view, science would benefit most from a "dose" of theoretical anarchism. University of Minnesota Press, 1975

19. "1917—365 days that shook the world," by Adam Tooze / December 13, 2016. *Prospect Magazine,* January 2017. *https://www.prospectmagazine.co.uk/magazine/1917-year-shook-the-world-russian-revolution-united-states*

20. "Self-Organized Criticality and Emergence in Dynamical Systems," James K. Gimzewski, Adam Z. Stieg, Victoria Vesna. *Handbook of Science and Technology Convergence.* Springer International, 2015, pp. 163–180

Horst Hörtner

Art, Technology, and Society as Research Practice

Ars Electronica Futurelab

Ars Electronica Futurelab, a laboratory and an atelier in which artists, engineers, designers, and scientists work together on creative and innovative ideas and prototypes, is an indispensable and vital part of Ars Electronica's creative ecosystem. Developed by the team with which we built the first Ars Electronica Center in 1995/96, it soon became a successful part of our organization, not only working for the Festival and the Center but collaborating as well with universities, business, and industry from all over the world.

By 2012, Futurelab had already grown to more than 50 full-time employees and, to allow for further growth without compromising the creative spirit, we made a spin off of Futurelab and founded Ars Electronica Solutions. Since then, Futurelab is concentrating on artistic development, technology-oriented research co-operation, and creative consulting, while Solutions has taken over the market-oriented realization of creative applications. With their successful projects and collaborations, both areas play an important role in the overall financing of Ars Electronica.

From the outset we knew that Ars Electronica could only forge new directions with the city of Linz if it was not just a place for presentation but also a place for production and creation. We wanted to inspire not just with words but also with real projects. Initially we faced some skeptical questions about the necessity of such a laboratory. The city agreed, but stipulated that Futurelab would have to be self-financing through co-operations and commissioned projects. Given the team's high level of competence in areas like VR, Interactive Interfaces, and the successful exhibitions at Ars Electronica Center as an attractive showcase and reference, clients from industry and research were soon found and Futurelab was established.

So we got our own think tank and production facility that we needed for the continually evolving development of Ars Electronica, plus the opportunity to reach out and work with the economy, local businesses, and entrepreneurs from the city and the region.

The strong anchoring in the artistic field at Ars Electronica Festival and Prix Ars Electronica guarantees that Futurelab will never become just technology and profit-oriented. A very characteristic constellation emerged of the same teams working on both the industrial projects and the art projects. The mutual experience gained from these collaborations and the response that we get from daily visitors to the Center have built up intensive competence for the design of interfaces and communication between humans and technical systems. This competence is gained equally from the artistic sensitivity to the human factors as well as from the experience of concrete project work with industry and research.

The augmented reality car navigation system already realized in 2002 and exciting cooperations with Honda's Asimo Team and Daimler with their prototype of a self-driving Mercedes Benz are just a few examples of how the artistic point of view can change the focus from technical solutions to a human-centered approach. The innovations resulting from such collaborations impressively demonstrate the potential of artistic participation.

Many members of Futurelab also teach at universities, work as artists, and share their knowledge while the international artists in residence bring in a constant flow of new ideas and know-how. And it has become very clear over the years that creative and innovative powers need to be continually renewed and replenished. We also need to understand the importance of art itself. Without work dedicated entirely to artistic concerns, this source of all creative energies would soon dry up.

Ars Electronica Residency Network

Futurelab has a worldwide network of collaborating partners and the Ars Electronica Residency Network (AERN) represents the successful attempt to formalize this network, offering extraordinary opportunities and challenges for artists and scientists, as well as partner institutions, through residency programs. AERN helps to create optimal conditions for the selected person-in-residence, providing fruitful encounters for the project work during the residency in order to achieve the best possible results. The residency may take place on the partner's premises, with optional research and development stays at the Ars Electronica Futurelab, or exclusively at the Ars Electronica Futurelab—depending on the nature of the pioneering work. At the heart of AERN is transdisciplinary research and artistic development, supported by the special competence of the Ars Electronica Futurelab to work in this field. The scope of the programs and projects is spread across disciplines and reflects the cultural and institutional background of the partners and residents.

The joint residencies within the framework of the EU funded program European Digital Art & Science Network are part of Ars Electronica's residency activities. It supports artists to develop their practice through access to one-of-a-kind scientific institutions, research facilities, as well as latest technological developments. It facilitates interdisciplinary artistic research and enables interdisciplinary collaboration in a worldwide network of scientists, researchers, engineers, innovators, and artists. Moreover, based in Ars Electronica's core interest, artists are also encouraged to embed their work in the wider context of society.

The vivid exchange with Futurelab experts is a fertile ground for artists in residence with out-of-the box thinking. Having been inspired and having developed an idea for their stay, they'll get further input and insight into the unorthodox workflow and collaborations of Ars Electronica Futurelab's innovative staff. It is no isolated incident if an artist in residence is inspired by the exchange of ideas to alter their plans and aspire to a different result. The lab is also the place where artists find an ideal studio equipped with state of the art technology and enough space to expand ideas. Having brilliant artists in residence is a win-win situation; Futurelab benefits from outside perspectives. The think tank tackles various research topics that have added up to a bold list of applied future science, such as creative catalyst, functional aesthetics, information aesthetics, interaction ecology, robo psychology, and media art in architecture among others.

The residency programs and projects are presented during the Ars Electronica Festival, with Ars Electronica providing the necessary infrastructure for the presentation of the project results.

Horst Hörtner (AT) is a media artist and researcher. He is an expert in the design of human-computer interaction and holds several patents in this field. He started to work in the field of media art in the 1980s and co-founded the media art group x-space in Graz, Austria in 1990. Hörtner was a founding member of Ars Electronica Futurelab in 1996 and since then he has been the director of this atelier/laboratory. He holds the position as a Conjoint Professor at the University of Newcastle, Australia. In his research Hörtner focuses on swarm behavior. Together with an interdisciplinary team of experts he has been developing SPAXELS® performances since 2012. SPAXELS® (=Space+Pixel) are visual elements positioned freely and dynamically in space. For this purpose drones with an LED lighting system are used and combined into a beautiful and organic swarm of airborne lights.

European Digital Art and Science Network

Cultural Partners

Ars Electronica (AT) has created an ecosystem for innovation. This ecosystem not only supports and enables a wide range of artistic developments and achievements, it also allows for pioneering technological developments because it replicates the artistic thinking process from inspiration to experiments through to creation, involving a wide range of disciplines and skills. This ecosystem evolves around the triangle of Art, Technology and Society that was coined for the first Ars Electronica Festival in 1979 and has since developed to encompass a whole spectrum of activities. *www.aec.at*

Centre for the promotion of science (RS): Promotion of science is one of the major tasks for every European country. In this field, the Centre for the Promotion of Science is already actively engaged in bringing science community closer to a larger public, with the ambition to become the top institution that binds together, provides help and supports all science popularization organizations and initiatives throughout Serbia. Special attention is given to the cooperation with scientific institutions—the Serbian Academy of Sciences and Arts in the first place, but also with leading scientific institutes and all universities in the country. *www.cpn.rs*

DIG gallery (SK) is the alternative platform for presentation of the contemporary forms of digital and media arts. Activities of DIG gallery are focused on mapping and popularization of this area, developing the local and international connectivity, supporting the artistic practice and creativity in general. DIG gallery collaborates with several institutions and independent initiatives within the interdisciplinary research, alternative education and partnership networks. DIG gallery was founded by DIG non-profit organization in 2012 as a model of the open-source gallery based in Košice. *diggallery.sk*

Zaragoza City of Knowledge Foundation (ES) is an independent public-private organization which is in charge of the program for the Etopia Center for Art & Technology. According with this mission they developed some interesting projects with international scope, providing a valuable experience to the Foundation. The most relevant of them are: Paseo Project (in collaboration with Ars Electronica), to promote technology-based creativity in the public space / Innovate! Europe (an European event on startup culture) / Das Detroit Projekt (coordinated by Schauspielhaus Bochum). Zaragoza City of Knowledge Foundation has also been quite active in participating in events and projects of the European Union, specially in the field of smart cities initiatives, urban innovation and Future Internet PPP. *www.fundacionzcc.org*

GV Art (UK) is the UK's leading contemporary art gallery which aims to explore and acknowledge the inter-relationship between art and science, and how the areas cross over and inform one another. The gallery curates exhibitions and events that stimulate a dialogue focused on how modern society interprets and understands the advances in both areas and how an overlap in the technological and the creative, the medical and the historical are paving the way for new aesthetic sensibilities to develop. *www.gvart.co.uk*

Kapelica Gallery / Kersnikova Institute (SI): Kapelica Gallery was established in 1995 as an art space with focus on Contemporary Investigative Arts and a production platform for research, investigation and experimenting with the limits of artistic discourses and art poetics. Kapelica art program is constituted by exhibitions, performances and artistic research. The gallery presents works of artists that dare to go beyond safe and pleasant themes and are challenging visitors to contemplate and wonder with them. Together with BioTehna wet lab Kapelica is an active production platform which encourages, facilitates and showcases investigative artistic production, create public debate and stimulates a critical understanding of the time we live in. *www.kapelica.org*

LABoral (ES) is a multidisciplinary institution which produces, disseminates and fosters access to new forms of culture rooted in the creative use of information and communication technologies (ICT). LABoral has been working in crossovers between arts, science and technology since its creation in 2007. The hybrid nature of the institution is seen through its focus on production, a practice that involves an intense knowledge exchange amongst professionals from different disciplines with a common objective. In this context, the collaboration with all these professionals has always been a new challenge, due to the differences and similarities between practices. Thus, this experience is to be shared, agreed and formalized, with similar hybrid institutions through the production of various research projects and related activities. *www.laboralcentrodearte.org*

Science Gallery (IE) is an organisation dedicated to igniting creativity and discovery where science and art collide. Science Gallery, since opening in February 2008, has welcomed over a million visitors with over 24 exhibitions ranging from EDIBLE, which examined the future of food, to BIO-RHYTHM, which got to grips with music and the body, to INFECTIOUS, an exhibition which showcased the first ever live simulation of a pandemic using RFID technology. Science Gallery is ranked amongst the top ten free cultural attractions in Ireland and is all about opening science up to passionate debate. Uniquely located in Ireland's leading research university, Trinity College Dublin, with a recognized expertise in astro physics and astronomy as well as a focus on public engagement with creative science, art and design. *dublin.sciencegallery.com*

... and Activities

Ars Electronica
Linz, Austria

An Innovative Ecosystem for Art,
Technology and Society

*Ein innovatives Ökosystem für Kunst,
Technologie und Gesellschaft*

⊞ ARS ELECTRONICA

Ars Electronica has created an ecosystem for innovation. This ecosystem not only supports and enables a wide range of artistic developments and achievements, it also allows for pioneering technological developments because it replicates the artistic thinking process from inspiration to experiments through to creation, involving a wide range of disciplines and skills. This ecosystem evolves around the triangle of Art, Technology and Society that was coined for the first Ars Electronica Festival in 1979 and has since developed to encompass a whole spectrum of activities.

At the annual **Ars Electronica Festival** every September, we bring together artists and scientists, creators and engineers, activists and economists from all over the globe to present their work and their visions of the future. It's a great feast of eclectic, enchanting, intriguing and captivating creations, a unique environment of intense discussions and inspiring encounters.

Prix Ars Electronica is the world's most highly regarded award for artists working in science and technology. About 4,000 submissions from more than 100 countries each year impressively document the dynamics of international media art. The presentations of the awarded projects and artists are special highlights of each Ars Electronica Festival.

Ars Electronica Center with its exhibitions and programs focuses all year long on educating people about how new technologies and sciences are changing their lives as well as engaging them in the process through interactive displays and experiences. Special education programs and workshops have earned the Center its reputation as a "School of the Future."
www.aec.at

Ars Electronica hat ein Ökosystem für Innovation geschaffen, das nicht nur ein breites Spektrum an künstlerischen Entwicklungen und Projekten unterstützt und ermöglicht, sondern auch bahnbrechende technologische Entwicklungen fördert. Unter Einbeziehung der unterschiedlichsten Disziplinen und Fertigkeiten repliziert es dabei die künstlerische Herangehensweise – von der Inspiration übers Experiment bis hin zur Implementierung. Dieses Ökosystem bewegt sich im Spannungsfeld von Kunst, Technologie und Gesellschaft. Das Konzept dafür wurde für das erste Ars Electronica Festival 1979 formuliert und seitdem stark weiterentwickelt, sodass es mittlerweile eine große Vielfalt von Aktivitäten umfasst. Das jährlich im September stattfindende **Ars Electronica Festival** bringt KünstlerInnen und Kreative, VertreterInnen aus Wissenschaft, Forschung, Technologie und Wirtschaft aus der ganzen Welt zusammen, um ihre Arbeit und ihre Vision von der Zukunft zu präsentieren. Es bietet eine Bühne für eklektische, faszinierende und überraschende kreative Arbeiten und ein einzigartiges Umfeld für intensive Diskussionen und inspirierende Begegnungen.

Der **Prix Ars Electronica** ist der international renommierteste Preis für Künstler und Künstlerinnen, die im Bereich von Wissenschaft und Technologie tätig sind. Die rund 4.000 Einreichungen aus mehr als 100 Ländern, die jedes Jahr am Wettbewerb teilnehmen, zeugen von der Dynamik der internationalen Medienkunst. Die Präsentation der prämierten Projekte und KünstlerInnen ist ein spezielles Highlight während des Ars Electronica Festivals.

Das **Ars Electronica Center** mit seinen Programmen hat es sich zur Aufgabe gemacht, dem Publikum mittels interaktiver, erlebnisorientierter Austellungen zu vermitteln, wie neue Technologien und Wissenschaften sich unmittelbar auf unser Leben auswirken. Dank spezieller Bildungsprogramme und Workshops hat sich das Center das Prädikat „Schule der Zukunft" erworben.
www.aec.at

The powerful pillar for research and development is **Ars Electronica Futurelab**, a place of inspiration and creative ideas, where artists, engineers, and developers team up to work together from the outset on art projects as well as commissioned research projects.

The two spin-offs of the Futurelab, **Ars Electronica Solutions** and **Ars Electronica Spaxels**, bring the creations and prototypes that emerge from this ecosystem to the market and support local industry and business in their development of new products and services.

u19–CREATE YOUR WORLD is the name of Ars Electronica's exciting programs for and with young creators. Since 1998 we celebrate and support the creative and innovative ideas of young people and their visions for the world of tomorrow.

Based on its big international network of artists and creators and the rich experience of curating and producing festivals and exhibitions, Ars Electronica has become an attractive collaborator for many museums, festivals, and exhibition venues worldwide. Under the name **Ars Electronica Export** we realize exhibitions and workshop programs worldwide, each custom-tailored for our partners.

With a permanent presence and activities in Tokyo and Osaka, **Ars Electronica Japan** is engaged in artistic projects, collaborations with universities and museums as well as research, development, and consulting projects with many Japanese leading companies.

The development and practical evaluation of new innovative methods and technologies for education and knowledge transfer with special consideration of new digital media, is the goal of **Ars Electronica Education**. The applications range from kindergarten and schools to special programs for universities and professional training and qualification services for business and industry.

Ars Electronica Archive is a remarkable collection of descriptions and documentations of more than 75.000 projects linked with Ars Electronica since 1979, a unique opportunity to research the cultural impact of the digital revolution.

Forschung und Entwicklung findet im **Ars Electronica Futurelab** statt, das eine tragende Rolle innerhalb Ars Eletronica einnimmt. Es ist ein Ort für inspirierende, kreative Ideen, an dem KünstlerInnen, IngenieurInnen und EntwicklerInnen von Anfang an in Teams an künstlerischen Projekten arbeiten, aber auch Auftragsforschung durchführen.

Zwei Spin-offs des Futurelab, **Ars Electronica Solutions** und **Ars Electronica Spaxels**, bringen die Prototypen und Kreationen, die dieses Ökosystem hervorbringt, zur Marktreife. Sie unterstützen die lokale Industrie und Wirtschaft bei der Entwicklung neuer Produkte und Dienstleistungen.

u19 – CREATE YOUR WORLD umfasst eine Vielfalt an aufregenden Programmen für und mit jungen Kreativen. Seit 1998 unterstützt Ars Electronica die erfindungsreichen, innovativen Ideen junger Menschen und ihre Visionen einer zukünftigen Welt.

Dank des großen internationalen Netzwerkes aus KünstlerInnen und ForscherInnen sowie der reichen Erfahrung bei der Kuratierung und Produktion von Festivals und Ausstellungen ist Ars Electronica zu einem attraktiven Kooperationspartner für viele Museen, Festivals und Ausstellungsorte weltweit geworden. Unter dem Label **Ars Electronica Export** realisieren wir maßgeschneiderte Ausstellungen und Workshopprogramme auf der ganzen Welt.

Dank einer permanenten Präsenz in Tokio und Osaka ist **Ars Electronica Japan** an künstlerischen Projekten, Kollaborationen mit Universitäten und Museen beteiligt. Im Bereich Forschung & Entwicklung sowie Consulting arbeitet Ars Electronica Japan mit führenden japanischen Firmen zusammen.

Die Entwicklung und praktische Evaluierung neuer, innovativer Methoden und Technologien für Bildung und Wissenstransfer unter besonderer Berücksichtigung neuer digitaler Medien ist das Ziel von **Ars Electronica Education**. Die Applikationen reichen von Kindergarten- und Schulniveau bis hin zu speziellen Programmen für Universitäten, zu professionellem Training und Qualifizierungsservices für Betriebe.

Das **Ars Electronica Archiv** versammelt Text- und Dokumentationsmaterial zu über 75.000 Projekten im Zusammenhang mit Ars Electronica und bietet eine einzigartige Möglichkeit, den kulturellen Impakt der digitalen Revolution seit 1979 zu erforschen.

Ars Electronica, Linz
Activities

Conferences

POST CITY Symposium I
Future Mobility – A Challenge for
Art & Science
Conference
Post City, conference square
04.09.2015
Alexander Mankowsky (DE), Martina
Mara (AT), Shunji Yamanaka (JP),
Takayuki Furuta (JP), Kilian
Kleinschmidt (DE), Ou Ning (CN),
Hiroshi Ishii (JP/US), Gerfried
Stocker (AT)

Prix Forum VI
Art & Science Round Table
Conference
Ursulinensaal, OÖ Kulturquartier
05.09.2015
Fernando Comerón (ES), Victoria
Vesna (US), Mónica Bello (ES),
Michael Doser (AT), Jurij Krpan (SI),
Jens Hauser (DE), Nahum (MX),
Ale de la Puente (MX)

European Digital Art and Science
Network Meeting
Conference
Post City, conference square
06.09.2015
Lale Eric Dobrivoje (Center for the
Promotion of Science/SR), Richard
Kitta (DIG Gallery/SK), José Carlos
Arnal (Zaragoza City of Knowledge
Foundation/ES), Jurij Krpan (Kapelica
Gallery/Kersnikova, SI), Robert
Devcic (GV Art/UK), Lucía García
(LABoral/ES) and Diane McSweeney
(Science Gallery/IE)

Prix Ars Electronica Forum
Art & Science
Conference
Central
09.09.2016
Prix Forum I – Computer Animation/Film/VFX
Gerfried Stocker (AT), Jürgen Hagler (AT),
Boris Labbé (FR), Yuya Hanai (JP), Mari-Liis
Rebane (EE), Johannes Schiehsl (AT)

Prix Ars Electronica Forum
Art & Science
Conference
Ursulinensaal, OK, OÖ Kulturquartier
10.09.2016
Prix Forum II – Digital Communities
Stacco Troncoso (ES), Paul Feigelfeld (AT),
Caoimhe Gallagher (IR), Nakano Hitoyo (JP),
Sarah Kriesche (AT)

Prix Ars Electronica Forum
Art & Science
Conference
Ursulinensaal, OK, OÖ Kulturquartier
10.09.2016
Prix Forum III – Interactive Art+
Mathias Jud (CH), Christoph
Wachter (CH), Frank Kolkmann (NL),
Victoria Vesna (US)

Prix Ars Electronica Forum
Art & Science
Conference
Ursulinensaal, OK, OÖ Kulturquartier
10.09.2016
Prix Forum IV – Visionary Pioneers
of Media Art
Jasia Reichardt (UK),
Christine Schöpf (AT)

RADICAL ATOMS Symposium
Conference
POSTCITY, Conference Hall
09.09.2016
SYMPOSIUM I.I.
RADICAL ATOMS – FROM VISION
TO PRACTICE
Gerfried Stocker (AT), Hiroshi
Ishii (US/JP), Daniel Leithinger (AT),
Sean Follmer (US), Ken Nakagaki (JP),
Luke Vink (NZ/NL), Amanda Parkes (US),
Lining Yao (CN/US), Joe Paradiso (US),
Jifei Ou (CN), Dávid Lakatos (HU)

RADICAL ATOMS Symposium
Conference
POSTCITY, FIS Stage
10.09.2016
SYMPOSIUM I.II.
RADICAL ATOMS – IMPACT
AND EXPECTATIONS
Hiroshi Ishii (US/JP), Christopher
Lindinger (AT), Carlo Ratti (IT),
Joachim Sauter (DE), Tomotaka
Takahashi (JP), Horst Hörtner (AT),
Martina Mara (AT), Yoichi Ochiai (JP),
Chiaki Hayashi (JP), Shiho Fukuhara (JP),
David Benjamin (US)

RADICAL ATOMS Symposium
Conference
POSTCITY, Conference Hall
09.09.2016
SYMPOSIUM II
THE ALCHEMISTS OF OUR TIME
Jurij Krpan (SI), Joe Davis (US),
Siegfried Zielinski (DE), Verena
Kuni (DE), Fumio Nanjo (JP),
James Gimzewski (US)

RADICAL ATOMS Symposium
Conference
POSTCITY, Conference Hall
11.09.2016
SYMPOSIUM III: ART AND SCIENCE
AT WORK
Session1: EUROPEAN DIGITAL ART
AND SCIENCE NETWORK
Session 2: ESTABLISHING BEST PRACTICE
Session 3: EXPLORING NEW FRONTIERS
Session 4: DISCUSSING THE FUTURE
OF THE LABS

Exhibitions

ELEMENTS OF ART AND SCIENCE
Exhibition
Ars Electronica Center
03.09.2015 – 30.08.2016
see Page 120

THE ALCHEMISTS OF ART AND SCIENCE
Exhibition
Ars Electronica Center
08.09.2016 – 30.08.2017
see Page 138

RADICAL ATOMS
Exhibition
Ars Electronica Center
07.09.2016 – 15.07.2017
see Page 154

Jury Meetings

Residency@CERN 2015
Jury Meeting
Ars Electronica Center
13. – 14.07.2015
Gerfried Stocker (AT), Horst
Hörtner (AT), Monica Bello (ES),
Mike Stubbs (UK), Michael
Doser (AT/CH)

Residency@ESO 2015
Jury Meeting
Ars Electronica Center
23. – 25.02.2015
Gerfried Stocker (AT), Horst
Hörtner (AT), Slobodan Coba
Jovanovic (SB), Richard Kitta (UK),
Fernando Comeron (ES),
Robert Devčić (UK), Jurij
Krpan (SI), Lucía García
Rodríguez (ES), Diane
Mc'Sweeney (IR), Fermin
Serrano Sanz (ES), José Carlos
Arnal (ES)

Residency@ESA 2016
Jury Meeting
Ars Electronica Center
08. – 09.07.2016
Gerfried Stocker (AT), Horst
Hörtner (AT), Claudia Mignone (IT),
Karen O'Flaherty (IE), Dobrivoje
Lale Eric (SB), Richard Kitta (UK),
Karin Ohlenschläger (ES),
Jurij Krpan (SI)

Residency@ESO 2016
Jury Meeting
Ars Electronica Center
22. – 23.02.2016
Gerfried Stocker (AT), Horst Hörtner (AT),
Martin Honzik (AT), Slobodan Coba
Jovanovic (SB), Richard Kitta (UK), Fernando
Comerón (ES), Robert Devčić (UK), Jurij
Krpan (SI), Lucía García Rodríguez (ES),
Lynn Scarff (IE), Fermin Serrano Sanz (ES)

Residencies

Residency@CERN
08.10. – 14.12.2015
Semiconductor (UK)

residency@Ars Electronica Futurelab, Linz, ESA/ESTEC, Noordwijk; ESOC, Darmstadt
17. – 21.10.2016, 27.02. – 17.03.2017,
28.04. – 20.05.2017, 11. – 24.06.2017
Aoife Van Linde Tol (IE)

residency@Ars Electronica Futurelab, Linz, ESO, Chile
13. – 25.05.2015, 27.7. – 15.09.2015
María Ignacia Edwards (CL)

residency@Ars Electronica Futurelab, Linz, ESO, Chile
24.05. – 18.06.2016, 15.08. – 15.09.2016
Quadrature (DE)

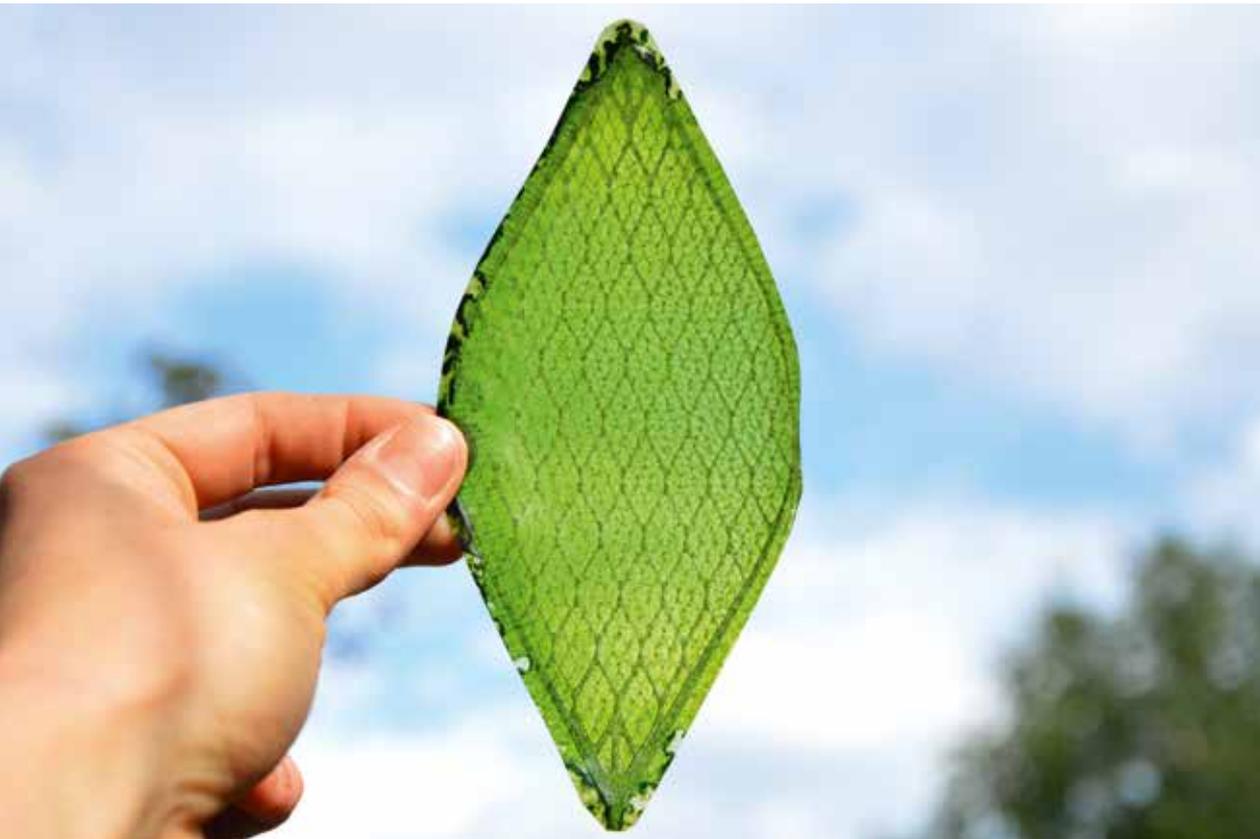### residency@Ars Electronica Futurelab, Linz, Fraunhofer MEVIS, Bremen
20. – 31.03.2017, 15.05. – 26.06.2017
Yen Tzu Chang (TW)

Elements of Art and Science
Exhibition
03.09.2015 – 30.08.2016

The exhibition *Elements of Art and Science* at Ars Electronica Center was a presentation of outstanding works whose origins straddle the worlds of art and science.

Silk Leaf, Julian Melchiorri

The *Elements of Art and Science* exhibition included several outstanding works that demonstrate the varied approaches and methods artists use when dealing with scientific subjects. Establishing interconnections among diverse fields of knowledge provides access to alternative perspectives and can foster the emergence of ideas for new developments.

Akira Wakita (JP)
Furnished Fluids

Furnished Fluid is a visualization that utilizes the air flow that we are practically unaware of in our daily lives. This installation, which integrates design miniatures and real-time images, enables us to use the power of science to make visible the appealing and valuable aspects of 20th century industrial design. *W. W. Stool* (1990) by Philippe Starck, *Hill House 1* (1902) by Charles Rennie Mackintosh, and the *Big Easy* (1991) by Ron Arad were selected in tribute to these great designers.

Akira Wakita (JP) conducted studies regarding the theme of physicality, focusing on real time images produced by physical simulation on the one hand and materials that can control colors and shapes on the other hand. In recent years, he developed original software based on fluid-dynamic and thermodynamic models, striving for visualization across science and art. *akirawakita.com*

Kepler's Dream
Ann-Katrin Krenz (DE), Michael Burk (DE)

Kepler's Dream is an esthetical investigation, exploring obsolete projection technologies in combination with computationally created content that is given a physical shape through 3D printing.

Michael Burk (DE) / **Ann-Katrin Krenz** (DE) are an interaction designer and a media artist based in Berlin. Focusing on the design of spatial media environments and physical interfaces, they pursue the creation of enriching experiences that enable a meaningful relation with the user or spectator. Ranging from critical design that provokes thought, to immersive interactive environments that blend boundaries of the virtual and the physical.
michael-burk.de; wp10612599.server-he.de/anni

AEC, Martin Hiesllmair

AEC, Tom Mesic

Ursula Damm (DE)
The Outline of Paradise

What would our cities look like if advertising messages were the techno esthetic of conventional advertising? The *Outline of Paradise* explores the promises and capabilities of technoscience and develops videos and installations out of these narratives. It sets the technology towards a natural, sensual esthetic, which would be natural and sustainable.

Ursula Damm (DE) became known for her installations dealing with geometry and its social impact on public space. Since 1995 these installations became interactive, dealing with architectural aspects on the basis of tracking technology. Aside she developed numerous installations on the relationship between nature, science, and civilization. Ursula Damm's works are shown worldwide in exhibitions and festivals. Since 2008 she holds the chair of Media Environments at Bauhaus University Weimar. *ursuladamm.de*
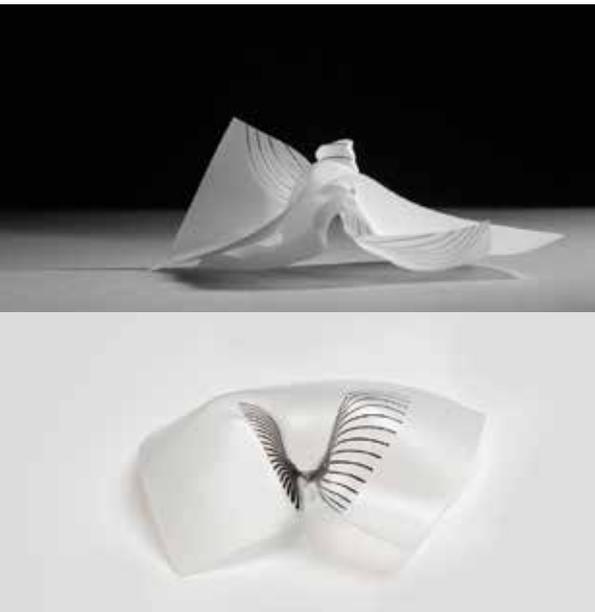
AEC, Tom Mesic

Dana Zelig (IL)
Traces

Traces explores the concept of programming everyday materials, a form of "physical programming" where objects are "made to act" on some form following specific instructions. To explore this idea, Dana Zelig developed 12 processed-folding objects series, designed with the Processing programming language and various physical techniques.

Dana Zelig (IL) is a designer and lives in Tel Aviv. She has a degree in Visual Communication from Shenkar College for Engineering, Design and Art, and a Master in Industrial Design from Bezalel Academy of Arts and Design in Jerusalem. *danazelig.com*

AEC, Florian Voggeneder

Yasuaki Kakehi (JP)
Transmart Miniascape

Transmart miniascape is an art installation for displaying volumetric images that blends in with ambient surroundings.

Yasuaki Kakehi (JP) is a media artist and a researcher. He has worked at Keio University and was a visiting scholar at MIT Media Lab. In intersections of art, design, and engineering, he has explored possibilities of technology and expressions beyond integrations of the physical and digital resources. He has also exhibited artworks as a team named plaplax. *xlab.sfc.keio.ac.jp*

James Bridle (UK)
Watching the Watchers

Watching the Watchers is a series of drone images from Google Maps and other publicly accessible sources of satellite images. These aerial photographs show military bases in the US, Afghanistan, Pakistan, and other places from which the military operates drones.

James Bridle (UK) is an artist and writer based in Athens. His artworks have been commissioned by galleries and institutions and exhibited worldwide and on the internet. His writing on literature, culture, and networks has appeared in magazines and newspapers including *Wired, Domus, Cabinet, Atlantic, New Statesman, Guardian, Observer* and many others, in print and online. He lectures regularly at conferences, universities, and other events. *booktwo.org*

Semiconductor (Ruth Jarman, Joe Gerhardt/UK)
A particular kind of conversation

In their art works the artist duo Semiconductor explores the fundamental material nature of our world and how we experience it through the lens of science and technology, investigating how devices mediate our experiences of nature and position man as an observer of the physical world. They combine methods of filming, animation, sound and dialogue; re-working and combining actual elements of the scientific language of particle physics (verbal, visual, aural, technological...) into new forms.

Semiconductor is UK artist duo **Ruth Jarman** and **Joe Gerhardt**. In their art works they explore the material nature of our world and how we experience it through the lens of science and technology, questioning how they mediate our experiences. They have exhibited and screened their works worldwide.

Cédric Brandilly (FR)
Architectural SonarWorks

The aim of *Architectural SonarWorks* is to create a musical / audio language based upon cartographic statements and architectural characteristics which belong to a definite space. It also consists in imagining architecture as a partition. Each architectural element, each building has characteristics that can be turned into sounds. The determination of a musical language from a linear—from point A to point B—is made possible. For this project the artist does not capture urban sounds to broadcast them at a later date, but instead writes real musical scores using map data.

Cédric Brandilly (FR) is a visual artist and performer. Having studied fine arts and architecture, he continued his education in the academic section of the Museo Nacional Centro de Arte Reina Sofía in Madrid. New technologies and the binomial Art and Science are currently right at the heart of his research and his work. *cedricbrandilly.com*

Golan Levin (US), Kyle McDonald (US), Chris Sugrue (US)
Augmented Hand Series

The *Augmented Hand Series* is a real-time interactive software system that presents playful, dreamlike, and uncanny transformations of its visitors' hands. Conceived as a tool for muddling embodied cognition, the installation consists of a box into which a visitor inserts their hand, and a display that shows their "reimagined" hand, altered by various dynamic and structural transformations.

AEC, Martin Hieslmair

Golan Levin (US) explores the intersection of abstract communication and interactivity. He is Associate Professor of Electronic Art at Carnegie Mellon University. **Kyle McDonald** (US) works with sounds and codes, exploring translation, contextualization, and similarity. Kyle is a member of FAT Lab, community manager for openFrameworks and an adjunct professor at the NYU ITP. **Chris Sugrue** (US) is an artist and engineer who develops interactive installations, audio-visual performances, and experimental interfaces. She teaches new media arts at The Parsons School of Design in Paris.

AEC, Tom Mesic

María Ignacia Edwards (CL)
Encounters

The artist works with equilibrium, lightness, and weightlessness of objects that she brings into balance by deploying their own weight or counterweights. Though, at first glance, her works are perceived as purely esthetic, artistic objects, it soon dawns on those who behold them that these constructions are the result of elaborate mathematical and physical calculations. Based on her experience at the ESO observatories La Silla and ALMA, María created a *Mobile Instrument* that is able to capture the movement of pieces located at distant places by a mechanism, as a reference to time and the motion of the universe.

María Edwards (CL). After receiving her BA in Arts from Finis Terrae University in Santiago und her Diploma in Cinema, Art Direction and Photography from the University of Chile, she lived and worked in New York City, exhibiting her artworks internationally. Recipient of the Art for Science prize, awarded by the National Commission for Scientific and Technological Research (CONICYT) in Santiago, Chile.

Nick Ervinck (BE)
VIUNAP

VIUNAP is a 3D print of one absurd building initially presented as a 2D wall print. The artist used traditional cottages, which he turned into absurd buildings. The cottages became figures with connotations to crabs and other sea animals that walk along the beach, resembling the impossible structures in the engravings of the mathematician Escher (1898 –1972).

Photo: Peter Verplancke

Nick Ervinck (BE) explores the boundaries between various media. Studio Nick Ervinck applies tools and techniques from new media, in order to explore the aesthetic potential of sculpture, 3D prints installation, architecture and design. His work oscillates between the static and the dynamic, prospecting new virtual or utopian territories. He creates huge installations, sculptures, prints, work drawings, and animated films. *nickervinck.com*

Nick Ervinck (BE)
Selected Works

ELBETAAD is a 3D print inspired by the voluptuousness of the so-called "Rubens woman." It brings into question the "skin" of the sculpture.

Photo: Peter Verplancke

For **AGRIEBORZ,** Nick Ervinck used imagery of human organs that he found in medical manuals as construction materials to create an organic form. Though imaginary, it seems to retain some familiarity due to its visual connection to human organs, muscles, and nerves.

Photo: Luc Dewaele

AYAMONSK is derived from vegetable structures and coated with a glossy varnish which in turn refers to the virtual genesis of this form.

Photo: Luc Dewaele

NIKEYSWODA / GARFINOSWODA seem made out of two components but are printed as one entity. The blue smooth form almost embraces the yellow explosive structure.

Photo: Peter Verplancke

BORTOBY is clearly animal-like, but is impossible to define well. One can see a lion-like body, crab-like legs and devils, but also a transformer robot or a monstrous creature.

Photo: Luc Dewaele

**Christa Sommerer (AT) and
Laurent Mignonneau (AT/FR)**
Portrait on the Fly

Portrait on the Fly consists of a series of interactive portraits and plotter drawings, inspired by Guiseppe Arcimboldo's fantastic composite heads from the mid-15th century. For the series *Portrait on the Fly* Sommerer and Mignonneau modeled virtual insects that can align themselves so as to compose human portraits in real time.
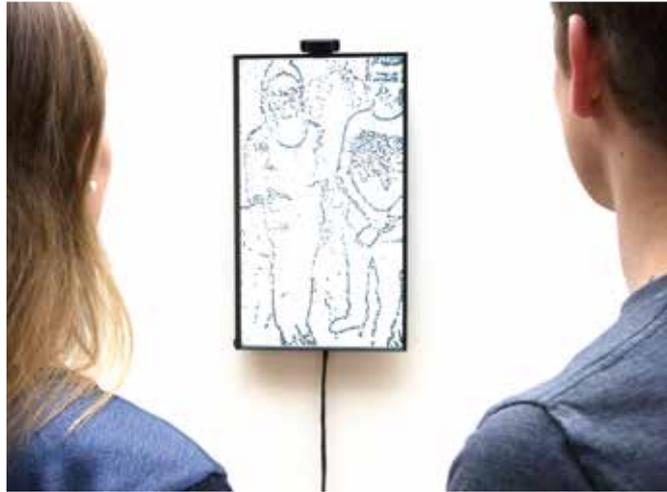
Laurent Mignonneau (AT/FR) and **Christa Sommerer** (AT) are internationally renowned media artists, researchers and pioneers in the field of interactive art. For 25 years now they have been exhibiting their works worldwide, and they have won numerous awards such as the 2012 Wu Guanzhong Art and Science Innovation Prize of the Ministry of Culture of the PRC and the Golden Nica of the 1994 Prix Ars Electronica. They are heads of the Interface Cultures Department at the University of Art and Design Linz, and guest professors at Aalborg University in Denmark and the Université Paris 8.

Jonathan Keep (SA/UK)
Seed Bed/Three Vases
3D printed ceramics

The *Seed Bed* relates to the fundamental concept of evolutionary morphologies but also creative growth. Generated in computer code my working method lends itself to altering the code to make related and evolving shapes. Being able to 3D print these unique and individual forms directly from the computer in clay represents the strength of this technology and fulfills my desire to explore the possibilities of ceramic form. For me art and science are inexplicitly linked.

Jonathan Keep (SA/UK) was born and grew up in South Africa, obtaining a BA (Hons) Fine Art degree from the University of Natal in 1979. In 1986 he moved to England and settled in Suffolk where he has a studio in Knodishall. In 2002 he received a MA from the Royal College of Art. He has exhibited and undertaken a number of artist residencies in the UK and abroad. *keep-art.co.uk*

Julian Melchiorri (IT/UK)
Silk Leaf

Inspired by natural mechanisms and physical phenomena, Julian Melchiorri conducted laboratory experiments in order to explore the potential for making materials that photosynthesize, and their possible applications. *Silk Leaf* is the first result of this research. It is a modular device that photosynthesizes, made of a biological material mostly composed of silk protein and chloroplasts.

Julian Melchiorri (IT/UK), a designer engineer and innovator, is internationally known for his visionary projects *Silk Leaf & Exhale,* where he proposes radical environmental solutions for the urban and industrial environment using novel photosynthetic devices he invented through intense laboratory experimentation. His works, located between art and science, explore new scenarios and experiences. *julianmelchiorri.com*

Brian Harms (US)
Suspended Depositions

Suspended Depositions is a novel rapid prototyping approach that aims to blur the line between processes of design and fabrication. The project explores the concept of programming everyday materials, a form of "physical programming," where objects are "made to act" on some form following specific instructions.

Brian Harms (US) is a Senior Research Engineer within the Think Tank Team at Samsung Research America, Silicon Valley. His work involves designing and developing digital tools and physical prototypes that help aid and inform creative design processes and fabrication methods. He has previously worked at such firms as IwamotoScott, Future Cities Lab, Griffin Enright Architects, and has consulted for Stephen Phillips Architects (SPARCHS), Doug Jackson Design Office, and Testa/Weiser. *nstrmnt.com*

IAAC-Institute for Advanced Architecture of Catalonia (ES)
Minibuilders

The construction industry is wasteful and inefficient, slow to adopt technologies that are already well established in other fields, such as robotics. *Minibuilders* is scalable, it supplants one large robot for a number of smaller agile robots, that work together effectively towards a single outcome.
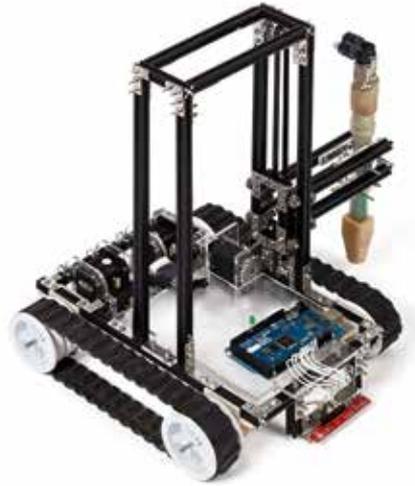
IAAC – The Institute for Advanced Architecture of Catalonia is an international center for Education, Fabrication and Research dedicated to the development of architecture capable of meeting the worldwide challenges in constructing 21st century habitability. With *Minibuilders* they tried to propose new ways and possibilities for the construction industry to work more efficiently and to produce as little waste as possible. *robots.iaac.net*

James Medcraft

Universal Everything (UK)
Presence

Presence turns the screen into a stage, the body into an abstracted sculpture. Experimenting with various materials and forms, the life-sized moving sculptures cycle through a randomized collection of "costumes" that range from colorful light trails to crystalline formations, with only the movement revealing the human presence within.

Universal Everything (UK)
Supreme Believers

A lone figure struggles to make his way across a sparse, grassy landscape, seemingly battling the elements as they beat him back. His body starts to decompose, surrendering to the invisible physical forces, and he disappears into a cascade of particles.

Universal Everything (UK)
Voxel Posse

Utilizing the powers of 3D printing and anthropomorphism, Universal Everything creates a fleet of miniature vector robots. Looking like crystalline rocks that sprouted legs, these creatures are yet another exploration into harnessing the most basic elements of the human form to infuse inanimate objects with the essence of life.

Universal Everything (UK) is a digital art practice and design studio based in Sheffield. The studio was founded in 2004 by Matt Pyke, who is the creative director. He studied botanical and technical illustration then graphic design before spending eight years at the Designers Republic (1996–2004). Universal Everything have worked with several well known brands and corporations including Chanel, AOL, Intel, Nike Inc., Hyundai, and Deutsche Bank. *universaleverything.com*

formquadrat (AT), Meinhard Schwaiger (IAT21 GmbH/AT)
D-Dalus:
A New Way of Traveling

The *D-Dalus* is the "enfant terrible" of the aircraft industry with outstanding and surprising new flight features. The D-Dalus can do more than just fly ... it can also start and land vertically, float, and turn on its axis. When the engines are switched off for a fraction of a second, the D-Dalus can even suction itself onto the landing surface, thus enabling it to land on ships or other planes.

formquadrat

Meinhard Schweiger (AT) is an inventor. He studied mechanical engineering and has been working in R&D and technical management since 1982. He is the founder / co-founder and CEO of three companies. His many awards include the Gold Solvin Innovation Award in 2007; the 2011 Green Dot Awards; nominations for the State Award Consulting in 2009 and 2013; the Upper Austrian Innovation Award and the Austrian Patent Office Inventum Award in 2012; and the Linzer Company of the Year Award in 2013.

Zeiss (DE)
Zeiss VR One

The *Zeiss VR One* is an innovative device that allows us to take our novel steps in the world of virtual reality. The *VR One* is the first and only VR headset that is made with a leading-edge optical design and Zeiss precision optics. With the *VR ONE,* the smartphone you carry in your pocket can take you to worlds of virtual and augmented reality. Compatible with many smartphones and hundreds of apps made for mobile VR devices, you can simply download and launch the app, lock your smartphone in the VR One precision tray, and slide it in the *VR One*. Experience VR games, videos, and amazing experiences that were never before possible.

Text and photos: *zeissvrone.tumblr.com, vrone.us*

exonemo (JP)
Body Paint

This work uses body painting to examine our physical definitions, our physicality, in a world of networked information devices. Each work in this portrait series features a person, nude, shaved, and painted entirely in a single shade of color, displayed on an LCD that has been entirely painted in the same color except for the human subject on the screen. The boundaries between background and foreground are erased—a human body and an electronic display body are both covered in the same color paint—and the works evoke the themes of ambiguity and confusion, and whether the individual depicted is a human being or a picture of a human being.

AEC, Martin Hieslmair

exonemo (JP) is an artist duo, formed in 1996 by Yae Akaiwa and Kensuke Sembo. Their experimental projects are typically humorous and innovative explorations of the paradoxes of digital and analog computer networked and actual environments in our lives. Their *The Road Movie* won the Golden Nica for Net Vision category at Prix Ars Electronica 2006. They have been organizing the IDPW gatherings and *Internet Yami-Ichi* since 2012.
exonemo.com

Vienna 3000

Dissatisfied with the reality of architecture as well as urban planning, the Architectural Design Studio at the Institute of Art and Architecture (Academy of Fine Arts Vienna/AT) was driven by the ambition to explore the radical uncertainty of the far future. Students were invited to develop individual trajectories into the unknown and encouraged to develop design projects that embody the potential to question our beliefs and standards of today. Funded entirely by the City of Vienna, the studio places great emphasis on planning scenarios for the Austrian capital.

Cenk Güzelis
Queer City

What if our body would not have to limit itself to a specific time and space? Liberating the body: dissolving boundaries and limits, departure from horizontal linearity. What are the consequences for the urban fabric? What does the condition of "in space" mean?
A vertical movement is introduced to the idea of space and city, placing emphasis on the space inbetween, the space where people meet and interact. Dynamics of a future urban reality between order and disorder. Frozen for display.

Anna Krumpholz
A Land of Honey

The citizens of Vienna—naked and without possessions—live in honey shelters. The whole city fabric consists of a semi-organic thread structure that produces and evaporates honey plasma. The plasma exists in gaseous and gel form and accumulates softly on the body, responding to individual sleeping patterns. Thus, Vienna is a city of constantly changing shape, always growing and shrinking.

Clemens Aniser & Wolfgang Novotny
Urban Stimulus

Urban Stimulus is the description of an artificial paradise driven by the stimulation of senses and sensations, envisioning an urban future based on perception. *Urban Stimulus* is recording and storing sensorial data, distributing information like radiant visuals and vibrating sounds; vaporing essences of aromatic memories via haze and mist; achieving tactile diversity through its ever changing surface and skin, shifting from oily to rough, hairy to hard, constantly blurring the borders between object and subject until they merge and create a complex unity.

Helvijs Savickis
Time Capsule
a nuclear waste information center

In the year 3000 the safe storage of nuclear waste will remain a challenge even if the use of nuclear energy has stopped. To highlight the danger of buried nuclear waste around the world a nuclear waste information center is built in Vienna—seat of the IAEA, International Atomic Energy Agency. An impressive underground space functions as a time capsule whilst also open to the public—safeguarding the continuity of knowledge about a major threat to humanity.
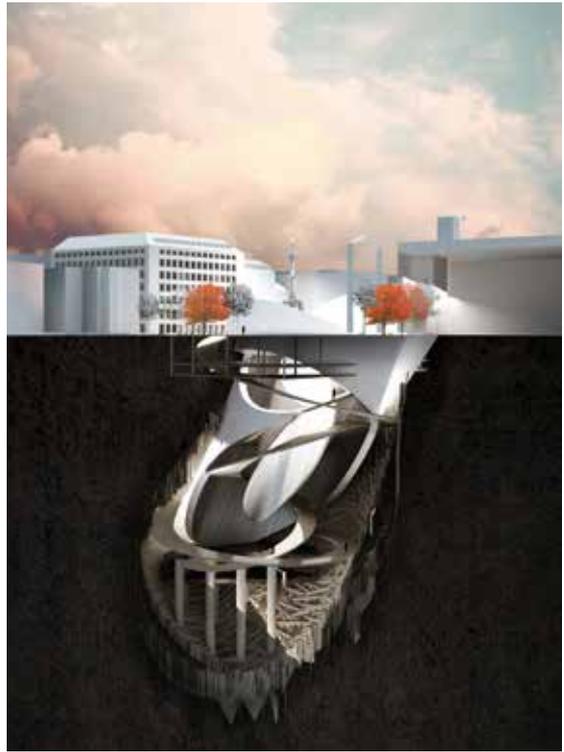
Matea Ban
Welfare State 3000

Welfare State 3000 displays a social housing unit for hybrids between animals and humans. It is built at a time when men and animals are all the same and DNA engineering has sufficient power to modify the human genome. People acquire major animal attributes like flying or a much-prolonged life span and require appropriate accommodation. Five cross-species live in a hybrid habitat, the so-called "unity of architecture and landscape." Hybrids between ladybirds, elephants, anacondas, crocodiles, seagulls, and humans reside in this housing estate.

Michael Glechner
Enlightened Being
Vienna as an energetic dynamic reality

Due to evolution human beings have developed abilities to handle energy more directly. They can survive on absorbing energy that light and atmospheric vibrations emit. The properties of the city have changed accordingly. Light has become the major driver of a constantly changing urban planning process. Consequently, architecture is adaptive too. Matter and energy cannot be seen as separate anymore. Like nature, architecture depends on light conditions. Where there is light, there is life and the potential for urban development.

Sasha Konovalov
Memento

The *Memento* project is dedicated to help find digital versions of reality that existed at some time in the past. These prior versions are called Mementos, and can be found in spatial archives or in systems that support versioning. *Memento* is a digital archaeology project that reconstructs virtual artifacts from the present time—in this case glitches from google earth—mistakenly understood as the past reality by the future inhabitants of our planet.
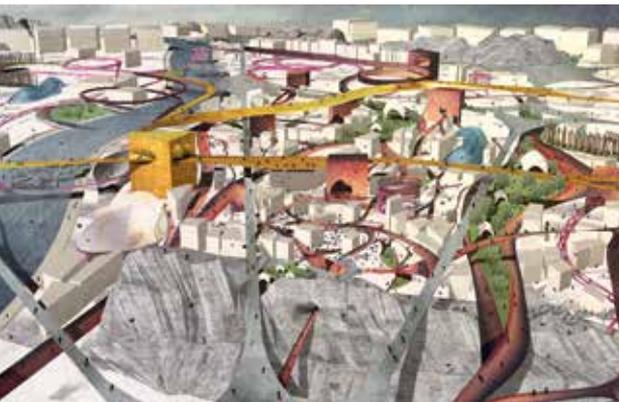
Marlene Lübke-Ahrens
Movements

In the far future any need for action has disappeared. Movement is pure leisure. Without the need for transportation infrastructure, the planning of the city is driven by notions of pleasure and experience. The bicycle has a renaissance as the ideal object for a pleasure ride and to retain the wellbeing of an otherwise passive society.

The Alchemists of Art and Science
Exhibition
08.09.2016 – 30.08.2017

The exhibition *The Alchemists of Art and Science* at the Ars Electroncia Center Linz presented both exciting, innovative projects at the intersection of art and science as well as the results of the various residencies within the European Digital Art and Science Network.

Ghost Cell, Antoine Delacharlery

Ars Electronica 2016 took "RADICAL ATOMS and the alchemists of our time" as its festival theme, a leitmotiv coined by Hiroshi Ishii that shifts attention to the human beings behind these works and developments. An extensive exhibition spotlighted positions and approaches from both directions—science and art—in which concepts such as art-thinking and creative prototyping and the idea of artistic work as catalyst play major roles. "Artists' Laboratories" focus on the workplaces of artists and interdisciplinary teams, and thus shed light on the extraordinary ecosystem of art and science collaboration. These exhibits featured jointly produced works that offer deep insights into the concepts and practices of art and science collaborations. The exhibition also featured projects that were the outcome of artist-in-residence programs e.g. by the German artists' collective Quadrature who spent time at the European Southern Observatory's research facilities in Chile and Germany.

AEC, Robert Bauernhansl

NOHlab (TR)
Prima Materia
a stereoscopic audiovisual journey

Alchemical authors have compared the *prima materia* to everything: To male and female, to the hermaphroditic monster, to heaven and earth, to body and spirit, chaos, microcosm, and the confused mass. It contains in itself all colors and potentially all metals. There is nothing more wonderful in the world, for it begets itself, conceives itself, and gives birth to itself. The stereoscopic piece by the Istanbul-based multidisciplinary Studio NOHlab will take the audience on an audiovisual journey.

Art Direction and Visuals by NOHlab
Sound Design By Giray Gürkal

NOHlab (TR) is a studio founded and directed by two experienced creative partners: Deniz Kader & Candaş Şişman. The studio was established at the end of 2011 as a result of highly successful collaboration between these two motion and visual artists in the past. Both follow a unique and distinctive art and concept direction in their projects, focused in the areas of art direction, motion design, projection mapping, audiovisual performance, and new media for art and culture and the advertising industry. *www.nohlab.com*

Jussi Ängeslevä (FI)
Beyond Prototyping

Beyond Prototyping is a research project looking at the dynamics between the designer, manufacturing process, and the consumer in creating everyday products in the age of digital fabrication. The "meaning" of an artifact transcends its physical utility and technical characteristics and is increasingly a personal narrative. The three case studies, *Ciphering, Locatable,* and *Highlight,* illustrate different strategies of how the experts and the target audience can together create meaningful, unique artifacts, based on an algorithmic design idea and through an online platform for intuitive interaction. The designs play with a distinct functional definition of a product and distinct esthetics, which are expressed through the end user's encoded input of meaning, resulting in well-designed and robust but individual products that go beyond prototype status.

Michael Burk
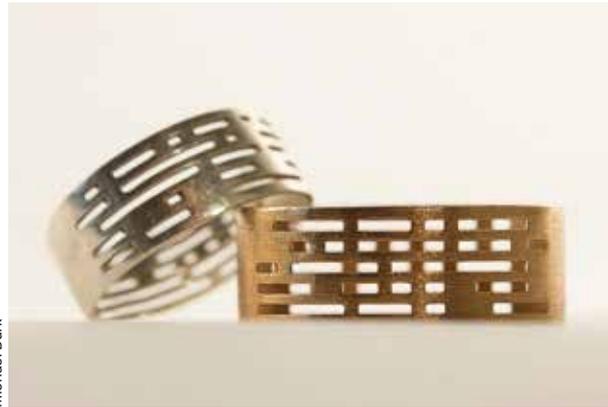
Jussi Ängeslevä; Iohanna Nicenboim; Michael Burk; Universität der Künste Berlin; Technische Universität Berlin; Einstein Stiftung Berlin; Bartmann Berlin; Recoltoir; Masonyte; pb.io; Hybrid Plattform

Jussi Ängeslevä (FI) teaches at the University of the Arts Berlin and the Royal College of Arts alongside leading the creative efforts at ART+COM Studios as a Vice Creative Director. Throughout his career his focus has always been intentionally in between fields: combining understanding of visual, physical, and interaction design with algorithmic, electronic, and mechatronic knowledge to create innovative and elegant experiences.
www.angesleva.iki.fi

Sarah Petkus (US)
NoodleFeet

NoodleFeet is the functioning robotic manifestation of an illustrated character who is built from light metals, 3D printed parts, and found objects. *Noodle* has been developed with mechanical and electronic systems which allow him to exhibit behaviors when stimulated by objects in his environment. His purpose is to exist freely in the world while reacting to situational encounters using self-defining methods of personal expression. Where most technology has a practical or utilitarian application meant to enhance our lives, Noodle is a unique entity who functions without regard to a human's perception of his purpose or usefulness. My goal is that this may provoke consideration about the motivation behind humanity's current innovations. I hope that those who interact with Noodle witness a meaningful sense of self from him that will encourage reflection in regard to the value of their own relation to the technology common in everyday life.

Sarah Petkus (US) is a kinetic artist and roboticist from Las Vegas, whose area of focus is in developing mechanical and electronic systems as characters, capable of reacting to environmental stimulation with unique, self-defining behavioral quirks. *zoness.com*

Aoife van Linden Tol (IE/UK)
Second Story

London based artist Aoife Van Linden Tol invited the residents of Linz to submit material for the second incarnation of her project *Second Story* which took place at the Ars Electronica Festival. The project explores the influence of words and images to create an explosive force within each individual as well as the emotional responses created when presented with literal physical explosions. The universal nature of both these phenomena inspired Aoife to create a project that allows many people to continue their own dialogue with explosive forces. Her aim was to uncover some of the collective and individual emotions of those living in Linz. On the Saturday of the Festival visitors were able to observe the artist while she processed the submitted material (photos, books, etc.) with different forms of explosions. The final outcome was later exhibited at the Ars Electronica Center.

AEC, Florian Voggeneder

Aoife van Linden Tol (IE/UK) graduated from Central St Martins College of Art and Design in 2002 with a BA Hons in Art & Design. She has exhibited internationally including at the ICA, London, the San Francisco MOMA, US, and the NGBK Berlin. Aoife has recently worked with Imperial College, researching light spectra for a series in neon and was invited by Disney to design a limited edition model Star Wars BB-8 robot, which was auctioned by Force for Change charity, benefiting Great Ormond St Hospital.

Helene Steiner (AT/UK)
Project Florence

Nature has many languages. *Project Florence* takes advantage of the sensibility of plants to different light frequencies and uses it to trigger electrical responses by a plant and compares the similarities between plant signals and natural language processes. It approaches plants as reactive living matter which generates new perceptions towards how we interface with our natural environment. This creates a rudimentary conversation with our natural environment. In this system, the user first attempts to communicate with or influence the plant through modulated natural language. Their inputs are analyzed for sentiment and semantic content. The resulting signals are used to modulate a light source that projects onto the plant. During this, the chemical and electrical signals are measured. The resulting responses from the plant are transformations of the input, driven by linguistic trees as well as lexical paraphrases. *Project Florence* can be a mediator between the natural environment and our technological world.

Project Florence is the creation of Helene Steiner, Artist in Residence, Microsoft Research. Microsoft Research; Helene Steiner, Paul Johns, Asta Roseway, Chris Quirk, Sidhant Gupta, Jonathan Lester.

Helene Steiner (UK) is a designer and researcher with a focus on new interactions in and with our (natural) environment. Her research follows an biological approach and looks at opportunities to not only bridge the physical and digital world but also the natural and artificial. Her background is in Product Design with a MDes from the Bauhaus University in Weimar. Currently she is a PostDoc Researcher in Human Experience Design at Microsoft Research Cambridge, UK. *http://www.helenesteiner.com*
Microsoft Research's studio99 aims to introduce artistic perspectives, processes, and values in the work of our organization. studio99 seeks to build collaborations between researchers/engineers and artists/designers to create beautiful and innovative experiences that inspire new ways of thinking about existing and future scientific challenges.

Afroditi Psarra (GR), Cécile Lapoire (FR)

Cosmic Bitcasting
A wearable cosmic ray detector

In our era of continuous technological and scientific discoveries, where space probes are scouting the galaxy for Earth-like planets and huge particle accelerators are trying to reproduce the birth of our universe, the data that we collect from looking at a macro scale—observing the cosmos, or at a micro scale—observing subatomic particles, are essential for humankind to grasp the invisible world that surrounds and rules our everyday existence. *Cosmic Bitcasting* emerges from the idea of connecting the human body with the universe by creating a wearable interface that can provide sensory feedback on the invisible cosmic radiation that passes through us. The project proposes the creation of an open-source, wearable detector that can detect secondary muons generated by cosmic rays hitting the Earth's atmosphere, by triggering a series of embedded actuators (light and vibration) as they pass through the human body.
www.zaragoza.es/ciudad/etopia

Cosmic Bitcasting was developed during a one-month residency at the Etopia—Center for Art and Technology in Zaragoza, in the context of the residency *Reverberadas* program, part of the European Art and Science Network, curated by Fermín Serrano.

Afroditi Psarra (GR), Dafni Papadopoulou (GR)
The Culture Series

The Culture series is an e-textiles project inspired by the *Space Operas* of British science fiction writer Iain M. Banks and his eclectic imagery of *The Culture*—a future civilization of people whose lives depend on sophisticated machines in a world where everything is sentient. The garment can be perceived as a hybrid organism, responsive to the user's vital functions—heartbeat—through subtle movements on the sleeves that behave as an augmented animalistic skin that breathes in and out. Technically, the project aims to combine electronic handicrafts with parametric design and digital fabrication on an ongoing research on wearables. The garment's sleeves are designed in Rhino and Grasshopper and have been laser-cut on leather and then assembled by hand in complex structures. The garment's circuit has an embedded Arduino microcontroller and lightweight actuators created using muscle wire, neoprene, and conductive copper fabric sewn into the inside of the leather structure, as well as a 3D-printed earring with an embedded pulse sensor.
www.wemake.cc

The Culture series was created during a two-week residency at WeMake—Milan's Makerspace in February 2015, curated by Zoe Romano.

Afroditi Psarra (GR), is a multidisciplinary artist and researcher working in the field of e-textiles. Her interest focuses on the creation of handcrafted technological artifacts and the use of the human body as an interface. She holds a PhD on *Cyberpunk, Digital art and Performance,* focusing on the merge of science fiction ideas with digital practices. In 2016 she joined the Center for Digital Arts and Experimental Media (DXARTS) at the University of Washington, Seattle, as assistant professor.
Dafni Papadopoulou (GR), is an architect who has collaborated with different architecture studios in Barcelona and Athens and has been awarded in various architectural competitions. Her fields of interest are focused on the interaction between body techniques, space and urban conditions. She has been experimenting on algorithmic design, interaction technologies, and electronic textiles.
Cécile Lapoire (FR) holds a PhD in experimental particle physics. She took part in the Higgs boson discovery at CERN in Geneva and spent a significant amount of time underground in the heart of the ATLAS detector. She is now back on the surface, orienting herself toward the world of textile and design.

Christoph Wachter (CH), Mathias Jud (CH)

"Can you hear me?"

Edward Snowden's disclosures shined the spotlight of public attention on Berlin's federal government district, revealing it to be the site of extremely intense surveillance and espionage by numerous intelligence agencies. This is precisely where the artists wanted to set up a temporary installation on the subject of power and powerlessness in the Digital Age. On the roofs of the Academy of Arts and the Swiss Embassy—right between the listening posts in the American and British Embassies—they set up improvised antennas and installed an independent Wifi communications network, the range of which included the Reichstag, the Office of the Federal Chancellor and the Swiss Embassy. Anyone with a Wifi-capable device could join the network and chat, send text messages and share files. Personnel of the embassies and German government agencies were cordially invited to join in too. Plus, anyone who wished could send messages to the intelligence organizations on precisely those frequencies on which the American NSA and the British GCHQ were listening in.

Christoph Wachter (CH), **Mathias Jud** (CH) live and work in Berlin. They have participated in numerous international art exhibitions and been awarded many international prizes As open-source projects their works uncover forms of censorship of the Internet, undermine the concentration of political power and even resolve the dependency on infrastructure. The tools, provided by the artists, are used by communities in the USA, Europe, Australia, and in countries like Syria, Tunisia, Egypt, Iran, India, China, and Thailand. Even in North Korea activists participate. But not everyone is fond of these projects. The People's Republic of China has denied Wachter and Jud a visa to enter the country since 2013.

Aniela Hoitink / NEFFA (NL)
MycoTEX

The purpose of *MycoTEX* was to create a textile out of living material and to develop a real garment out of it. Aniela started by combining mycelia with textiles, in order to create flexible composite products. But during the research process she developed a method for retaining flexibility without using traditional textile materials, but only pure mycelia. Building the textile out of modules provided a number of relevant benefits. Repair and replacement of the garment are easy and do not interfere with the look of the fabric. The garment can be built three-dimensionally and shaped while being made, to suit the wearer's wishes. Thus it is possible to adjust its length or to add elements. This allows growth of just the right amount of material needed, eliminating any potential waste during the production process. Once the garment is no longer in use it can easily be composted, making it possible to completely rethink future possibilities for fashion items.

Project credits: NEFFA; Universiteit Utrecht; Officina Corpuscoli; Mediamatic
This project is presented in the framework of the European Digital Art and Science Network and co-funded by the Creative Europe program of the European Union.

Aniela Hoitink (NL) launched NEFFA in 2004. Textile innovation, but just that bit different, is what NEFFA is all about. Through her multi- and interdisciplinary way of working and by altering or adding properties to textiles, Aniela Hoitink investigates how we can and how we will use textiles in the future and what the related implications will be. Using technology and microbiology, she is on a quest to improve / change the properties of traditional textile materials. *neffa.nl*

CIID Copenhagen Institute of Interaction Design (DK) is an international hub of creative minds. The integrated structure creates a unique environment that encompasses world-renowned education, a cutting edge research group, an award-winning consultancy and a startup incubator. The overarching objective for CIID is to create impact through the design of innovative products, services, and environments.

CIID Projects:

PELARS

PELARS stands for Practice-based Experiential Learning Analytics Research and Support. The very title of CIID's research project is indicative of the fact that not only the mind comes into play in the learning process; haptic input and sensory experience also play key roles. Accordingly, a scholarly alliance under the direction of CIID is performing research on how people learning science, technology, and mathematics go beyond the purely intellectual and thereby employ not only their mind but also their hands. How can learning environments be equipped with digital and electronic technologies so that, when students perform manual work, the data pertaining to these activities can immediately be gathered and used for analytical purposes? This is the matter under investigation. In going about answering it, the project participants are drawing inspiration from, among others, the do-it-yourself movement, hacker culture, and the electronics hobbyists of our day.

CIID Copenhagen Institute of Interaction Design (DK) with Universität Bremen (DE), Arduino (SE), Universitatea Din Craiova (RO), Danmarks Tekniske Universitet (DK), Perch Dynamic Solutions Limited (IR), National College of Art and Design (IR), Scuola Superiore di Studi Universitari e di Perfezionamento Sant'anna (IT), Malmoe Hoegskola (SE), University College London (UK), European Network of Living Labs (BE), Fundació Privada Pel Foment de la Societat del Coneixement (ES)

Andreas Refsgaard (DK), Line Birgitte Borgersen (DK), Manu Dixit (IN), Riccardo Cereser (IT)

Future Self Mirror

This project was a part of the *Enchanted Objects* course taught by David Rose, Adrian Westaway, and Francisco Gomez Paz at the Copenhagen Institute of Interaction Design. Moises Bottage helped in managing the space and materials.

Health and fitness data is being tracked everywhere these days, but can one really make sense of this data? Graphs and charts are often not enough to motivate people. So how might we visualize the available health data in a more motivating way? A mirror is the metaphor for self-reflection and is an everyday object. We prototyped a mirror that gathers data from fitness trackers like fitbits, smartwatches, and smartphones and visualizes the future health directly on a person's body when they look in the mirror. In a way, the mirror accelerates time so you see your future self staring back at you. Today's habits shape tomorrow's image. Daily choices of diet, exercise, stress, smoking and more have a visible impact. This mirror augments one's reflection with visual predictions of future health, made possible by extrapolating the health data from fitness devices and smartphones.

Andreas Refsgaard (DK) is an interaction designer and a creative coder. *andreasrefsgaard.dk*
Line Birgitte Borgersen (DK) is an illustrator, a storyteller and an interaction designer. *linebirgitte.dk*
Manu Dixit (IN) is an interaction designer and a computer science engineer. *manudixit.net*
Riccardo Cereser (IT) is a digital service designer and social-media marketing expert. *www.riccardocereser.com*

Sharon Hsienpu Chen, James Zho

Spiritum

No matter how environmentally friendly our lifestyle is, our very existence—literally every breath we take—contributes to emitting CO_2 into the atmosphere. *Spiritum* is a concept for a wearable filter that's designed to be our constant companion in everyday life and to help us reduce our CO_2 emissions. It captures the air we exhale and withdraws the carbon dioxide from it before it escapes into the atmosphere. *Spiritum* exists in a society where reducing our carbon footprint is a necessity. Carbon conscious individuals can choose to filter the carbon dioxide from their breath before releasing it into the air.
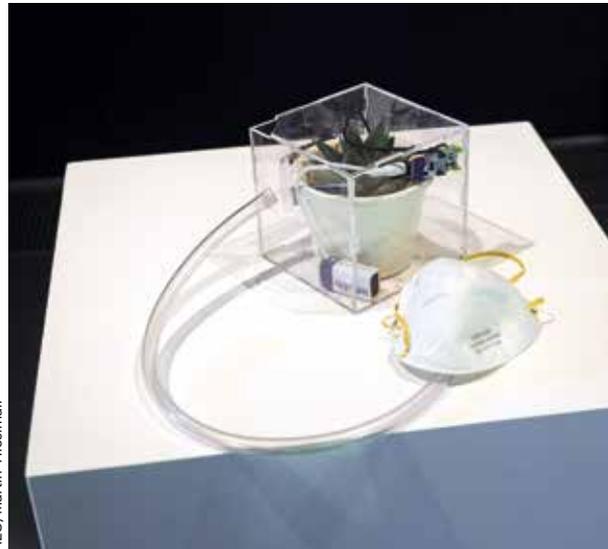
AEC, Martin Hieslmair

Window to the World
CIID Copenhagen Institute of Interaction Design (DK), TME Toyota Motor Europe (EU)

CIID Copenhagen Institute of Interaction Design

An automobile's windshield only had to be transparent and shatterproof heretofore. But now, "Window to the World" manifests a futuristic vision of mobility in which the glass front panel separating the passenger compartment from the world extends an invitation to a new form of interaction between inside and outside. The pane becomes an interface that moves driving beyond transportation and makes the car a vehicle for entertainment, play, and information.
Toyota Motor Europe (TME) and CIID collaboratively developed a speculative concept in which the safety glass becomes a touchscreen, and Augmented Reality gives the outside world a voice. *Window to the World* informs passengers about things worth seeing and knowing about their immediate surroundings, and thus interrelates those inside with the outside. Plus, you can create drawings on the glass' interior surface that then react to the scenery rushing past and thus develop a life of their own.

Copenhagen Institute of Interaction Design (CIID), Toyota Motor Europe (TME)

Toyota Motor Europe (TME) is the regional headquarters of Toyota in Europe. TME oversees the wholesale sales and marketing of Toyota and Lexus vehicles, parts and accessories, and Toyota's European manufacturing and engineering operations.

Eric Dyer (US)
Implant

Implant is an imaginary medical device that fits into a blood vessel, neuron, etc. It is super-enlarged, making the viewer feel microscopic. With a genetic retinal disease in his family's DNA, Dyer has closely followed developments in gene therapy, including the insertion of healthy genes into the body using viruses. With *Implant* he plays with the paradoxical threat and promise of bleeding-edge, anatomically invasive and potentially rampant medical practices. Viewers explore the cylindrical spinning sculpture with hand-held strobe lights, discovering thousands of colorful, fluffy, and sinister nanobots performing unknown tasks and a spiral of organic-synthetic gears inside the tube.

Imaging Research Center, University of Maryland Baltimore Campus, US
Creative Capital

Eric Dyer (US) is an artist, experimental filmmaker, and educator. His work has been exhibited worldwide at events and venues such as the Smithsonian National Gallery of Art, Ars Electronica, London International Animation Festival, and the Cairo and Venice biennales. He has been honored as a Fulbright Fellow, Sundance New Frontier Artist, Creative Capital Artist, and Guggenheim Fellow. Dyer's work explores a variety of cyclic ideas and themes through zoetrope-like sculptures. He teaches animation at UMBC, Baltimore. *www.ericdyer.com*

Antoine Delacharlery (FR)
Ghost Cell

Scientific and dreamlike documentary at once, *Ghost Cell* is a stereoscopic plunge into the guts of an organic Paris seen as a cell through a virtual microscope.

Screenwriter, editor: Antoine Delacharlery; Executive producer, Line producer: Nicolas Schmerkin, Autour de Minuit Productions; Production manager: Émilie Schmerkin
Crew: Animation: Antoine Delacharlery, Bastien Dubois, Mathieu Bernadat, Jean Delaunay;
Editing: Antoine Delacharlery; Music Composer: Bastien Prevosto

Antoine Delacharlery (FR) studied 3D animation and then turned to the field of animated short filmmaking and digital arts, all the while putting a great deal of manual work into his many projects. Exhibiting consummate versatility, he's equally adept at exploring many different techniques: 3D, camera work, graphic experimentation and bricolage. His work thus seeks to weave interconnections among the real, the dreamlike, and the organic. *www.antoinedelach.com*

AEC, Martin Hieslmair

Paolo Cirio (IT)
Obscurity

This artwork is composed of over fifteen million mugshots of people arrested in the US. It obscured the criminal records of mugshot websites by cloning them. The mugshots have been blurred to make the faces unrecognizable while their names have been shuffled by an algorithm that samples data based on common age, race, location, and charges, all of which are kept accurate in order to provide social context on the actual arrests. A participatory feature lets people judge the arrested individual by deciding to keep or remove their data from the mugshot websites. *Obscurity* explores the emotional underpinning of unflattering personal information exposed on the Internet. Beyond the use of criminal records for the social experiment and the performative hack, the project promotes a legal Right to Remove personal information from search engines in US. The *Obscurity* artwork deployed strategies that are oriented on problem-solving as a form of Internet social art practice.

Paolo Cirio (IT) works with information systems that impact the dynamics of social systems. Cirio's artworks investigate privacy, copyright, and finance. He shows his works through prints, installations, videos, online performances, and interventions in public spaces. Cirio has presented in international museums and his works have been covered by hundreds of media outlets worldwide.

AEC, Florian Voggeneder

Ralf Baecker (DE)

Interface I

Interface I investigates the boundary between two interacting systems rendered into the physical. One system is a compound of motors, twine and elastic bands arranged horizontally. Each motor is connected to its opposing motor in the facing system by a string, and to its neighbors by an elastic thread. In order to excite the system's behavior, each motor is fed with random impulses from a Geiger-Müller tube. The mesh couples each element to its surrounding elements in order to achieve a local emergent behavior. *Interface I* reproduces space and time in constantly shifting configurations.

Produced by NOME Gallery Berlin 2016. Production assistant: Antje Weller
Research and experiments essential to the realization of *Interface I* were carried out as part of Ralf Baecker's research project, *Time of Non-Reality,* at the Graduate School, University of the Arts, Berlin.

Ralf Baecker (DE), works at the intersection of art, technology and science. Through installations and machines, he explores fundamental mechanisms of action and the effects of new media and technologies. Ralf Baecker studied computer science and media art at the Academy of Media Arts Cologne, and has taught at Bauhaus University in Weimar and the University of the Arts in Bremen. Baecker is currently a fellow at the Graduate School, University of the Arts Berlin. *www.rlfbckr.org*

AlteredQualia (SK) + Fractal Fantasy (AT/CA)

Uncanny Valley

Creating convincing synthetic human beings is a notoriously difficult task. The "uncanny valley" phenomenon is a hypothesis that as you try to increase the realism of your human-like creations, there is a point behind which improvements actually become negative, causing a sense of unease or repulsion. Something flips in the mind of the observer, and the creature starts to be seen as a "human with which something seems to be wrong" instead of "human-like", a doll becomes a corpse. It takes a lot more effort to climb out of the valley, every little detail that was abstracted away comes back into play. We created the *Uncanny Valley* project to explore these concepts. It is an interactive webpage experiment with three animated virtual human heads reacting to the user's mouse movements, accompanied by three songs, featuring light sources synchronized to the music. The experiment is trying to find out what can be achieved today on the web, with very limited resources, on a constrained platform.
fractalfantasy.net/uncannyvalley

Uncanny Valley is the result of a collaboration between the computer graphics programmer AlteredQualia, and the platform Fractal Fantasy.
Visuals, code and rendering: Branislav Ulicny, AlteredQualia
Fractal Fantasy, Songs by: Sinjin Hawke, Martyn Bootyspoon, Zora Jones

Branislav Ulicny / AlteredQualia (SK) likes to explore possibilities of real-time computer graphics on the web. Before succumbing to the temptations of dark arts of rendering, he dabbled in academic research of artificial life, crowd simulations, and bioinformatics. He is an alumnus of a popular open source project *three.js* and holds a doctorate in computer science from EPFL. *alteredqualia.com*
Fractal Fantasy (AT/CA) has established itself as an observatory for otherworldly textures, both aural and visual, over the last past years. The brainchild of Sinjin Hawke and Zora Jones found life as an outlet for audiovisual pieces in 2013 and has since grown to encompass code experiments and interactive musical works, all the while remaining a fluid and ever-expanding endeavor. *fractalfantasy.net*

STONES
Storage **T**echnology for **O**bserved **N**earby **E**xtraterrestrial **S**helters

Astronomical research is very much subject to the human tendency to observe and evaluate any findings within the context of our own culture. Yet the truth of scientific results goes far beyond the duration of our current civilizations. Just the detection of exoplanets in the habitable zone* already constitutes a scientific milestone. Detached from any contemporary interpretation, the work archives pure knowledge for the coming millennia. In a notation that requires no previous cultural education but can be deciphered based on logic and scientific observation, the knowledge itself is the main message.

* A planet outside our solar system, orbiting its parent star in a particular area so that water may be present on its surface in liquid form. This is regarded as a prerequisite for the emergence of life. So far, 42 such objects have been identified. (Source: Planetary Habitability Laboratory, UPR Arecibo.)

AEC, Florian Voggeneder

Quadrature (DE)
MASSES
Motors **a**nd **S**tones **S**earching for **E**quilibrium **S**tate

AEC, Florian Voggeneder

We place two stones on top of a balanced steel plate. The aim of the machine is to position the stones so that the system is perfectly balanced. In an incessant process, continuous efforts repeatedly briefly avert the constant threat of divergence, only for it to appear elsewhere a moment later. Instead of the desired state of well-adjusted stability, the work achieves a permanent state of incessant motion—a fragile but constant situation between falling and floating. As the precision of modern research instruments advances, so their vulnerability increases, and with it the need to compensate for even the smallest disturbing influences. Supported by a machinery of sensors and people, the apparatus performs an endless sequence of observation and calibration.

The members of the **Quadrature** artists' collective, Jan Bernstein, Juliane Götz, and Sebastian Neitsch (all DE), met at Burg Giebichenstein University of Art and Design in Halle. After completing their education, the artists worked individually in, among other cities, Antwerp, Linz, Valencia, Vienna, and Stuttgart. They collaborated for the first time in 2009, and went on to establish Quadrature, a collective in which each member inputs his/her own specific skills and focal-point themes. Most of their artistic projects focus on the contradiction between knowledge and comprehension.

Radical Atoms

Exhibition
07.09.2016 – 15.07.2017

The exhibition *Radical Atoms* centers around the digital world's merger with the physical one and is a reference to the visions and prototypes that have emerged from the MIT Media Lab's Tangible Media Group. Developed in cooperation with Professor Hiroshi Ishii, this exhibition demonstrates how ideas derived from art can lead to new technological concepts.
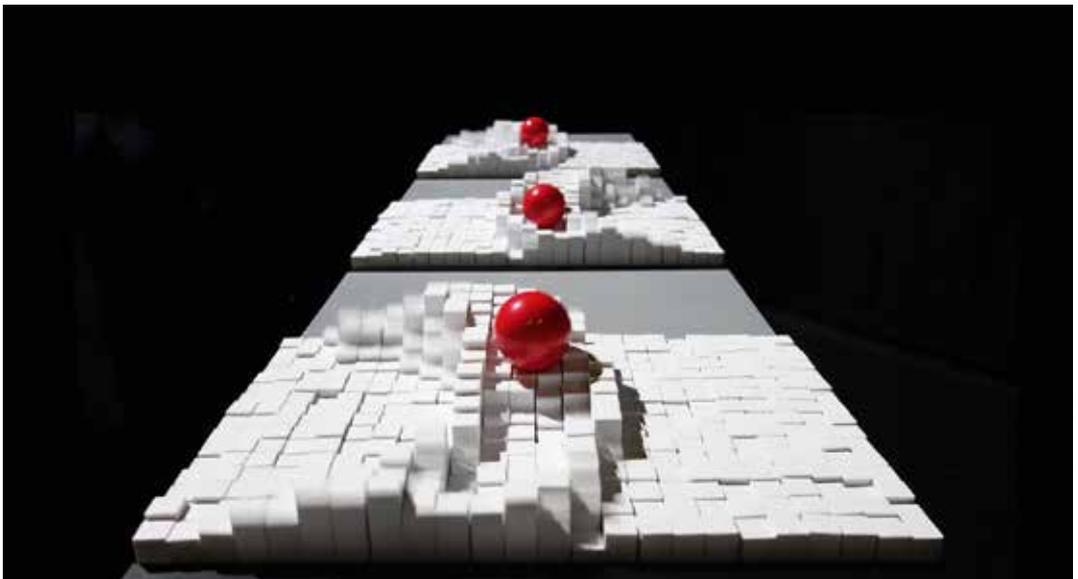
Tangible Media Group / MIT Media Lab

Arranged on a thematic and chronological axis, this exhibition took the theories and works of Hiroshi Ishii, a professor at MIT Media Lab and one of the pioneers in artistically inspired technological development, as its point of departure. Examples from the early years of the Tangible Bits Group demonstrated how ideas derived from art led to the development of trailblazing and fundamentally new technological concepts. First and foremost among them are *musicBottles*, a 1999 work by Hiroshi Ishii (US/JP). Supplementing this exhibition were works by Carlo Ratti (US), Joachim Sauter (DE), and Ars Electronica Futurelab (AT), which were on display after the festival at Ars Electronica Center.

The **Tangible Media Group at MIT Media Lab**, led by Professor Hiroshi Ishii, explores the Tangible Bits & Radical Atoms visions to seamlessly couple the dual world of bits and atoms by giving dynamic physical form to digital information and computation. **Hiroshi Ishii** (US/JP) is Jerome B. Wiesner, professor of Media Arts and Sciences, associate director of MIT Media Laboratory, and director of the Tangible Media Group. Hiroshi's research focuses upon the design of seamless interfaces between humans, digital information, and the physical environment.

Christophe Guberan and the Self-Assembly Lab
MIT School of Architecture & Planning
Active Wood Products

Traditional wood-bending techniques require complex steaming equipment, labor-intensive forming processes, and a high degree of expertise. In addition, the natural pattern of wood grain and its physical properties make it difficult to curve into complex shapes. Novel printing and composite material technologies can now overcome previous limitations on wood forming. *Active Wood Products* are produced with a printed wood filament and carefully designed flat patterns that when subject to moisture can self-transform into the final shape of the product. We imagine a variety of products from tableware to jewelry and even furniture that can be designed and printed, shipped flat in a moisture pack, and then self-transform at home.

AEC, Florian Voggeneder

AEC, Florian Voggeneder

Tangible Media Group – MIT Media Lab
LineFORM

LineFORM is a shape-changing interface in the form of a "line." Lines have several interesting characteristics from the perspective of interaction design: abstractness of data representation; a variety of inherent interactions; and constraints as boundaries or borderlines. Utilizing such aspects of lines together with the added capability of transformation, this project investigates the design space of line-based shape-changing interfaces through presenting various applications such as shape-changing cords, mobiles, body constraints, and data manipulation.

Research: Ken Nakagaki, Sean Follmer, and Hiroshi Ishii
Exhibition: Ken Nakagaki, Nikolaos Vlavianos, and Hiroshi Ishii
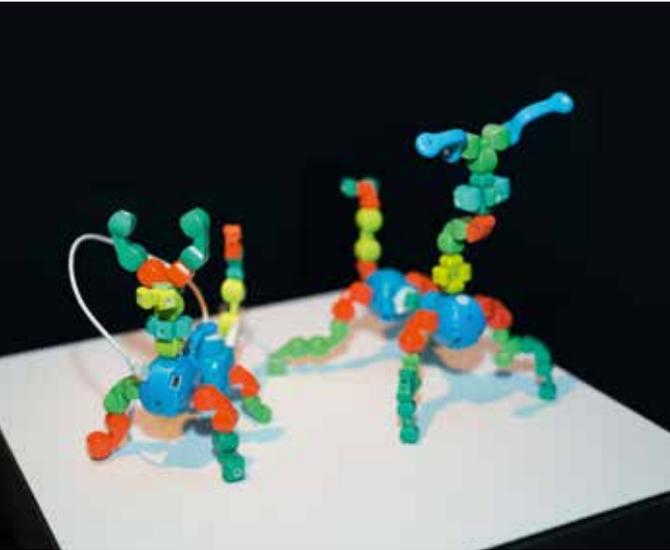
Tangible Media Group – MIT Media Lab
Topobo

What is it like to sculpt with motion? *Topobo* is a construction toy with a kinetic memory, able to record and playback physical motion. Snap together passive (static) and active (robotic) pieces into a creation, and with a press of a button and a flick of the wrist, you can teach your creation how to dance or walk. Just as you can learn how buildings stand by stacking up blocks, you can discover how animals walk by playing with *Topobo*.

Research: Hayes Raffle, Amanda Parkes, Laura Yip and Hiroshi Ishii
Exhibition: Penny Webb and Hiroshi Ishii

AEC, Florian Voggeneder

Tangible Media Group – MIT Media Lab
SandScape

SandScape is a tangible interface for designing and understanding landscapes through a variety of computational simulations using sand. Users view these simulations as they are projected on the surface of a sand model that represents the terrain. The users can choose from a variety of different simulations that highlight either the height, slope, contours, shadows, drainage, or another aspect of the landscape model.

Research: Yao Wang, Assaf Biderman, Ben Piper, Carlo Ratti, and Hiroshi Ishii
Exhibition: Daniel John Fitzgerald, Luke Vink, Ken Nakagaki, Nikolaos Vlavianos, and Hiroshi Ishii

Tangible Media Group, MIT Media Lab

Tangible Media Group – MIT Media Lab
musicBottles

musicBottles is an interactive installation for visitors to interact with sound waves encapsulated in bottles. The bottles are used as containers for trapping audio memories; escaping the bottle and vaporizing into sound at the opening of a lid. The installation consists of a set of bottles that encapsulate sounds from Boston, Cambridge, and the MIT neighborhood. In 1999, *musicBottles* was first introduced as a tangible interface for handling digital information. The bottles "contained" the sounds of the violin, the cello, and the piano in Édouard Lalo's *Piano Trio in C Minor, Op. 7*. Opening a bottle by removing its stopper made the corresponding instrument audible. In addition to the sounds played, a pattern of colored light was projected onto the table's translucent surface to reflect changes in pitch and volume. Originally, *musicBottles* used custom-designed electromagnetic tags embedded in the bottle and the stopper, allowing wireless identification of the containers. The modern version works on the same principles, except it uses off-the-shelf RFID tags to identify each bottle and stopper.

Research: Rich Fletcher, Ali Mazalek, Jay Lee, Seungho Choo, Joanna Berzowska, Craig Wisneski, Charlie Cano, Andres Hernandez, Colin Bulthaupand, Joe Paradiso, and Hiroshi Ishii
Exhibition: Udayan Umapathi, Penny Webb, Mitchell D Hwang, Patrick Shin, and Hiroshi Ishii
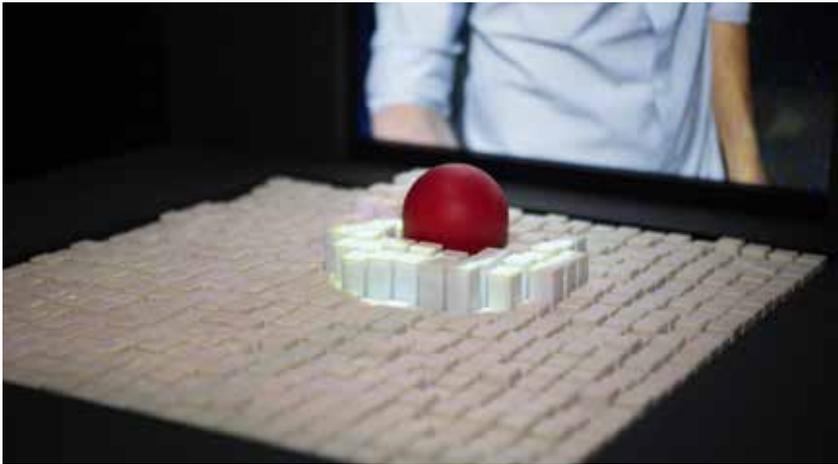
AEC, Florian Voggeneder

Tangible Media Group – MIT Media Lab

inFORM

inFORM is a shape display that gives physical form to digital information. Imagine being able to reach out and grasp a digital model right in front of you or to handle physical objects thousands of miles away! Motorized pins act like physical pixels that extend from a tabletop to form a dynamic, computer-controlled sculpture that users can view, touch, and deform. Besides rendering information, *inFORM* can interact with the world around it by accurately moving and manipulating objects placed on its surface.

Research: Daniel Leithinger, Sean Follmer, Alex Olwal, Philipp Schoessler, Jared Counts, Ken Nakagaki, David Doan, Basheer Tome, Akimitsu Hogge, and Hiroshi Ishii
Exhibition: Daniel Leithinger, Ken Nakagaki, and Hiroshi Ishii

Tangible Media Group – MIT Media Lab

PneUI

Energy or substance, air is one the most abundant resources on earth. In many mythologies across culture, air brings life to and animates static substance. *PneUI* explores the dynamic interaction between the air and sheet materials. The digital fabrication processes enable various shapes to be created and transformed in a programmable way. With these tools, new materials are created to design robots that are soft, furniture that is adaptive, clothing that is intelligent, and art works that breathe.

Exhibition: Jifei Ou, Nikolaos Vlavianos, and Hiroshi Ishii
Research: Jifei Ou, Felix Heibeck, Lining Yao, Ryuma Niiyama, Nikolaos Vlavianos, Melina Skouras, and Hiroshi Ishii

**Responsive Environments Group –
MIT Media Lab**
Rovables

We envision that future wearable technology will move around the human body, and will react to its host and the environment. To proof this concept, we developed *Rovables,* miniature robots that can move freely on unmodified clothing. The robots are held in place by magnetic wheels, and can climb vertically. Our applications include on-body sensing, modular displays, tactile feedback and interactive clothing and jewelry.

Research: Artem Dementyev, Hsin-Liu (Cindy) Kao, Inrak Choi, Deborah Ajilo, Maggie Xu, Joe Paradiso, Chris Schmandt, Sean Follmer
Exhibition: Artem Dementyev and Joe Paradiso

Tangible Media Group -MIT Media Lab
bioLogic

bioLogic is growing living actuators and synthesizing responsive bio-skin in the era where bio is the new interface. Natto bacteria are harvested in a bio lab, assembled by a micron-resolution bio-printing system, and transformed into responsive fashion, a "Second Skin." The synthetic bio-skin reacts to body heat and sweat, causing flaps around heat zones to open, enabling sweat to evaporate and cool down the body through an organic material flux.

Research: Lining Yao, Wen Wang, Guanyun Wang, Helene Steiner, Chin Yi Cheng, Jifei Ou, Oksana Anilionyte, and Hiroshi Ishii
Exhibition: Lining Yao, Jifei Ou, Wen Wang, Hiroshi Ishii

Mybosswas

Carlo Ratti (IT) is an architect and engineer, who practices in Italy and teaches at MIT, where he directs the Senseable City Lab. Ratti has co-authored over 250 publications and holds several patents. His work has been exhibited in several venues worldwide, including the Venice Biennale, New York's MoMA, London's Science Museum, and Barcelona's Design Museum.
www.carloratti.com
www.senseable.mit.edu

Carlo Ratti Associati (IT) and OpenDot team
Lift-Bit

Lift-Bit is a modular, digitally reconfigurable furniture system that allows a sofa to seamlessly turn into a chair, a chaise longue, a bed, a complete lounge, and a myriad of other configurations. The system is composed of a series of individual, upholstered stools. Each element is motorized using a linear actuator, enabling it to be raised or lowered. It can double (or halve) in height in just a few seconds. *Lift-Bit* can be controlled in person, via a simple gesture (just by hovering your hand over the seat), or from a distance by a mobile app.

Lift-Bit is a project by Carlo Ratti Associati, developed with the support of Vitra; Engineering and interaction design: Opendot; Originally realized in spring 2016 for the *ROOMS: Novel Living Concepts* exhibition organized by Salone del Mobile.Milano as part of the XXI Triennale; Carlo Ratti Associati team: Carlo Ratti, Giovanni de Niederhausern, Andrea Cassi (project leader), Ina Sefgjini, Damiano Gui, Antonio Atripaldi, Emanuele Protti, Gary Di Silvio, Daniele Belleri; OpenDot team: Alessandro Masserdotti, Fabrizio Pignoloni, Vittorio Cuculo.

Tangible Media Group – MIT Media Lab
jamSheets

This work introduces layer jamming as an enabling technology for designing deformable, stiffness-tunable, thin sheet interfaces. Interfaces that exhibit tunable stiffness properties can yield dynamic haptic feedback and shape deformation capabilities. Shifting the focus from designing form to designing stiffness would enable a new type of human-object interaction. When the material is soft, one can form it as desired, then switch it to rigid and let it perform. By switching it back to soft, one can reshape the material again. The prototype of *jamSheets* shows a formal and functional adaptive furniture: from a carpet to a table to a chair and back.

Research: Jifei Ou, Lining Yao, Daniel Tauber, and Hiroshi Ishii
Exhibition: Jifei Ou, Nikolaos Vlavianos, and Hiroshi Ishii

AEC, Florian Voggeneder

ART+COM Studios (DE), Ólafur Arnalds (IS)
Infinite Cube 2006/2010/2013

Infinite Cube is a spatially concentrated but at the same time expansive kinetic installation. The spheres follow a computational narrative that molds them into a fluid succession of abstract shapes. An optical illusion extends the apparently clear spatial confines of the installation into infinity. Viewers are also reflected in the installation, and their presence adds an additional layer to the interplay of real and reflected space. Combined with the specially composed music by Ólafur Arnalds, a poetical correlation of the three elements of reflection, sound, and movement is obtained.

Nils Krueger

ART+COM Studios (DE) designs and develops new media installations and spaces and uses new technology as an artistic medium of expression and as a medium for the interactive communication of complex information. Joachim Sauter is a co-founder of ART+COM and Head of Design at ART+COM Studios. *artcom.de*

CPN – Center for the Promotion of Science
Центар за промоцију науке (ЦПН)

Belgrade, Serbia

CENTER FOR
THE
PROMOTION
OF SCIENCE

CPN – Center for the Promotion of Science, created only seven years ago, already has diverse international cooperations, well established partnerships, and unique practices. Through almost 20 EU projects to date, the Center aims to bring the best European initiatives and concepts to Serbia and also to offer creative minds from Serbia opportunities to share their results, views and ideas.

CPN is a public institution with the mission to bridge the gap between science and society by bringing together researchers, educators, scientists, artists, policy makers, civil society organizations, business and industry, and the general public in the process of research and innovation. The ultimate aim is to influence and adapt the general research agendas to reflect the needs of society and to address societal challenges, engaging all actors involved in the process.

CPN's most important public resource is the Science Club, located in the center of Belgrade. It comprises a space for the exhibitions, talks, presentations, and workshops, and also has a makers' lab equipped with tools and machines, such as 3D printer and plotter, for production of the exhibits. This Club is at the same time part of the Network of Science Clubs, which was initiated by CPN and currently has 13 members across Serbia.

Center also has its travelling version—Mobile CPN! The crucial parts are SciTruck, with a 120 square meter exhibition area, and Mobile Planetarium, which can host up to 50 spectators.

Центар за промоцију науке (ЦПН), иако основан пре само седам година, активно развија своју међународну сарадњу и партнерства, и креира јединствене програме и активности.

Учешћем у 20 ЕУ пројеката до сада, Центар непрекидно покушава да у Србију пренесе и представи најбоље европске иницијативе и концепте, али и да пружи прилику креативним и талентованим људима из Србије да покажу своје резултате, домете и идеје.

Центар за промоцију науке је јавна установа основана са циљем да се премости јаз између науке и грађана, повезивањем и укључивањем истраживача, научника, едукатора, уметника, доносиоца одлука, невладиних организација, привреде и индустрије у процес истраживања и иновација. Коначни циљ је прилагођавање општег процеса истраживања стварним потребама друштва и укључивање свих актера који могу да допринесу решавању друштвених изазова.

Најважнији ресурс Центра јесте Научни клуб који се налази у самом срцу Београда. Састоји се од излагачког простора намењеног изложбама, радионицама, предавањима и другим јавним догађајима, као и од практичне радионице са алатима и машинама за израду експоната, 3Д штампачем и другом опремом. Овај централни клуб је истовремено и део Мреже научнх клубова у Србији, коју је такође покренуо Центар и која тренутно броји 13 клубова широм Србије.

Центар такође поседује и своју покретну варијанту – Мобилни ЦПН! Његови кључни елементи су Научни камион са излагачким делом од 120 квм и Мобилни планетаријум у који може да стане око 50 посетилаца.

As a partner of the European Digital Art and Science Network, CPN successfully infused the national scene with fresh and intriguing concepts, connecting seemingly opposed disciplines. Not alone anymore in this attempt, CPN created links with others involved in similar projects: major national research institutes, Serbian Academy of Sciences and Arts, The Cultural Center of Belgrade, independent galleries, platforms and initiatives, and several art faculties, including both public and private institutions, universities in Serbia's capital Belgrade and also in other towns.

With its experience in the production of diverse and complex Art & Science events, CPN regularly communicates news and outcomes of the intersection between arts, science and emerging technologies. The contemporary research, the interdisciplinary approach, and the overwhelming influence of advanced technologies are the key messages that we're sharing and presenting through the collaboration with the Ars Electronica, other partner organizations, and three major European scientific institutions.

cpn.rs/artandscience

Као партнер пројекта "Европска мрежа дигиталне уметности и науке", ЦПН је успешно освојио локалну сцену са свежим и иновативним концептима који повезују наизглед супротстављене дисциплине. У међувремену су се овом покушају и програмима прикључили и други партнери – велике истраживачке организације у Србији, Српска академија наука и уметности, Културни центар Београда, независне галерије, платформе и иницијативе, као и неколицина државних и приватних уметничких факултета из Београда и других градова.

Поред знатног искуства у продукцији разноврсних и сложених Art & Science програма, ЦПН редовно извештава јавност о новинама и резултатима насталим укрштањем уметности, науке и напредних технологија. Савремена истраживања, интердисциплинарност и свеприсутни утицај расположивих технологија су кључне тачке и главне поруке које ЦПН представља као резултате сарадње са Арс електроником, другим пројектним партнерима и трима највећим научним организацијама у Европи.

cpn.rs/artandscience

CPN – Center for the Promotion of Science
Activities

Presentations

Promotion campaign of the open calls
Presentations, talks, discussions
Belgrade, Serbia
December 2014 – June 2016
Dobrivoje Lale Eric, Slobodan Coba Jovanovic

Presentation of the project at the open event during CREAT-IT project meeting
Presentation
Rome, Italy
07.03.2015
Dobrivoje Lale Eric

Presentation of the project at Creative Europe Conference
Presentation
Belgrade, Serbia
27. – 28.04.2015
Dobrivoje Lale Eric

Art & Science @ May Month of Mathematics (M3) 2015
Presentation of the best nine applications from Serbia and two winners of the national selection for 2015/16
Belgrade, Serbia
(Gallery of Science and Technology of the Serbian Academy of Sciences and Arts)
12.05. – 28.05.2015
Imaginary Maps by Aleksandra Jovanić
Frequency Chamber by Bogdan Stefanović
and other 7 shortlisted projects by Nataša Teofilović, Karolina Mudrinski, Milan Lićina, Isidora Todorović, Marija Strajnić, Marija Lipkovski & Miklos Barna, Milos Jez & Dejan Dimitrijević

Art & Science in Serbia
Presentation of the plans, results, and outcomes at the national level, at the Conference during Ars Electronica Festival
Linz, Austria
06.09.2015
Dobrivoje Lale Eric

Presentation of the European Digital Art and Science Network at the CREAT-IT International Conference
Presentation, paper (abstract)
Athens, Greece
09. – 10.10.2015
Dobrivoje Lale Eric

Presentation of the European Digital Art and Science Network at the Conference Media Archaeology
Presentation, paper (abstract)
Belgrade, Serbia (Faculty of Dramatic Arts)
29.10.2015
Dobrivoje Lale Eric

Presentation of the European Digital Art and Science Network at TEDx Novi Sad Conference
Talk
Novi Sad, Serbia
29.10.2016
Dobrivoje Lale Eric

Workshops

Two educational workshops for the artists, art students and academicians
Workshop
Belgrade, Serbia (Kolarac Foundation)
16. – 17.12.2015
Martin Honzik, Veronika Liebl, Dobrivoje Lale Eric, Slobodan Coba Jovanovic, Nemanja Djordjevic, Dragana Ilic, Aleksandra Jovanic, Bogdan Stefanovic, Fernando Comerón (via skype), Jurij Krpan (via skype)

Exhibition

Art + Science Exhibition 2016
Exhibition + parallel programs
The Cultural Center of Belgrade, Belgrade, Serbia
07. – 27.04.2016

Art + Science Exhibition 2017
Festival (several exhibitions + parallel programs)
Belgrade, Novi Sad, Kragujevac, Ritopek
27.04. – 25.05.2017

Art + Science 2016
Exhibition I
07.04. – 07.05.2016

The first *Art + Science* Exhibition in Belgrade opened in April, 2016, and during a month long period over 3,500 visitors had the chance to see two national winning productions as well as works by several European artists.

The Art + Science program in Belgrade presented two national winning productions as well as the works by visiting artists Gisela Nunes from Portugal, Werner Jauk from Austria, Cédric Brandilly from France, and Universal Everything art collective from UK. Center for the Promotion of Science premiered two winning artworks within the national selection for 2015. *Imaginary Maps* and *Frequency Chamber,* brilliant installations by Aleksandra Jovanić and Bogdan Stefanović, were presented at Podroom Gallery, Cultural Center of Belgrade, downtown exhibition space in the heart of the city. In parallel with the main exhibition, several other events were held, including lectures, panel discussions, master classes, workshops for art students and high school children, public tours, 3D printing program etc.
For the closing event at Movie Theater, Cultural Center of Belgrade, two grand live performances were presented. One by LP Duo, from Quantum Music project, and the second by Cédric Brandilly and Romain Dubois, who performed their *Architectural SonarWorks.* A second exhibition in Belgrade in the framework of the European Digital Art and Science Network took place in 2017.

Milovan Milenković / CPN

Aleksandra Jovanić (RS)
Imaginary Maps

The Idea behind the work is based upon the potential for transforming recognized regularities and irregularities in nature and social sciences into the visualization of personal narratives. The stories we are made of, our microcosmoses, can be enlarged beyond our dimensions—in an immersive environment—and presented as personal maps. In this way, links are being created between our life choices and events, on the one hand, and what the universe looks like, on the other.

Aleksandra Jovanić (RS) holds a PhD in Digital Arts and a Diploma in programming. She uses these two related fields of arts and science on a daily basis, researching internet art and web design, technology of the new media and interactive media. She is an assistant professor, currently teaching the undergraduate program of the Faculty of Fine Arts in Belgrade, master studies at the Faculty of Applied Arts, and art doctoral studies at the University of Arts in Belgrade. She develops web projects for clients, both independently and in teams, and has been exhibiting in groups and as a solo artist since 2003. *aleksandrajovanic.com*

Bogdan Stefanović (RS)
Frequency Chamber

The idea of the work is based on the audio-visual presentation of events in the space at the level of particles and waves, which make up the entire micro and macro cosmos. All physical objects around us contain frequencies and wavelengths. Every star, every living being, everything is based on a similar principle, like the story that says that each of us contains a fraction of the stars that have created us. Sound and color are linked because, we can say, they are two almost identical things: both have their own frequency, i.e. wavelengths, and both have a certain spectrum of visible and invisible to humans, i.e. the sounds we can and cannot hear. The movements are recorded via a thermal camera, which is connected with the specially programmed application.

Milovan Milenkovic / CPN

Bogdan Stefanović (RS) did a masters degree at the Arts Academy in Novi Sad, in the class of Stevan Kojić. His first video, *Life,* was presented at exhibitions in Belgrade and Lisbon. In September 2014, he participated in the art colony "River of Tolerance" in Samokov (BG). In 2015, he started studying quantum physics, which offers new and very different approaches to art. "Intangible" media have since become the main topics of his research.

Gisela Nunes
Break the Ice

Milovan Milenkovic / CPN

Break the Ice calls for our action, demands a deep dive into ourselves to find out who we really are and what surrounds us. In a world where we are always connected and our steps constantly captured, monitored, archived, what do we show to our friends or foes? Our inner self or our outer self? Does anyone really know what we think?
Inside the installation, people are detected over a circular rug in real-time by a Kinect sensor. The ice cracks depend on the positions of the users and time they spent there. Their movements can either make the ice recede, making a video visible underneath, or make the ice form. The sound corresponding to the graphics is also generated in real-time using overtones, involving the cracks, running water, and ice formation. Those three synthesized sounds are marking the three moments of the interaction in the installation.

Gisela Nunes (PT) is a media artist who focuses on interactive new media art. Her practice explores the object, the device, and the audience, to present interactive live experiences. While project themes vary, real time processing, augmented reality, and data visualization make up the backdrop to her work. *arianing.eu*

Werner Jauk (AT)
iHome

iHome / personal home wants to be the continuation in the gesture-interaction of human beings with spaces, to a life with partner-like living spaces. It recognizes the mood of the person by his/her gestural, whole-body expression, which primarily communicates arousal, and adaptively learns to homeostatically optimize the state of arousal according to the respective behavioral change. *iHome* is thereby an extension of the hedonic body and leads this way to the social domain: it creates common places for every body

Werner Jauk (AT), scientist & media artist, professor at the University of Graz, working on "pop/music + media/art" and focusing on music as a role model for the media arts. His studies in experimental aesthetics led him to bridge the gap between science and art, two fields that deal with how physical bodies adapt to dynamized and coded virtualities. Auditory logic and hedonistic behavior, formalized in pop/music, serve as explanatory hypotheses.

Milovan Milenkovic / CPN

Cédric Brandilly (FR)
Architectural SonarWorks feat. Romain Dubois (live)

Immobile architectural elements, which are the result of human activity, are transposing to music through specific software package. On this basis, a new type of sound language drawn from city map readings is defined. For the first time, thanks to precise analyses, we are now capable of creating a sound score of any urbanized zone. Because they all have specific urban morphologies, cities will also have their own language and sound.

Cédric Brandilly (FR) is a visual artist and performer. After studying fine arts and architecture, he continued his education in the academic section of the Museo Nacional Centro de Arte Reina Sofía in Madrid. His first project, *Urne,* was performed at the Grand Palais in Lille during the European Contemporary Fair in April 2012. This was followed by a series of exhibitions in Paris, Brussels, and Rennes. Since then, the philosopher and academician Michel Serres has taken an interest in Cédric's work and offered to sponsor him. **Romain Dubois** (FR) is a versatile composer and sound engineer. He has composed contemporary dance music, film scores, French songs, pieces for advertising and radio and focuses in particular on the relationship between rhythm, body, and image in general, exploring all aspects of these–which he believes are three pieces of the same puzzle.

Universal Everything (UK)
Presence

A series of large-scale video pieces of motion-captured dance performances create abstract forms with a human presence. A collaboration with choreographer Benjamin Millepied and the LA Dance Project, the work continues Universal Everything's line of enquiry into the essence of choreography, movement, and the human form. Commissioned by Media Space London for their inaugural exhibition, *Presence* turns the screen into a stage, the body into an abstracted sculpture. Experimenting with various materials and forms, the life-sized moving sculptures cycle through a randomized collection of "costumes" that range from colorful light trails to crystalline formations, with only the movement revealing the human presence within.

Universal Everything (UK)
Walking City

Referencing the utopian visions of 1960s' architectural group Archigram, *Walking City* is a slowly evolving video sculpture. The language of materials and patterns seen in radical architecture transform as the nomadic city walks endlessly, adapting to the environments she encounters. Winner of Prix Ars Electronica 2014 Golden Nica: Computer Animation / Film / VFX.

Universal Everything (UK)
Voxel Posse

Utilizing the powers of 3D printing and anthropomorphism, Universal Everything creates a fleet of miniature vector robots. Looking like crystalline rocks that sprouted legs, these creatures are yet another exploration into harnessing the most basic elements of the human form to infuse inanimate objects with the essence of life.

Universal Everything (UK) is a digital art and design studio founded by Matt Pyke in 2004. Their work explores the tension between abstract and figurative form and the synthesis of sound and image, leading to expressive, vibrant digital work imbued with emergent life and anthropomorphism. Exhibited at Museum of Modern Art (New York), Media Space and V&A Museum (London), Art HK (Hong Kong), Central Academy of Fine Arts (Beijing), and Sydney Opera House, among others.

Art + Science 2017
Exhibition II
27.04. – 27.05.2107

Ivan Zupanc / CPN

Quadrature (DE)
MASSES
Motors **a**nd **S**tones **S**earching for **E**quilibrium **S**tate

Two stones lie on top of a balanced steel plate.
The aim of the machine is to create a perfect
equilibrium state by moving the stones to the
appropriate positions. The concept was
developed during a residency at ESO—the
European Southern Observatory in Chile.
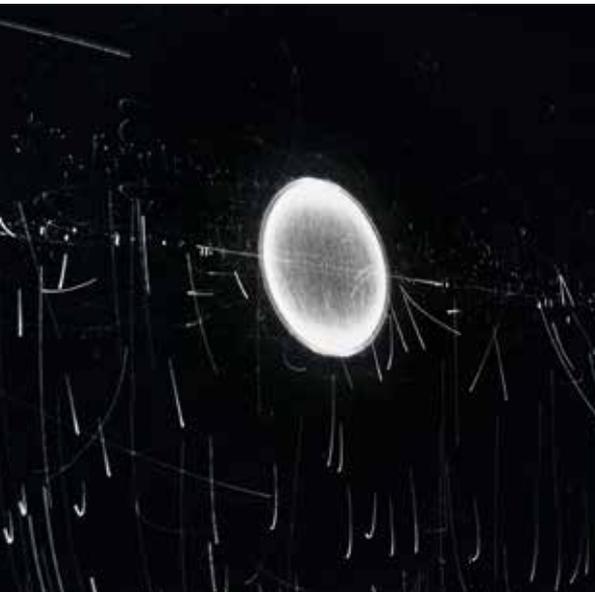
Ivan Zupanc / CPN

Quadrature (DE)
Orbits

Merging the two sources, balancing between
artistic autonomy and the necessary scientific
rigorousness, the performance is an aesthetic
and intuitive live experiment, revealing this
new layer of human infrastructure.

Quadrature (DE)
Unclassified Objects

One database gathers only classified data, based on observations of (amateur) astronomers. It contains identified secret satellites, but also the ugly by-products of satellite technology: related space debris and even some completely unknown objects.

Ivan Zupanc / CPN

Quadrature (DE) is an artists' collective by Jan Bernstein, Juliane Götz, and Sebastian Neitsch, based in Berlin. Their artistic exploration gravitates towards scientific interests and physical experiments, using new technologies or academic research as sources and inspiration. They all share a love for machines and outer space. *quadrature*.co

Ivan Zupanc / CPN

Marija and Milan Ličina (RS)
To the Distant Ones...

To the Distant Ones... represents a generative interactive audio-visual experience with narrative properties indicating issues of potential methods of communication with other intelligent beings. Exploring language, forms of non-verbal communication, and stylization, the work examines the constant drive for the harmonization of human relations. The installation does not present a utopic view of humanity, instead posing questions of whether we can become like this and present ourselves in the best possible light to all those that (may) come.

Marija Ličina (RS) works as an independent designer and part of the Hostile Takeover Visual Lab team. Her fields of research are in traditional and computer animation, video production, illustration, and graphics design.
Milan Ličina (RS) is an assistant professor at the Faculty of Digital Arts of Metropolitan University in Belgrade. He is the founder of the Hostile Takeover Visual Lab, part of the design team at the creative collective Galerija 12+, participant in several group exhibits, and author of several independent performances.

Isidora Todorović (RS)
Horologium Nocturnum

Horologium Nocturnum is a spatial installation consisting of three hanging geometric elements with water dripping through them. It has been developed based on the water clock principle, where water is the unit of measure (factual and symbolic) of a given phenomenon that affects humans. Each object has been shaped as a generated fractal, showing the probability for the occurrence of three events, along with the three symbolic times they measure, through the amount of dripping water. In the context of this installation, water is seen twofold, as the symbolic flow of three times (human time, Earth time and solar time).

Ivan Zupanc / CPN

Isidora Todorović (RS). Her work explores the technological, culturological, and political context of art, in the context of biopolitical theory, post-feminism, and DIY culture. She often uses the format of political social games, interactive installations, and socially engaged projects as a means of expression. Isidora completed basic and master studies at the Department of New Media at the Academy of Arts in Novi Sad, where she is currently an assistant professor. *isidoratodorovic.com*

Quantum Music feat. LP Duo (live)
EU project

The project *Quantum Music* is a meeting point of quantum physics and music. The project was initiated with the aim to explore the relations between music and quantum physics, which would result in a creation of a completely new, scientifically founded musical genre—Quantum Music. Aside from constructing the new electronic music instrument which will be used exclusively for *Quantum Music* performances, the final stage of the project is a *Quantum Music Live* concert performed by LP Duo, who play on modified acoustic pianos directly connected to computer simulations of quantum systems and quantum experimental equipment. *quantummusic.org*

Quantum Music was presented twice in Art+Science 2016 / 2017

Ivan Zupanc / CPN

LP Duo (RS) was founded in 2004 by the pianists Sonja Loncar and Andrija Pavlovic. LP Duo has performed in Serbia, The Netherlands, Germany, Slovenia, Croatia, Denmark, Switzerland, Finland, Macedonia, San Marino, Poland, Italy, Hungary, Bosnia and Herzegovina, US (Carnegie Hall), and Singapore.

Saša Spačal, Mirjan Švagelj, Anil Podgornik (SI)
Myconnect

"For to connect is to affirm, and to affirm, to connect". (John Rajchman)
Myconnect is a symbiotic interspecies connector that questions the anthropocentric nature-human division. With its circuit of signals and impulses, generated and translated by biological and technological organisms, *Myconnect* performs an immersive experience of symbiotic interdependence. Through this experience the technological nature-human distinction can be seen as an arbitrary definition that serves particular biopolitical interests in human society, which can then be shamelessly wrapped in an ideology of utilitarianism and may conceal excessive exploitation.

Saša Spačal (SI) is a post-media artist with a background in the humanities. She currently works at the intersection of living systems research, contemporary and sound art. Her work focuses on a post-human environment, in which humans exist and function as one of the elements in an ecosystem, and not as its sovereign. *agapea.si*
Mirjan Švagelj (SI) is a doctor of biomedicine currently residing in Ljubljana and working for a biotech research and development laboratory. He finished his doctoral studies in Biomedicine at the University of Ljubljana in the field of medicinal mushrooms. **Anil Podgornik** (SI) is a DIY enthusiast with a big talent for electronics, mechanics, and physics. Since 2012 he has been a part of the *Mycophone_genus* and *Myconnect* project.

raum.null (RS, AT)
Dark Wind Trilogy
feat. Mussurunga (live)

Ivan Zupanc / CPN

Quadrature (2014), with White Sample
The Sixth Wave of Mass Extinction (2015), with Didi Bruckmayr
Chant of The Proto-Alchemists (2016), with Mussurunga
Radical art as something that expresses important topics in a very basic and understandable way, maybe also in a loud and expressive way, is an important strategy to make the audience aware of a pressing socio-political topic. So if you want to use this as a strategy, it is important to act and think strategically, choose the right situation, and work it out thoroughly.

raum.null are sound artists **Dobrivoje Milijanovic** (RS) and **Chris Bruckmayr** (AT). **Mussurunga** is **Siegmar Aigner** (AT) – performer, opera singer, and Kyma scientist. The name raum.null (space zero) refers to the potential existence of an existential Nil, a hidden force field inside the hole of a three-dimensional torus, a scientific model describing the shape of the universe. The members of raum.null are sonic archeologists, isolating drones, and their hidden pulses (the basic grooves) out of this primal soup of noise. *raumnull.tumblr.com*

Shinseungback Kimyonghun (KR)
Flower

Flower presents a series of distorted flower images that have still been recognized as "flowers" by a computer. The project attempts to examine computer vision and human vision by showing a distorted subject. The technology used for the project is the Google object recognition system, which is regarded as one of the best computer vision technologies in the world.

Ivan Zupanc / CPN

Ivan Zupanc / CPN

Shinseungback Kimyonghun (KR)
Cat or Human

Human faces recognized as cat faces by a cat face detection algorithm. Cat faces recognized as human faces by a human face detection algorithm.

Shinseungback Kimyonghun (KR) is a Seoul-based artistic duo consisting of computer engineer Shin Seung Back and artist Kim Yong Hun. Their collaborative practice explores the impact of technology on humanity.

Alex Guevara (PE)
ÑOQAYKU

ÑOQAYKU is an ongoing research project by Alex Guevara resulting in a series of animated pictures about the armed conflict that took place in Peru during the years 1980–2000. *ÑOQAYKU,* through images and sounds, seeks to facilitate identification with the victims of the conflict, implying that they were not the others, that they were us.

Ivan Zupanc / CPN

Alex Guevara (PE)
UNIT Live

UNIT is an audiovisual live performance. It's a compilation of previous audiovisual pieces by Alex Guevara.

Ivan Zupanc / CPN

Alex Guevara (PE) is a digital artist born in Lima and currently based in Berlin. He works in a wide range of fields including digital art, interaction design, data and real time music visualization, generative design, interactive installations, combining art and technology to create immersive experiences and landscapes. *alex-guevara.com*

Ivan Zupanc / CPN

Azucena Giganto, Guillermo Casado (ES)
Deep Life

Deep Life is an interactive installation that explores and reflects on the life and structure of the processes and relationships between living things that allow life to happen. The network of relationships can be observed at different scales—micro and macroscopic—and it is also something alive in itself, sensitive to the presence of visitors, it mutates and reacts unpredictably as an analogy to the interventions and actions of human beings in Nature.

Azucena Giganto (ES), graduate in Fine Arts of Universidad Complutense, Madrid. Her main tool for investigation and expression is image in movement, especially in digital media and new technologies. *azuzen.com*
Guillermo Casado (ES) is a multimedia designer, engineer, and digital artist specialized in interactive media, and is currently based in Madrid. His work is located in an area where several disciplines and philosophies converge: art, science, technology, sociology, play, experiment, learning... *peripecio.com*

Ivan Zupanc / CPN

Paolo Cirio, Alessandro Ludovico (IT)
Face to Facebook

The project addressed surveillance, privacy and the economy of social media monopolies as well as art interventions within global media. During the performance the artwork received over a thousand mentions in the international press, eleven legal threats, five death threats, and several letters from the lawyers of Facebook.

Paolo Cirio (IT) uses popular language, irony, interventions, and seductive visuals to engage a wide public in critical issues and sophisticated works of art. Cirio's artworks have been presented and exhibited in major art institutions. He has won a number of awards, among others Golden Nica first prize at Ars Electronica and Transmediale second prize. *paolocirio.net*
Alessandro Ludovico (IT) is a researcher and an artist and has been chief editor of *Neural* magazine since 1993. He is an associate professor at the Winchester School of Art, University of Southampton, and lecturer at Parsons Paris – The New School. He has published and edited several books, and has lectured worldwide. *neural.it*

Bojan Zivojinovic / CPN

Dragan Ilić
Cluster Z-III / RoboAction live

Inspired by investigations in contemporary physics into the multiverse, the artist drew on paper with amplified sound, simultaneously projecting images onto moving balloons. The artist performed in a specially constructed simulated "Virtual Reality" suit with attached TV helmet.

"Physics and mathematics inform my work. I explore in visual and aural terms the power of technology—manual and robotic—in collaboration with human volition and intuition. My work considers the threshold between our quasi-android relationship with tools today and the robotics of tomorrow."

Dragan Ilić (RS, AU, US) is an artist who lives and works in New York and Belgrade. He has participated in many group exhibitions and festivals and has had numerous international solo appearances and exhibitions. Dragan initiated and constructed the ITS-Z1 (International Test Site-Z1) in Ritopek as an independent art space/laboratory where artists and scientists of all levels from around the world can meet, brainstorm, experiment, create, and ultimately promote new ideas in a vast array of fields. The goal of the art space/lab is to address the advancement of global cultural interaction. *draganilic.org*

Dušan Rodić (RS), Mi-Ah Rödiger (DE), Timo Preece (US)
Tuning In

"My brain is only a receiver, in the Universe there is a core from which we obtain knowledge, strength, and inspiration. I have not penetrated into the secrets of this core, but I know that it exists."
(Nikola Tesla)

Step into the process of light becoming energy, transforming into sound. Look into your shadow, find the frequency, remember it. Tune in every day.

Dušan Rodić (RS) is a visual artist from Belgrade who currently lives and works in Berlin. Rodić creates sculptures and art installations by remaking everyday functional objects. *dusanrodic.com*
Mi-Ah Rödiger (DE) is a German visual artist. Mi-Ah's body-related sculptures and jewelry are metamorphoses of natural organic forms into surreal, expressive art objects through which she examines human emotions, dreams, and desires. *mi-ah.com*
Timo Preece (US) is a sound designer, musician, audio technologist, and multi-media consultant, and is one-half of the audio/visual unit Planetary Cymatic Resonance (PCR). *gravityterminal.com*

Ivan Zupanc / CPN

Karkatag (RS)
From Safety to Where?

The interactive installation *From Safety to Where?* is an invitation to an un-safe game, where you as an individual will probably suffer no consequences but will take part in physical destruction and the creation of un-safe conditions and the illusion of risk. In this sense, the work is evocative of a specific childhood experience—taking part in forbidden games and irresponsible activities, not thinking of the consequences.

Karkatag (RS) is a Belgrade based art collective, created in 2009, which focuses on theoretical and practical work in the field of interactive art and new media, intersecting with performative. The group constructs specially designed machines, interactive and autonomous installations and objects that trigger audience participation. Karkatag has participated in numerous events, exhibitions, festivals, and performances all over Europe, and has run Praksa makerspace Belgrade at Magacin cultural center since 2015. *karkatag.org*

Nick Sousanis (US)
Unflattening

Unflattening, the doctoral dissertation defended in 2014 at the University of Columbia, is written and drawn entirely as comics. Through this amazing work of graphical art, the author Nick Sousanis defies conventional forms of scholarly discourse with a serious inquiry into the ways humans construct knowledge.
Unflattening is an insurrection against the fixed viewpoint. Weaving together diverse ways of seeing drawn from science, philosophy, art, literature, and mythology, Sousanis uses the collage-like capacity of comics to show that perception is always an active process of incorporating and reevaluating different vantage points. His vibrant, constantly morphing images connect in nonlinear fashion to other visual references, becoming allusions, allegories, and motifs, pitting realism against abstraction.

Ivan Zupanc / CPN

Nick Sousanis (US) is a comics' artist and educator, and a professor of Humanities and Liberal Studies at San Francisco State University. *spinweaveandcut.com*

CREATIONS
feat. primary schoolchildren from Belgrade and Ruki Krstur (live)
EU project

Bojan Zivojinovic / CPN

Among the current CPN projects, a special place is held by those dedicated to improving teaching at schools and supporting interdisciplinary cooperation among teachers. If we were to go a step further, we could ask the following: Can math and music teachers hold classes together? Do drama skills have any value in the chemistry classroom? Is a scientific opera at all possible?

The answers to these and many other dilemmas in connecting and intertwining arts and science in the educational process are offered by the large scale European project *CREATIONS*. Financed through the EU program Horizon 2020, it gathers various institutions, universities, associations, and institutes engaged in creativity and science education in eleven European countries—Germany, Switzerland, Spain, Great Britain, Greece, Norway, Finland, Malta, France, Sweden, and Serbia. *creations-project.eu*

Tanja Vujinović (RS/SI)
Universal Objects
Exhibition

At the Gallery of Science and Technology of the Serbian Academy of Sciences and Arts, Tanja Vujinović exhibited five works from the *Universal Objects* cycle: *Park 1, Park 2, Garden, Observers*, and *Levitations*. These are works created in real-time computer game environments. The digital world is taken over by mutated objects, creating a space for contemplation and relaxation. Visitors can enjoy chance walks or embark on an unlimited exploration of space; through the use of a keyboard, anyone's avatar may systematically discover the author's virtual world. Through her work, Tanja is analyzing the relationship between awareness and technology, through digital animism and contemplative play.

Ivan Zupanc / CPN

Tatjana Tanja Vujinović Kušelj (RS/SI) graduated from the Faculty of Fine Arts in Belgrade in 1999, has been a guest student at the Kunstakademie in Düsseldorf, and holds a PhD in Philosophy and Theory of Visual Culture from the Faculty of Humanities Koper. Since 1997 she has participated in 140 collective and 29 individual international exhibitions including galleries and museums. She lives and works in Ljubljana. *ultramono.org*

DIG gallery
Košice, Slovakia

DIG
NEW MEDIA GALLERY

DIGGALLERY.SK

"We are into progressive and innovative, we are interested in what is contemporary or strategic—from the local culture through the horizon of creative industrialization to the globalized artistic context New Media Folklore."

DIG gallery was founded by DIG group in 2012 and was settled within the brownfield of the former tobacco factory in Košice. As a nonprofit project that is aimed at the presentation, education, and promotion of interdisciplinarity and contemporary media art, DIG gallery is one of the first of its kind in Slovakia. A parallel activity—Digital Intervention Group (DIG)—was founded by a group of enthusiastic artists in 2009 as a platform for author's research and application of the new forms of media art.
A crucial part of the DIG gallery dramaturgy includes, in addition to local and international exhibitions, workshops and specific co-editing formats. In the archive of exhibitions devoted to various fields of media arts, we need to highlight in particular the 2013 flagship exhibition: *Media arts / Made in Japan,* which was also the first live contact between the DIG gallery and the unique Ars Electronica Festival. One of the main DIG gallery missions is networking on a local and international level that promotes communication between partners not only within the art and science area. In the preparatory phase of the unique European Digital Art & Science Network, a successful exhibition called *No Pain No Game* was held in DIG gallery in 2015, and there was significant media coverage of this topic in our geographical area.

„Sledujeme progresívne a inovatívne, zaujíma nás aktuálne a strategické – od lokálnej kultúry cez horizont kreatívnej industrializácie, až po globalizovaný umelecký kontext. New Media Folklore."

DIG gallery bola založená zoskupením DIG v roku 2012 a osadená v rámci brownfieldu bývalej tabakovej továrne v Košiciach. Ako neziskový projekt zameraný na prezentáciu, edukáciu a propagáciu interdisciplinarity a súčasného mediálneho umenia patrí DIG gallery k prvým galériám svojho druhu na Slovensku. Paralelné artistické zoskupenie DIG (Digital Intervention Group) bolo založené skupinou entuziastických umelcov v roku 2009 ako platforma pre autorský výskum a aplikáciu nových foriem mediálneho umenia.
Podstatnú časť dramaturgie DIG gallery tvoria okrem domácich a zahraničných exhibícií workshopy a špecifické koedukačné formáty. V archíve výstav, ktoré sú venované rôznym oblastiam media artu, musíme upozorniť najmä na emblematickú exhibíciu z roku 2013: Media arts / Made in Japan, ktorá bola zároveň prvým živým kontaktom medzi DIG gallery a unikátnym festivalom Ars Electronica.
Jedným z hlavných poslaní DIG gallery je networking na lokálnej a medzinárodnej úrovni podporujúci komunikáciu medzi partnermi a to nielen v zóne umenia a vedy. V prípravnej fáze jedinečného projektu European Digital Art & Science Network bola v roku 2015 v DIG gallery realizovaná úspešná výstava s názvom No Pain No Game, ktorá v našej geografickej zóne prispela k výraznej medializácii danej témy.

A wider concept of the exhibitions called *Art & Science / vol. 1 – 3* (Oct 2016 – Jan 2017) had a similar initiation character and presented spectacular but also miniature works by eight foreign and five Slovak media artists.

The *Creative Playgrounds* exhibition (Jul – Sept 2017) consisted of modular compatible units, including presentations of foreign media art platforms as well as the network partner activities. The concept of the exhibition could be characterized by such terms as variable, processual, but also some very specific topics for which the multidisciplinary "thinking" and "action" are significant.

Since 2013, DIG gallery has been collaborating with Dive Buki publishers on the production of the *ENTER+ |Creative Manual* that focuses on promoting contemporary media art. Since 2016, DIG gallery has been collaborating with the K.A.I.R. (Košice Artist in Residence) and Technical University of Košice (TUKE) for the residencies of scientists and artists, in various combinations. Regarding the impact on the local environment, there is equally important contact with the academic field (Faculty of Arts TUKE, CIT FEI TUKE), with CIKE (Creative Industry Košice), and other partners such as K13, Tabačka Kulturfabrik, and White Night Košice. The results of these activities were evaluated in 2017 to support the bid to designate Košice as a UNESCO Creative City of Media Arts.

Finally, we believe that the long-term interest of DIG gallery in the development of innovative cultural strategies will result in the production of original outputs not only in the artistic field, but also within other disciplines, and the distance between local and global will become even more irrelevant. *diggallery.sk*

Text: Richard Kitta, Michal Murin

Širšie koncipovaná séria výstav pod názvom Art & Science / vol. 1 – 3 (október 2016 – január 2017) mala obdobný iniciačný charakter a predstavila spektakulárne, ale aj miniatúrne diela 8 zahraničných a 5 domácich mediálnych umelcov.

Pripravovaná výstava Creative Playgrounds (júl – september 2017) pozostáva z modulárnych kompatibilných celkov, vrátane prezentácií zahraničných media art platforiem a aktivít partnerov networku. Koncept výstavy charakterizujú pojmy ako variabilita, procesuálnosť, ako aj značne konkrétne témy, pre ktoré sú signifikantné práve multidisciplinárne „myslenie" a „akcia".

Od roku 2013 kooperuje DIG gallery s vydavateľstvom Dive Buki v rámci produkcie „kreatívnych manuálov – ENTER", ktoré sú zamerané na propagáciu súčasnej media artovej tvorby. Od roku 2016 ponúka DIG gallery spolu s organizáciou K.A.I.R. a Technickou univerzitou v Košiciach (TUKE) rezidencie pre vedcov a umelcov, a to v rôznych kombináciách. Z pohľadu impaktu pre lokálne prostredie je nemenej dôležitý kontakt s akademickým prostredím (Fakulta umení TUKE, CIT FEI TUKE), s organizáciou CIKE (Creative Industry Košice) a ďalšími partnermi ako K13, Tabačka Kulturfabrik alebo Biela noc Košice. Výsledky týchto aktivít boli zhodnotené v roku 2017, keď mesto Košice vyhlásilo svoju kandidatúru v rámci prestížneho titulu UNESCO Creative City of Media arts.

Napokon veríme, že dlhodobý záujem DIG gallery o rozvoj inovatívnych kultúrnych stratégií bude mať za následok generovanie originálnych výstupov nielen na poli umenia, ale aj v rámci jednotlivých vedeckých disciplín a vzdialenosť medzi lokálnym a globálnym bude ešte zanedbateľnejšia. *diggallery.sk*

Nikolas Bernáth

DIG gallery, Media Art, CZ, 2016

Dávid Hanko

No Pain No Game, DIG gallery, 2015

Art & Science / vol. 1 – 3
Exhibition series
Vol. 1: 01.10. – 31.10.2016
Vol. 2: 01.11. – 30.11.2016
Vol. 3: 01.12. – 31.12.2016 (prolonged till 31.01.2017)

This *Art & Science* exhibition series was a kind of a challenge for the Slovak audience, because there are still not so many existing parallels within the domestic culture context.

A series of three specific international exhibitions at DIG gallery exposed the art works by eight foreign artists and five Slovak artists who oscillate between the contemporary art zone and areas of scientific research. An Art & Science topic is quite an intuitive area, even for the local artists and scientists, so we chose a co-education-like format and the exhibition also presented the goals of the the European Digital Art & Science Network.

Art & Science / vol. 1
01.10. – 31.10.2016
Vol. 1 curated by:
Richard Kitta, Michal Murin

Projects by:

Cédric Brandilly (FR)

**Ursula Damm,
Klaus Fritze (DE)**

Soichiro Mihara (JP)

Daniel Mikolajčák (SK/AT)

Art & Science / vol. 2
01.11. – 30.11.2016
Vol. 2 curated by: Michal Murin,
Richard Kitta

Projects by:

Universal Everything (UK)

Dana Zelig (IL)

Ján Gašparovič (SK)

Matej Vakula (SK/US)

Art & Science / vol. 3
01.12. – 31.12.2016
(prolonged till 31.01.2017)
Vol. 3 curated by: Richard Kitta,
Matej Ivan

Projects by:

Jonathan Keep (UK)

Universal Everything (UK)

**Michael Burk,
Ann Katrin Krenz (DE)**

Michal Murin (SK)

**Digital Intervention
Group (SK**)

Matej Vakula (US/SK)
Well Plate Utopias

Well Plate Utopias (2016) uses nanoparticle-based experimental cancer drugs to project images of Thomas More's Utopian Alphabet, on cancer tissues grown in Petri dishes. The Alphabet was part of More's masterpiece, *Utopia* (1516), which is one of the most influential books in the Western philosophical and literary tradition. Let's think about the concept of *Utopia* as a fruitful path, rather than a destination. Let's draw a compelling parallel between nanotechnologies, scientific gaze, and the laboratory as a place where the future and its relationship to contemporary society, culture, humanity's hope for disease treatment, and continuity of life is created.

Veronika Žídová

Matej Vakula (US/SK) is an artist, educator, curator, theorist, programmer, & DIY enthusiast who specializes in data visualization, bio and urban issues and is based at Open Source Space Administration Institute, Public Laboratory for Open Technology & Science, CLAKULA Art Productions.

Nikolas Bernáth

Ján Gašparovič (SK)
Ungraspable

Ungraspable consists of a few boxes that create electro-shelters from our modern paranoia of an electro-smog that is constantly being recalled by a special measuring device.

Ján Gašparovič (SK) is a multimedia artist based in Žilina, Slovakia. He is interested in the creation of objects, environments, and performing arts, crossing the boundaries between the fields of art and science, and reflecting various social and cultural aspects. He is also a director and curator of Plusmínusnula Gallery, Žilina, Slovakia.

Art & Science / vol 3
Digital Intervention Group (SK)
CORE LABs

CORE LABs platform, initiated in 2014, is an open source laboratory environment with functional architecture, autonomous sub-environments, and individual real-time systems for generating the multiple unexpected interactions. It provides tools for individual interdisciplinary research and the creation of artistic and/or scientific outputs.
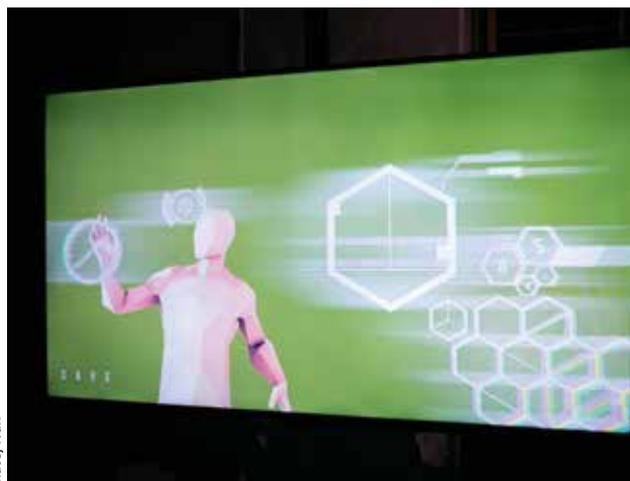
Matej Ivan

DIG -Digital Intervention Group (SK) was established in 2009 in Košice, Slovakia, by artists and associated members as an open artistic platform and an interactive platform between contemporary arts and science. It focuses on building and developing specific media art projects. The CORE LABs concept was developed by DIG core members Richard Kitta, Matej Ivan, and Martin Kolčak.

Lukáš Matejka (TRAKT)

Art & Science / vol 3
Dark Matter Spray
Michal Murin (SK)

Dark Matter Spray (2016) is an interactive performance project which uses the hybrid VVVV programming software and infrared sensor interface in the shape of the spray can. Users can create a digital black matter that interferes with selected images from the ESA photo archive. The concept is based on the illusion of the correction of the light level (the absence of the light particles) while implanting the black digital matter in the 2D image area. Technical support: Lukáš Matejka, Pavol Soukal.

Michal Murin (SK) works in the field of conceptual and sound art, installation and action art. He is a curator at DIG gallery in Košice (since 2012) and head of Digital Media Studio at FVU in Banská Bystrica (since 2005) and of New Media Studio at FU TU Košice (since 2011), focusing on interactive art, sound art, video art, game art, and art & science. He is editor of *Profile – Contemporary Art* and the interdisciplinary magazine *ENTER* on new technologies in art, computer and digital art.

From Art – Through Science – To Creative Industry (and back)

Art & Science Conference
24.11.2016
University Library, Technical University of Košice, Slovakia

Nikolas Bernáth

Michal Vasiľ

The international Art & Science Conference presented the various examples of interdisciplinary thinking of today, as well as the possibility of linking the areas that may seem incompatible at first sight. The event showed the non-traditional approaches of scientists, artists, and creative teams that are—in addition to innovative concepts or strategies—able to generate also the products of global importance. The main goal of cooperation among DIG (within the European Digital Art & Science Network project), CIKE – Creative Industry Košice, and Faculty of Arts TUKE was to create an open discussion platform focusing on contemporary issues of the Creative Industries.

Speakers

Martin Honzik (AT), Ars Electronica, Linz
Mairéad Hurley (IE), Science Gallery, Dublin
Erik Lale Dobrivoje (RS), Center for the Promotion of Science, Belgrade
Ljiljana Ilić (RS), Center for the Promotion of Science, Belgrade
Ján Michlík (SK) / Slovanet, Creanet
František Babič (SK), Department of Cybernetics and Artificial Intelligence, TUKE
Tomáš Boroš (SK), Department Of Architecture, Faculty of Arts, TUKE
Michal Murin (SK), New Media Studio, Faculty of Arts, TUKE
Boris Vaitovič (SK), New Media Studio, Faculty of Arts, TUKE
Richard Kitta (SK), DIG gallery, Košice

Zaragoza City of Knowledge Foundation

Fundación Zaragoza Ciudad del Conocimiento

Zaragoza, Spain

Zaragoza City of Knowledge Foundation is a private non-profit foundation founded in 2004. Its founding objectives include the dissemination, at all levels in the city of Zaragoza, of the progress made by the knowledge society to construct a more participative, equalitarian, inclusive, and innovative society, open to the new development expectations offered by the intersection of art, science and technology. We thus place special emphasis on scientific dissemination among younger people, on the fight to overcome the digital gaps for citizens with a greater risk of social exclusion, and on promoting the inclusion of women into the scientific-technological field.

The Foundation headquarters has been located, since 2013, in Etopia Centre for Art and Technology, a municipal space of the city of Zaragoza intended for learning, sharing, and enjoying the capacities of creative technology, citizen science, the possibilities offered by digital culture, and as a center for multi-disciplinary production.

La Fundación Zaragoza Ciudad del Conocimiento es una fundación privada sin ánimo de lucro fundada en 2004. Entre sus objetivos fundacionales se encuentran difundir en todos los ámbitos de la ciudad de Zaragoza los avances de la sociedad del conocimiento para construir una sociedad más abierta, participativa, igualitaria, inclusiva, innovadora y abierta a las nuevas expectativas de desarrollo que ofrece la intersección del arte, la ciencia y la tecnología. Para ello ponemos especial énfasis en la divulgación científica entre lo más jóvenes, en luchar por la superación de las brechas digitales a aquellos ciudadanos con mayor riesgo de exclusión social y favorecer la incorporación de la mujer en el ámbito científico-tecnológico.

Desde 2013, la Fundación tiene su sede en Etopia Centro de Arte y Tecnología, un espacio municipal de la ciudad de Zaragoza destinado a aprender, compartir y disfrutar las capacidades de la tecnologías creativas, la ciencia ciudadana, las posibilidades que ofrece la cultura digital, y como centro de producción multidisciplinar.

As a content agent for Etopia, the educational programs of the Foundation with creative technologies currently enjoy great prestige, particularly in the field of child-youth education, with our Etopia Kids program. At another level, the Foundation develops projects that address artistic and digital creation in the public space or new forms of cognition and perception with technological, interfaces. Furthermore, in 2017, the Foundation was ready to set up permanent working groups that will address areas such as educational innovation, technology and women, as well as an audiovisual experimentation group. All of this is carried out with a cross-cutting approach, in an attempt to involve citizens with different professional and academic profiles in a common project and to share know-how.

The Foundation also made a qualitative leap in 2015 when it joined the European Digital Art and Science Network (EDASN). Participating in this network is a real challenge for the Foundation. In 2016, it produced the *Reverberadas – Reverberations: Exploration about Science and Art* exhibition, which studied how science can be a source of inspiration for art, and how art can explore the new frontiers of science. In 2017 the *BIOESTETICA* project was developed. The aim is to show the public at large how the impact of the biotechnological revolution is going to change and alter classical notions of what we know as human and nature—through artistic residencies, workshops, lectures, a film cycle, and a bioart exhibition, entitled *Postnatures*. In short, the European network has enabled us to expand our programs from a local to an international sphere, exchanging experiences with other centers and spaces of prestige that address the connection between science and art, and to consolidate our position as a content production agent for Etopia—a line of work that the Foundation will continue to develop and foster over the coming years. *www.fundacionzcc.org; www.etopiakids*

Como agente de contenidos para Etopia, actualmente, los programas educativos de la Fundación con tecnologías creativas gozan de gran prestigio, pero especialmente en el campo de la educación infanto-juvenil, con nuestro programa Etopia Kids. A otro nivel, desarrolla proyectos que abordan la creación artística y digital en el espacio o nuevas formas de cognición y percepción con interfaces tecnológicos. Además, en 2017 lanzará grupos de trabajo permanentes que aborden áreas como la innovación educativa, tecnología y mujer, y un grupo de experimentación audiovisual. Todo ello desde un enfoque transversal, procurando que ciudadanos de diferentes perfiles académicos y profesionales colaboren en un proyecto común y compartan saberes.

Pero un salto cualitativo de la Fundación ha sido formar parte desde 2015 de la Red Europea de Arte Digital y Ciencia (EDASN). Para la Fundación participar en esta red es todo un desafío. En 2016 produjo la exposición *Reverberadas – Reverberations: Explorations about Science and Art,* que indagaba cómo la ciencia puede ser una fuente de inspiración para el arte y cómo el arte puede apelar a la exploración de las nuevas fronteras de la ciencia. Ahora en 2017 está desarrollando el proyecto BIOESTETICA, con el que a través de residencias artísticas, talleres, conferencias, un ciclo de cine y una exposición de bioarte titulada *Posnaturaleza;* se buscará acercar al gran público cómo el impacto de la revolución biotecnológica va a cambiar y alterar nociones clásicas de lo que conocemos como lo humano y la naturaleza.

En definitiva, la Red europea, ha permitido a la Fundación ensanchar sus programas desde local a la esfera internacional, intercambiar experiencias con otros centros y espacios de prestigio que abordan la conexión entre ciencia y arte, y afianzar su posición como agente de producción de contenidos para Etopia. Una línea de trabajo que la Fundación seguirá desarrollando y potenciando en los próximos años. *www.fundacionzcc.org; www.etopiakids*

Zaragoza City of Knowledge Foundation
Activities

Exhibitions

Reverberadas / Reverberations
Exhibition
Etopia Center of Art and Technology
20.05. – 18.09.2016
see Page193

BIOESTETICA
Exhibition: Postnature
Etopia Center of Art and Technology
21.09.2017 – 13.01.2018
see Page 199

Conferences

Reverberadas / Reverberations
Symposium
Etopia Center of Art and Technology
20.05.2016
Panel 1: The role of cultural institutions
in art-science converge.
Martin Honzik (Ars Electronica), Karin
Ohlenschläger (LABoral), Jurij Krpan (Kapelica
Gallery), Aisling Murray (Science Gallery Dublin),
Robert Devčić (GV Art London) and Eric
Dobrivoje Lale (Center for the Promotion
of Science)

Reverberadas / Reverberations
Symposium
Etopia Center of Art and Technology
20.05.2016
Talk
Art and Technology from Engineering
José Ramón Beltrán (University of Zaragoza)

Reverberadas / Reverberations
Symposium
Etopia Center of Art and Technology
20.05.2016
Performance: *Data Drops*
Mar Canet & Varvara Guljajeva

Reverberadas / Reverberations
Symposium
Etopia Center of Art and Technology
20.05.2016
Panel 2: Symbiotic Practices or
Inspiring Mirrors?
Erich Prem (FEAT), Francisco Castejón (CIEMAT),
Diego Guitérrez (University of Zaragoza) and
Javier Cenarro (CEFCA)

Reverberadas / Reverberations
Symposium
Etopia Center of Art and Technology
20.05.2016
Talk
Art and Science: connections
and interferences
Karin Ohlenschläger (LABoral)

Reverberadas / Reverberations
Symposium
Etopia Center of Art and Technology
20.05.2016
Talk
The Art and Science of Falling
Michael Doser (CERN)

Reverberadas / Reverberations
Symposium
Etopia Center of Art and Technology
20.05.2016
Performance: Live Set
Santiago Latorre

Reverberadas / Reverberations
Symposium
Etopia Center of Art and Technology
20.05.2016
Performance
Tryptic in Time
Jaime de los Ríos and Ibon Gurrutxaga

BIOESTETICA
Etopia Center of Art and Technology
21.09.2017
Panel: exhibition introduction
Daniel López del Rincón (curator), Brandon
Ballengée (artist), Laurent Mignonneau (artist),
and Marina Nuñez (artist)

BIOESTETICA
Conference
Natural Science Museum of Zaragoza University
18.10.2017
CRISPR, the future of genomic writing
Lluis Montoliu (CSIC)

BIOESTETICA
Conference
25.10.2017
Natural Science Museum of Zaragoza University
Anthropocene: Human Impact in Today
Ecosystems
Fernando Valladares (CSIC) and Blas Valero
(CSIC)

BIOESTETICA
Conference
Natural Science Museum of Zaragoza University
09.11.2017
Metallic Organ compounds
Concepción Gimeno (UZ-CSIC)

BIOESTETICA
Conference
Natural Science Museum of Zaragoza University
15.11.2017
An Aesthetic of Concentration
Laura Benitez (Curator and researcher)

BIOESTETICA
Conference
Natural Science Museum of Zaragoza University
22.11.2017
It's Time for Chthulu
Helena Torres (Artist)

Workshops

BIOESTETICA
Workshop
Etopia Center of Art and Technology
05.05.2017, 06.05.2017
Algorithm Nature
Jaime de los Ríos

BIOESTETICA
Workshop
Etopia Center of Art and Technology
02.06.2017, 03.06.2017
Bioknowledge
Paula Pin and Laura Benitez

BIOESTETICA
Workshop
Etopia Center of Art and Technology
26.06 – 28.07.2017
Robotic Garden
Pablo Aliaga, Francisco Doroste y Fátima
Akrache

BIOESTETICA
Workshop
Etopia Center of Art and Technology
26.06 – 28.07.2017
Microlab
Cristina Hernández y Miriam Escos

BIOESTETICA
Workshop
Etopia Center of Art and Technology
October – November 2017
Biocopists
Cristina Hernández

Film Screening

BIOESTETICA
Film Screening and debate.
Etopia Center of Art and Technology
19.10.2017
Splice (Vincenzo Natali, 2009)

BIOESTETICA
Film Screening.
Zaragoza Filmothek
20.10.2017
Island of Lost Souls (Erle C. Kenton, 1932)

BIOESTETICA
Film Screening and debate.
Etopia Center of Art and Technology
26.10.2017
Gattaca (Andrew Niccol, 1997)

BIOESTETICA
Film Screening.
Zaragoza Filmothek
27.10.2017 (+debate), 09.11.2017
Frankenstein (James Whale, 1931)

BIOESTETICA
Film Screening.
Zaragoza Filmothek
10.11.2017, 24.11.2017
The Fly (Kurt Newmann, 1958)

BIOESTETICA
Film Screening and debate.
Etopia Center of Art and Technology
16.11.2017
The Clone returns Home (Kanji Nakajima, 2008).

BIOESTETICA
Film Screening.
Zaragoza Filmothek
17.11.2017 (+ debate), 01.12.2017
The Fly (David Cronenberg, 1986)

BIOESTETICA
Film Screening and debate.
Etopia Center of Art and Technology
11.01.2018
Blade Runner (Ridley Scott, 1982)

Cycle I: Reverberadas
Exhibition
20.05.2016 – 18.09.2016

Reverberadas was the exhibition of the Zaragoza City of Knowledge Foundation for Etopia Center of Art and Technology as part of the European Digital Art and Science Network.

In *Reverberadas* (Reverberations), art and science go hand in hand in creative compositions, reverberating off each other. They are tools used by society to intervene in reality by making the inaccessible accessible—even if only partially, by capturing and revealing some properties. The reverberated works are like dots in a Join the Dots game, part of a vast picture and space for cooperations by different artistic disciplines and scientific branches.

Reverberdas curated by: Fermín Serrano

Iñaki Gil ©FZC

María Ignacia Edwards (CL)
Encounters, 2016

This artwork is the product of shared observation and experience, inspired by astronomy, music, and mathematics. The result of this gave rise to the works *Mobile Wind* and *String Instrument* comprising a piano as its resonance chamber and 11 swings as the extension and projection of its key. The project was realized during a EDASN residency project (ESO Observatory, Chile, and Ars Electronica Futurelab, Linz.)

María Ignacia Edwards (CL). The artist's work has its origin in her efforts to be an active observer of the world, investigating different phenomena and the relationship to human beings. Her work has been exhibited in Chile and internationally. She received the "Art for Science" award from the National Commission for Scientific and Techno-logical Research (CONICYT) in Santiago, Chile.

Óscar Sanmartín (ES)
Digital Composition 3, 2011

All works display features of the time they were created. Technology or ideas from a certain era are visible in their aesthetic or formal aspects. This work, which clearly reveals romantic aesthetics and appears to be a traditional pencil drawing, is recreated with digital tools and technology.
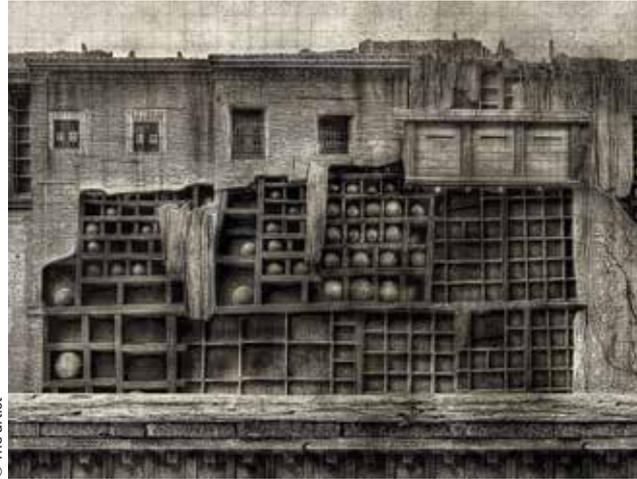
Óscar Sanmartín (ES) is an illustrator and designer. His works include fields such as magazine and record covers, theater set design, and films. He has participated in many exhibitions. *www.oscarsanmartin.com*
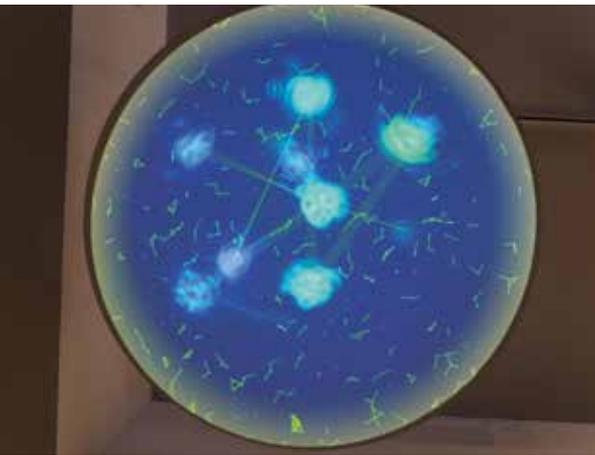
Edu Comelles (ES), Andrea Pazos (ES)
Constellation, 2016

Constellation is a generative audio-visual installation inspired by and created using countless sound files extracted from open databases from different spatial agencies and universities across the world, as well as unrecognizable fragments of soundtracks, effects, and iconic dialogues from cinematographic science fiction.

Edu Comelles (ES) is a sound designer, musician, and curator. He is currently involved in several individual and collective projects ranging from sound art, soundscapism, and experimental music. *www.educomelles.com*
Andrea Pazos (ES) studied Digital Art at Pompeu Fabra University. She is a creative artist currently working at the Media Lab of Manchester Metropolitan University, UK. *www.andreapazos.com*

Varvara Guljajeva (EE), Mar Canet (ES)
Data Drops, 2015

Data Drops is a data sculpture project, which addresses the issue of personal data collection and its usage through a metaphor. The data was obtained from a survey on how people felt about their personal data being used by third parties, designed by researcher Ramon Sangüesa *(www.thecityandyourdata.net).* The colors resulting from people´s emotional data, collected in a previous survey, are visualized as droplets on microscope slides. The droplets move freely on the slides, chasing, merging, and interacting with each other.

Photo by Iñaki Gil ©FZC

Mar Cannet (ES) and **Varvara Guljajeva** (EE) is an artist duo formed in 2009. Their work is often inspired by the digital age and addresses social changes and the impact of the technological era. Varvara & Mar are also fascinated by kinetics and participation, which are integral parts of their work. *www.varvarag.info*

Photo by Iñaki Gil ©FZC

Guillermo Casado (ES), Azucena Giganto (ES)
Deep Life, 2012

Life is a network of relationships of different self-organized ecosystems that relate to each other. We explore the similarities—at least on the aesthetic level—between structures on microscopic and macroscopic scales, and observe how the network itself is a living entity that mutates and reacts unpredictably.

Guillermo Casado (ES) is a physicist, coder, and digital artist. He specializes in interactive systems and new media and is interested in researching links between different knowledge fields, building connections through the alternate use of technology and how interactive technology can bring science closer to society in a creative way. *www.peripecio.com*
Azucena Giganto (ES) is a graduate in Fine Arts from Universidad Complutense in Madrid and a multimedia artist. Her main tool for investigation and expression is image in movement, particularly in digital media and new technologies. She has her own design company that specializes in motion graphics and FX. *www.azuzen.com*

Jaime de los Ríos (ES)
5th Column, 2016

When the machines begin to write and paint, contemporary art is facing an existential crisis. Digital reproducibility capacity is already unlimited, which brings many possibilities but also many potential problems. *5th Column* is a completely arbitrary installation that encourages reflection on the power of machines.

Photo by Iñaki Gil ©FZC
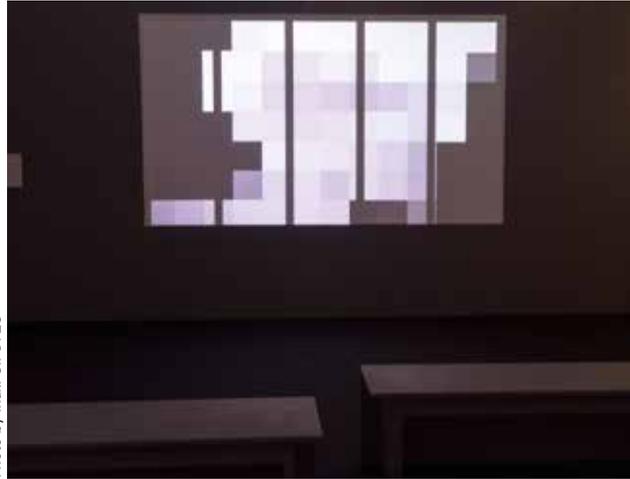
Jaime de los Ríos (ES) is founder of the open laboratory of Art and Science ARTEK [Lab]. His work focuses on the intersection of these disciplines and systemics science, especially regarding the mechanisms, rhythms and natural patterns, and collective intelligence. *arteklab.org*
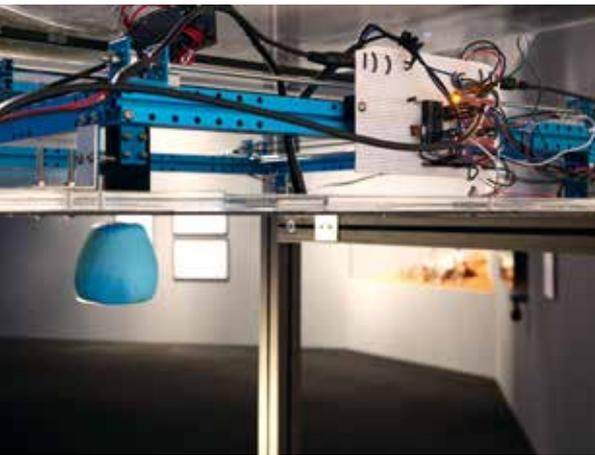
© Jürgen Ropp and Marta Pérez Campos

Metrysym, 2016
Jürgen Ropp (AT), Marta Pérez (ES)

Symmetry stands for balance, perfection and beauty. Symmetric shapes and objects attract each other, re-establishing the ideal equilibrium. The ideal of symmetry is consistently followed and investigated in physics, which led to the development of the antimatter concept. One of the main questions in this project is: How would gravity affect antimatter? *Metrysym* theorizes about the idea that antimatter and visible matter react differently to gravity.

Jürgen Ropp (AT) is currently in the Master´s program at the Interface Cultures department of the Art University Linz (AT) and has a background in media technology and design. His artistic work is based on the intersection between art and science with the purpose of communicating scientific research discoveries and the implied issues to a broader audience. *www.juergenropp.at*
Marta Pérez Campos (ES) is a masters candidate at Interface Cultures, Art University Linz (AT) and is currently carrying out research for her masters thesis at IAMAS: Institute of Advanced Media Arts and Sciences (JP). With a background in Fine Arts, her main interest is on human communication and the interference that occurs in our verbal exchanges. *www.martapcampos.com*

CEFCA—Centro de Estudios de Física del Cosmos de Aragón (ES)

Images from CEFCA

Teruel, a little-known province in Aragon, eastern Spain, is home to a center for research in Astrophysics and Cosmology (CEFCA). This young institution makes good use of the Javalambre Auxiliary Telescope and its unique features, which attracts scientists from all over the world to come and observe the night sky at the Observatory.

Photo by Iñaki Gil. ©FZC

CEFCA Foundation (ES) is an institution of the Government of Aragón, whose activities focus on the technological development and operation of the Astrophysics Observatory of Javalambre (OAJ) and on its scientific exploitation. The main research lines of CEFCA are Galaxy Evolution and Cosmology. *www.cefca.es*

Carlos Sicilia, Luis Martín, Alejandro Gállego, Luis Frisón (ES)

Open Curiosity, 2016

Photo by Iñaki Gil. ©FZC

Open Curiosity is an open source ExoMars rover (1:5 scale) that facilitates affordable space exploration for all. Based on the NASA Curiosity Rover, it uses Arduino. Data gathered (temperature, pressure, radiation, distance, wheel position, arm position) is available on the internet for educational, scientific, or other purposes. Sensors detect obstacles to avoid collisions and it has a HD video camera.

Carlos Sicilia (ES), **Luis Martín** (ES), **Alejandro Gállego** (ES), and **Luis Frisón** (ES), are four engineer friends who enjoy DIY technologies. *Open Curiosity* is their latest creation.

Afroditi Psarra (GR), Cécile Lapoire (FR)
Cosmic Bitcasting, 2016

Cosmic Bitcasting is an open-source, wearable detector of secondary muons generated by cosmic rays hitting the Earth's atmosphere that penetrate the human body by triggering a series of embedded actuators (light, sound and vibration). *Cosmic Bitcasting* emerges from the idea of connecting the human body with the universe by creating a wearable interface that can provide sensory feedback on the invisible cosmic radiation that passes through us.

Photo by Iñaki Gil. ©FZC

Afroditi Psarra (GR) is a multidisciplinary artist working with e-textiles, DIY electronics, and sound. Her artistic interest focuses on concepts such as the body as an interface, contemporary handicrafts and folk tradition, pop iconography, retrofuturistic aesthetics, and the role of women in contemporary culture. *www.afroditipsarra.com*
Cécile Lapoire (FR) is a data scientist and research scientist who has worked at CERN (The European Organization for Nuclear Research) in Geneva for 4 years. She holds a PhD in experimental particle physics from the University of Marseille and has worked on the ATLAS detector, a general-purpose detector at the Large Hadron Collider (LHC). She is currently working as a data scientist at Infinite Analytics, a startup based in Boston, US.

Photo by Iñaki Gil. ©FZC

Santiago Latorre (ES)
E6, 2011

E6 is a music piece based on four chords that are repeated for six minutes. In the first part, the chords are executed by synthetic sounds, generated from human DNA molecules thanks to the sound synthesizer developed by the artist. *E6* uses the infrared spectrum of the basic molecules that make up DNA as source of information. As the piece evolves, the synthetic sounds open and transform as they remain restricted to the same harmonic cycle. A big fake orchestra emerges.

Santiago Latorre (ES) uses his voice, saxophone, and electronics to break the gravity, make you float, and take you on a trip around the Cosmos. After a few years composing music for dance, theater, and videoart he released *Órbita*. This album took him on tour in the USA, Japan, and China, and to festivals like Sónar or LEM. *www.santiagolatorre.com*

Cycle II: BIOESTETICA
Exhibition Postnature
21.09.2017 – 13.01.2018

BIOESTETICA is the second project of Zaragoza City of Knowledge Foundation within the program of the European Digital Art and Science Network. It is an ambitious project that takes the form of an expanded exhibition, made up of artistic residencies, workshops, conferences, exhibitions, and films, on the impact of biotechnology on contemporary artistic imaginary.

The term "post-nature" reminds us that nature is no longer what it was, and that we urgently need to find spaces, ideas, and practices for critical thinking. What role do science and technology play in redefining life in the 21st century? What ethical and aesthetic implications emerge? What influence do humans have in the Anthropocene period? Will a post-anthropocentric paradigm be able to change this? What role can creative action play in this scenario? There are many heterogeneous artistic practices, sometimes generically referred to as "bioart", keeping pace with biotechnological transformation. How can artistic practice express bioknowledge? What problems and potentials arise from the multiple interactions possible between art, science and technology?

Curated by: Daniel López del Rincón

© Barcelona University . CRAI Biology Library
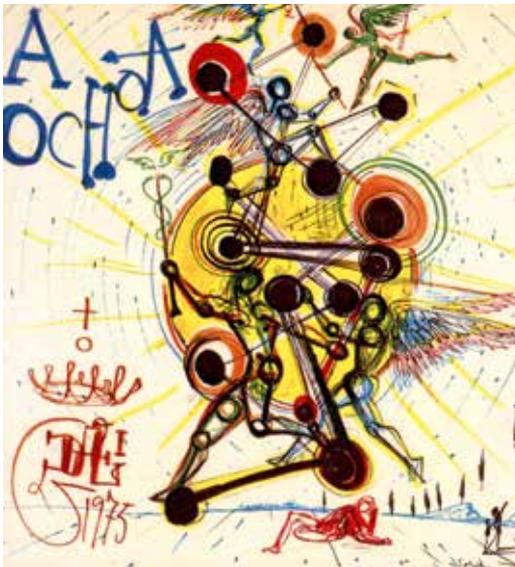
Salvador Dalí (ES)
Jacob's Ladder, 1975

Dalí's *Deoxyribonucleic Acid and Jacob's Ladder,* or simply *Jacob's Ladder* (1975), is a surrealistic depiction of DNA structure, with angels ascending and descending the ladder. The bond between genetics and religiosity is clear and DNA forms a link between the divine and the human.

Salvador Dali (ES) was an important surrealist artist. He was fascinated by science and was closely acquainted with prominent scientists and theories. *https://www.salvador-dali.org/es*

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Francisco de Zurbarán or Juan Fernández (ES)
Bodegón (Still Life), 1625–1629
Light box reproduction

The *Still Life with a Vase and Flowers, also with a pewter plate with peaches, two books, a cup with water, roses and a rosary* is a Spanish still life from the start of the Baroque period, possibly by either Francisco de Zurbarán during his early period in Llerena, 1625, or by the enigmatic still life painter Juan Fernández, known as "el labrador."

© Goya Museum, Zaragoza

Francisco Zurbarán (ES) Fuente de Cantos (Badajoz) 1598 – Madrid in 1664.
Juan Fernández (ES), "el labrador" ("the farmer") was an enigmatic, Spanish Baroque painter, active between 1629 and 1636, who specialized in still life painting.

© Goya Museum, Zaragoza

Carlos de Haes (BEL/ES)
Jinete y caballo bebiendo agua de un río en los alrededores de Madrid (Rider and horse drinking water from a river in the surroundings of Madrid), 1860
Light box reproduction

Landscape of the surroundings of Madrid originally painted with oil on canvas.

Carlos de Haes, Brussels 1828 – Madrid 1898, introduced landscape painting to Spain.

Francisco de Goya y Lucientes (ES)
Asta su abuelo, 1799
(And So Was His Grandfather)
Light box reproduction

This print of an ass sitting at a low table with an open book is a pointed criticism of Manuel de Godoy, an extremely powerful and much-hated man in Spain.

Francisco de Goya (ES). Fuendetodos, Zaragoza 1746 – Bordeaux 1828. Francisco de Goya y Lucientes was a universal Aragonese and Spanish painter.
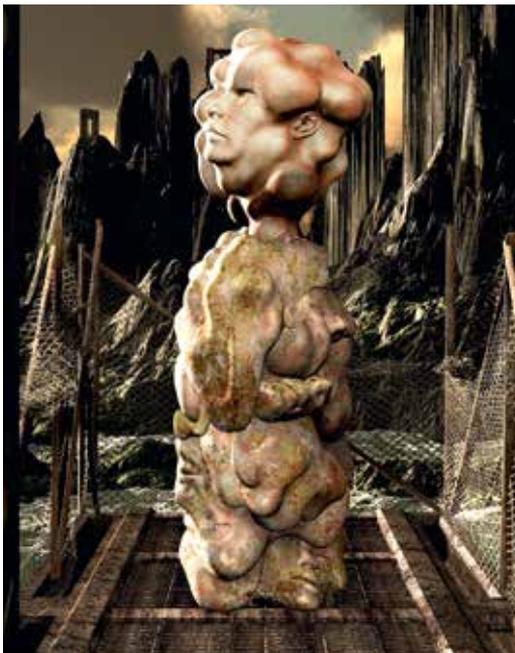
Marina Nuñez (ES)
Demasiado mundo, 2010
(Too Much World)
Single channel video, 1′ 6″

In the video projections, some closed doors gradually open up to show us the world outside .... They then close with a bang, rudely awakening us and bringing us back to reality ... Desolate landscapes, crumbling ruins, the remnants of buildings in which we can see human remains, chimeras, that compose enigmatic scenes ... Against this apparently immobile backdrop we are trapped by an explosion. One being arises from another being, a new life immediately springs forth. Mutant heads with non-controlled, excessive growth are joined together and trapped. Taken from Alicia Vela, "Chimeras". In *Demasiado Mundo,* exhibition catalogue (2010). Valencia (Spain): Centre del Carmen, p. 213.

Marina Nuñez (ES) received her degree in fine art from the University of Salamanca and is currently a professor at the Faculty of Fine Art of Pontevedra at the University of Vigo. *http://www.marinanunez.net*

Marco Brambilla (IT)
Civilization [Megaplex], 2008
Single channel video, 3' 22''

Originally conceived as a single piece, during his work Marco Brambilla got the idea for two further works, *Evolution,* 2010, and *Creation,* 2012, which would become a big mosaic of our time. The video shows micro-histories of diverse aspects such as Nazism, beauty contests, Michael Jackson, and space shuttles launchings, at the same time placing them in a wider context—the human condition itself, Hell, Purgatory, and Paradise.

© Sorigué Foundation

Marco Brambilla (IT) is a visual and an installation artist, based in New York and Berlin. He is primarily known for his elaborate re-contextualizations of imagery, often employing new technologies in his work.
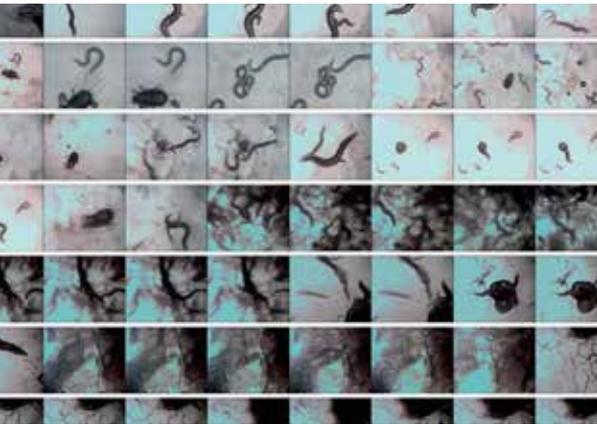
© The artist

Empar Buxeda (ES)
El mutante ggi-1, 2008-2017
El genoma del gusano incierto
Mutant ggi-1, 2008-2017
The Genome of the Uncertain Worm
Installation

The project *Mutant ggi-1 (the genome of the uncertain worm)* is based on the artist's genetic transformation of a *C. elegans* worm, frequently used in biological lab research, rendering it completely useless for any further lab research. The 2017 residency in Etopia reproduces this genetic transformation of a live and alive specimen artwork.

Empar Buxeda (ES) is a fine art graduate and has a masters in Artistic Productions and Research from the University of Barcelona. 2007 – 2012 she carried out intense artistic research in biology laboratory practices applied to art. *www.emparbuxeda.com*

Regina Galindo (GT)
Recorte por la línea (Cut by the Line), 2005
Video performance with the participation of Dr. Billy Spence

© The artist

The original performance took place in Caracas, with Dr. Billy Spence, the best plastic surgeon in Venezuela. The doctor is marking all the areas on Regina José Galindo's body that need to be altered in order to create the perfect body according to existing aesthetic codes. The video documents the performance and shows how patriarchal codes literally rewrite the women's body using medical science (aesthetic surgery) as a tool for this purpose.

Regina Galindo (GT) is a visual artist based in Guatemala. Her art practices are connected with performance art where she explores universal ethical implications of social injustices linked with racial discriminations, gender, and other abuse located in the unequal power relations power in modern societies.
www.reginajosegalindo.com

Joana Moll (ES)
CO2GLE, 2015
DEFOOOOOOOOOOOOOOOOOOOOOOOOREST, 2016
net-art

© The artist

Hardly anybody recalls that the Internet is made up of interconnected physical infrastructures that consume natural resources. *CO2GLE* is a real-time, net-based installation that displays the amount of CO_2 emitted each second by global visits to *google.com*.
DEFOOOOOOOOOOOOOOOOOOOOOOOOREST is a net-based piece that shows the number of trees needed to absorb the amount of CO_2 generated by global visits to *google.com* every second.
[Excerpt from the website of the artist].
http://www.janavirgin.com/CO2/
http://www.janavirgin.com/CO2/DE-FOOOOOOOOOOOOOOOOOOOOOOOREST.html

Joana Moll (ES) is an artist and a researcher whose work critically explores the way post-capitalist narratives affect the alphabetization of machines, humans, and ecosystems. Her main research topics include Internet materiality, surveillance, online tracking, critical interfaces, and language. *janavirgin.com/*

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© Feldman Gallery, NY

Brandon Ballengée (US)
Zaragoza Eco Actions, 2017
Texts, video documentation, photography, maps

Zaragoza Eco Actions is a transdisciplinary bioart project involving the public that analyses the health of local Zaragoza ecosystems by investigating amphibian malformation and disease levels. Local frogs are studied on "Eco-Actions," participatory field trips involving the public, and everything is documented to encourage Zaragoza residents to learn more about their local post-natural ecosystems.

Brandon Ballengée (US). Visual artist, biologist and environmental educator based in Louisiana. Ballengée creates transdisciplinary artworks inspired by his ecological field and laboratory research. Since 1996, a central research focus has been the occurrence of developmental deformities and population decline among amphibians.
brandonballengee.com

© The artist

Joaquín Fargas (AR)
Proyecto bioesfera
Biosphere Project
Ecosystem installations

The *Biosphere Project* consists of natural ecosystems isolated inside sealed containers that only allow the external influence of heat and light. These systems, like our planet, depend on light as a source of energy for the development and continued existence of the life cycles that take place inside of them.

Joaquín Fargas (AR) integrates the arts, science and technology in his artistic production. He is professor of Art and Technology at Maimonides University, where he founded the Bioart Lab and became its director.
www.joaquinfargas.com

Quimera Rosa (ES)
Transplant: Connecting Mycorrhiza with Internet, 2017

Texts, documents, videos, graphics, pictures, and code, form this mixed media biotech installation that features the found remains of a vanished biohacker team in 2024 when the resources of planet Earth have been exploited. One part of the installation has soil and mycorrhiza connected to electronic sensors whose activity is altered by the audience presence.

© The artists

Quimera Rosa (Pink Chimera) (ES) is an experimentation and research lab on identities, body and technology. They adopt Donna Haraway's definition of the Cyborg: "chimeras, theorized and fabricated hybrids of machine and organism." The group's installations and performances are based on the deconstruction of sex and gender identities and on body/machine/environment interaction. *www.quimerarosa.net*

© The artist

Allison Kudla (US)
Growth & Decay, 2017
Photography

This is a set of two photographic prints depicting tiles from the project *Growth Pattern*. This diptych shows the tiles in the initial state with lush, green leaves that have recently been cut into a botanical abstraction and in the final state, with leaves that have begun to decay, with mold and bacteria. *Growth Pattern* creates a generative image and time-lapse animation.

Allison Kudla (US) has been working at the Institute for Systems Biology since 2012. Before that, she was an artist-in-residence and faculty member at the Srishti School of Art, Design and Technology in Bangalore, India. Her PhD focused on creating art for the purpose of looking at the universe as an operating system. *www.allisonx.com*

Christa Sommerer (AT),
Laurent Mignonneau (FR/AT)
Portrait on the Fly, 2016
Interactive video installation

This interactive installation consists of a monitor that shows a swarm of a few thousand flies. When a person positions himself in front of the monitor, the insects build up the contour of the person, which changes as the person moves, reflecting transience and impermanence.

Christa Sommerer (AT), **Laurent Mignonneau** (FR/AT). This artist duo is a pioneer in the research and development of systems of artificial and interactive life applied to the world of art. Currently, they are professors of Interface Culture at the University of Art and Design, Linz (AT), and at IAMAS in Gifu (JP). *www.interface.ufg.at*

Perejaume (ES)
Pintura d'Olot que ha tornat la seva imatge a Olot, 1993
(Painting of Olot which has given Olot its image back)
Object, canvas, wood

This return of images to their places of origin has been a recurring theme in the work of Perejaume. The constancy of this obstinacy that the images go backwards and return to the world they come from has been translated into the claim that the artist has expressed many times in literary terms. (trans. of Martí Peran, "Tractat sobre les formes de recular i trobar el lloc", 2011)

Perejaume (ES) began his artistic career in the late seventies, and became associated with avant-garde movements such as Dada, Surrealism, and Conceptual art, and also to Romanticism and nineteenth-century Catalan landscape painting.

Joan Fontcuberta (ES), Pere Formiguera (ES)
Fauna / Pirofagus Catalanae, 1989
Photography

Fauna is a large-format installation of multiple elements around the figure of a forgotten scientist and his discoveries in the animal world. The starting point is the supposed discovery by two photographers of the lost archives of the German zoologist Peter Ameisenhaufen, who catalogued a series of rare animals, such as Pirofagus Catalanae, a dragon found in Sicily, abandoned by the Catalan invaders in the sixteenth century, that swallowed its own flame after ejecting it.

Joan Fontcuberta (ES) is one of the most internationally renowned Catalan photographers. *www.fontcuberta.com*
Pere Formiguera (ES) is a photographer, writer, and curator. One of the key personalities to understand photography in Spain in the last decades.
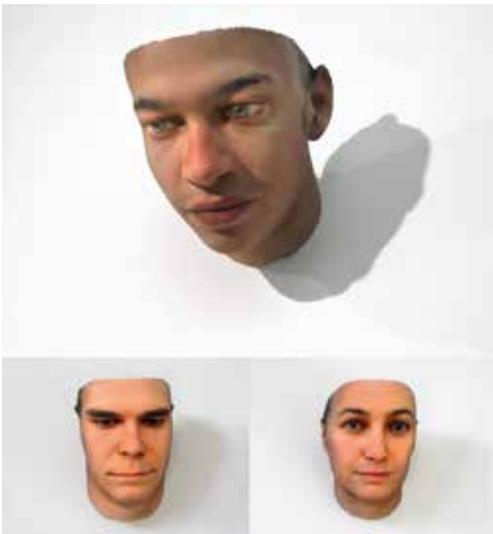
© The artist

Heather Dewey-Hagborg (US)
Stranger Visions, 2012–13
3D printing face reproductions

In *Stranger Visions* I collected hairs, chewed up gum, and cigarette butts from the streets, public bathrooms, and waiting rooms of New York City. I extracted DNA from them and analyzed it to computationally generate 3D printed lifesize full color portraits representing what those individuals might look like, based on genomic research. (Excerpt from *Stranger Visions* by Heather Dewey Hagborg)

Heather Dewey-Hagborg (US) is a transdisciplinary artist and educator who is interested in art as research and critical practice. *deweyhagborg.com/projects/stranger-visions*

GV Art London

GVart

GV Art London is the London hub for art and science discourse, fostering collaborations through a program of curated exhibitions & events. Its core mission is to pave the way for new esthetic sensibilities and catalyze the exchange of ideas between these intersections.

Over ten years GV Art has curated and produced more than fifty exhibitions and over a hundred events working within these intellectual parameters and encouraging interdisciplinary practice and creative entanglements. Such exhibitions place great emphasis on public education and engagement, inviting the public and artistic and scientific communities to initiate conversations on shifting ethical guidelines for future collaborations and experimentation. Critical to GV Art's success are the strong strategic partnerships enjoyed with many major institutions (Human Tissue Authority, Newcastle University, University of Westminster, University of the Arts London, Central Saint Martins, Kings College London, Imperial College London, Manchester University, University College London, University of Oxford, Goldsmiths University of London, Portsmouth University, Middlesex University, London Metropolitan University, Queen Mary University of London, Barts Pathology Museum, and the University of Western Australia). These have resulted in a number of powerful exhibitions including *Of the Flesh, Brainstorm, Experiments, Dendritic Forms, Relics of the Mind, +Art & Science, Sense of Taste, Coming of Age, Trauma, Polymath,* and *Graphite* while simultaneously fostering a coordinated approach towards the exhibition, and the cataloguing and preservation of these new works.

GV Art strives to create new perspectives whether that means continuing the ethical debate around the use of human remains for the production of art (made possible GV Art's privilege of holding a Human Tissue Authority Licence for Public Display and Storage) or through displaying graphene within a new cultural context to explore and illustrate graphite's remarkable history and materiality. New debates on the Anthropocene are highlighted in works by Anaïs Tondeur while existing discussions on mental health are given fresh insights with challenging new forums for neuroscientists and industry professionals. Collectively, they reiterate the need to look more deeply at our understanding of the human condition.

GV Art also represents the estates of numerous artists at the forefront of the art+science discourse including the Franciszka & Stefan Themerson Estate. It strives to ensure their ideas retain their relevance in contemporary discourse. It works with institutions such as the Tate and V&A to place artworks in collections so that future generations understand the meaningful interdisciplinary collaborations that shape the development of art & technology past, present, and future. *www.gvart.co.uk*

#postARTandSCIENCE
A one-day symposium
22.09.2017

Over the last 30 years art+science has grown from a niche interest to a legitimate field of inquiry and experimentation, producing many exciting projects, interdisciplinary collaborations, and lively debates across various academic and artistic institutions. At the same time, concerns have been raised that aesthetically engaging art is all too frequently used to illuminate a scientific idea and, in this way, help scientists communicate with a wider audience. Even some of the more collaborative projects between artists and sciences maintain the distinction between the two fields, which temporarily come together in various funded projects. So, is it time to move on from art+science?

#postARTandSCIENCE has as its main theme thinking beyond art+science—especially in the sense in which this pairing is conventionally understood. Are we satisfied with the way art+science has operated to date, and, if not, what should come after it? Can art change what we understand by science? Can science itself be considered a form of art? Should the relation be extended to take in other methods and approaches, such as those associated with engineering, geography, anthropology, literature, philosophy, or media? Or does *#postARTandSCIENCE* call for an a-disciplinary approach?

Within that rubric, a number of questions are raised by this symposium, focusing on three key themes:

Institution
To date, art+science has been associated largely with the research foundation (e.g. Wellcome), the research center (e.g. CERN), the university, and the arts festival (ISEA, Ars Electronica). To what extent are we ready to move beyond such traditional institutional forms? For example, does the Common Room set up by Polish avant-garde artists, the Themersons, provide one possible model that could be adapted and updated for the 21st century? Could this be a way of inventing a #postARTandSCIENCE community? Should #postARTandSCIENCE be *post-research foundation, post-university,* and *post-arts festival* too?

Funding
What possible avenues for support are available for a more experimental approach to art+science that does not merely aim to use the relatively large amounts of funding that are available to science in order to support art, with the latter then being required to fulfill its part of the bargain by acting in the service of the former? What are the important differences between the ways art and science are funded, and the wider rationales as to why they are being practiced in the first place? When do they converge and when do they diverge? Are there agencies, companies and funding bodies that can support *#postARTandSCIENCE?* Are there any successful examples of this happening already?

The human subject
It seems that too often the "art+science" relationship has consisted of art curators and critics engaging posthumanist and anti-humanist art and science, i.e. art and science that challenges the primacy of the human as the main agent and driving force of the world, whether it concerns Artificial Intelligence and Artificial Life, cognition, robotics, genomics, or the Anthropocene—in a rather humanist way. Can we imagine a *posthumanist* approach to art and science? What forms might that take? What media would it use to present its outcomes? And what kinds of ethical and political questions would be raised by this shift towards a more posthuman art+science?

#postARTandSCIENCE
one-day symposium
Wellcome Collection auditorium
22.09.2017

Curated by GV Art London

Speakers:

Martin Kemp, Emeritus Professor of the History of Art, Trinity College, Oxford

Joanna Zylinska, Professor of New Media and Communications, Goldsmiths, University of London

Gary Hall, Professor of Media and Performing Arts, Coventry University

William Latham, Computing Department Goldsmiths, University of London

Stelarc, Performance artist and Distinguished Research Fellow, School of Design and Art, Curtin University

Nina Sellars, Artist in Residence, SymbioticA, The University of Western Australia, funded by the Australia Council for the Arts

Euan Lawson, Partner at Simkins LLP

Moderated by Luke Robert Mason, Director of Virtual Futures

Kapelica Gallery Kersnikova Institute

Galerija Kapelica Zavod Kersnikova

Ljubljana, Slovenia

Kersnikova Institute provides the framework for Kapelica Gallery and two laboratories that deal with artistic research, development, and education. The first laboratory, BioTehna, is a platform for artistic research of living systems (wet lab) in which the artists are joined by scientists and engineers and together they develop projects which will later be presented in the Kapelica Gallery. Similar activities also take place in the second laboratory, Rampa (hacker space), where new artistic projects emerge as a result of the research carried out there. The two laboratories also share intense educational activities, where children, youth, and the expert public can become inspired by artists and scientists who use the laboratory infrastructure for their projects.

Since 1995 Kapelica Gallery has been producing and presenting artistic projects that address contemporary technological society. We mostly investigate the influence of high technologies that became ubiquitous with the ever greater accessibility to computers and the internet. Telecommunication, automation, robotics, internet, social networks, biotechnology, and aerospace are changing the relationships within contemporary society so radically that certain new social phenomena can only be reached through artistic sensibility. However, in order for artists to be able to consistently address the phenomena that have initiated their meta-physical interest, they have to understand the logic behind the technological intervention that led to this. For this reason, artists join forces with engineers and scientists who help them understand and use the technologies, materials, and scientific processes with which they create their works of art.

Pod okriljem Zavoda Kersnikova delujejo Galerija Kapelica in laboratorija za umetniško raziskovanje, razvoj in izobraževanje. Laboratorij BioTehna je platforma za umetniško raziskovanje živih sistemov (wet lab), v katerem umetniki skupaj z znanstveniki in inženirji razvijajo svoje projekte, ki jih kasneje predstavljajo v Galeriji Kapelica. Podobne dejavnosti potekajo tudi v laboratoriju Rampa (hacker space), kjer ob raziskovanju nastajajo novi umetniški projekti. Oba laboratorija skupaj povezuje tudi intenzivna izobraževalna dejavnost, prek katere otroke, mladostnike in strokovno javnost navdihujejo umetniki in znanstveniki, ki sicer uporabljajo laboratorijsko infrastrukturo za svoje projekte.

Že od leta 1995 se v Galeriji Kapelica predstavljajo umetniški projekti, ki tematizirajo sodobno tehnologizirano družbo. Predvsem gre tu za raziskovanje vpliva visokih tehnologij, ki so z večjo dostopnostjo računalnikov in interneta postale vseprisotne. Telekomunikacije, avtomatika, robotika, internet, družbena omrežja, biotehnologija, vesoljske tehnologije ipd. razmerja v sodobni družbi tako radikalno spreminjajo, da se je mogoče nekaterih novih družbenih fenomenov dotakniti le skozi umetniško senzibilnost. Toda da bi umetniki lahko dosledno tematizirali fenomen, ki je pognal njihov metafizični interes, morajo razumeti logiko tehnološke intervencije, ki je do tega pripeljala. Zato se umetniki povezujejo z inženirji in znanstveniki, ki jim pomagajo pri razumevanju in rabi tehnologij, materialov ali znanstvenih postopkov, s katerimi na umetniški način izvedejo svoje delo.

In most cases artists cooperate with scientists and engineers they know from their school or neighborhood, a kind of cooperation that goes far beyond the usual collaboration between experts. The producers from Kersnikova Institute often supervise the cooperation between the artists and the scientists. By doing this, they ensure that the communication, organization, and logistics between the participants are effective, which in turn contributes to the success of the project. The project thus runs more smoothly and the artists and scientists can focus on the final outcome, while at the same time forming more sustainable connections between the gallery and institutes (including universities and companies) in which scientists and engineers work. Through this they establish long-term connections, which facilitate cooperation in future projects. With this in mind we at Kersnikova Institute established excellent yet informal connections with the Institute of Biochemistry and the Institute of Cell Biology at the University of Ljubljana, the central national scientific Institute Jožef Stefan (Department for Robotics and Artificial Intelligence), the Biotechnical Faculty and the Institute of Chemistry, the Slovenian Centre of Excellence for Space Sciences and Technologies (Space-SI), and others.

V večini primerov umetnice in umetniki sodelujejo z znanstveniki in inženirji, ki jih poznajo še iz srednje šole ali iz svojega bivalnega okoliša, saj ta sodelovanja presegajo golo strokovno razmerje. Običajno v okviru produkcije umetniškega projekta za sodelovanje med umetniki in znanstveniki poskrbijo producenti v Zavodu Kersnikova, ki prevzamejo komunikacijo, organizacijo in logistiko med deležniki ter s tem izdatno pripomorejo k uspešnosti projekta. V takih primerih je delo ustvarjalcev projekta veliko bolj tekoče in osredotočeno na končni izdelek, hkrati pa vzpostavljanje povezav med galerijo in inštituti (tudi univerzami in podjetji), na katerih delajo znanstveniki in inženirji, omogoča bolj trajnostna sodelovanja, ki bistveno olajšajo sodelovanje tudi pri nadaljnjih projektih. S tem namenom smo v Zavodu Kersnikova vzpostavili odlične, toda še vedno neformalne povezave z Inštitutom za biokemijo in Inštitutom za biologijo celice na Univerzi v Ljubljani, z osrednjim nacionalnim znanstvenim Inštitutom Jožef Stefan (Oddelek za robotiko in umetno inteligenco), Biotehniško fakulteto in Kemijskim inštitutom, Centrom odličnosti Vesolje-SI in drugimi.

The invitations extended to scientists to participate in various debate panels which take place in the form of a science café, have helped sensitize them and establish connections that lead to later cooperation. Through these events they have learnt more about the hybrid activities that take place at Kersnikova Institute, and all have shown great enthusiasm for cooperating in following art projects. During this process we have witnessed extremely interesting social and expert dynamics that have inspired everybody involved in the project. The productivity of artists and scientists has almost become a general meme, but regardless of the long-term endeavors, we have so far not managed to formalize the cooperation between art and science institutions to the extent that creative partnerships are systematically recognized and included in the scientific research environment. Our endeavors to establish transdisciplinary connections also apply to the institutionalized level, for we hope that the political decision makers in charge of funding will have sufficient vision to enable systematic cooperation between artists and researchers, and not discriminate against them financially. Only equal conditions will guarantee sustainable innovate dynamics, for innovation and creativity cannot be ordered on command. Innovation and creativity can emerge only if the right conditions and circumstances are established.

Text: Jurij Krpan

Taktično so pri senzibiliziranju, povezovanju in kasneje sodelovanju pomagali angažmaji znanstvenikov, ki smo jih povabili na različne tematske pogovore v obliki znanstvene kavarne. Ob teh priložnostih so se seznanili z dejavnostmi na Zavodu Kersnikova in se vsi navdušili za sodelovanje pri umetniških projektih, ki so sledili in pri katerih smo bili priča izjemno zanimivim socialnim in strokovnim dinamikam, ki so inspirirale vse udeležene v in ob projektih. Produktivnost sodelovanja med umetniki in znanstveniki je takorekoč že splošni meme, toda kljub dolgoletnim prizadevanjem sodelovanja med umetniškimi in znanstvenimi inštitucijami še vedno nismo uspeli formalizirati do te mere, da bi bila kreativna partnerstva sistematično priznana in vgrajena v znanstvenoraziskovalno okolje. Zato naša prizadevanja za ustvarjanje transdisciplinarnih povezav merijo tudi na inštitucionalno raven, saj si prizadevamo, da bi resorni politični odločevalci zmogli toliko vizionarskosti, da bi omogočili sistematično prepletanje ustvarjalcev in raziskovalcev, ki ne bi bili finančno diskriminirani. Le pod takimi enakopravnimi pogoji je mogoče pričakovati vzdržno inovacijsko dinamiko, saj inoviranja in kreativnosti ni mogoče enostavno naročiti s pritiskom na gumb. Da bi inovacije in kreativnost lahko vzniknili, moramo zanje ustvariti primerne pogoje in okoliščine.

Kapelica Gallery / Kersnikova Institute
Activities

Exhibitions

Saša Spačal, Slavko Glamočanin: **Syncness**
Kapelica Gallery, Ljubljana
12.01. – 05.02.2016

Earth Without Humans I

Gilberto Esparza: **Autophotosynthetic Plants**
Vžigalica Gallery, Ljubljana
16.05. –18.06.2016

Adam W. Brown: **ReBioGeneSys – Origins of Life**
Kapelica Gallery, Ljubljana
09.06. – 15.07.2016

Andy Gracie: **Drosophila Titanus**
Rampa Lab, Ljubljana
09.06. – 15.07.2016

Aljoša Abrahamsberg: **The Game has Begun in Secret**
Sonoretum, Ljubljana
09.06. – 15.07.2016

Nelo Akamatsu: **Chijikinkutsu**
Kapelica Gallery, Ljubljana
01.09. – 29.09.2016

Ralf Baecker: **Interface I**
Kresija Gallery, Ljubljana
22.03. – 16.04.2017

Earth Without Humans II

Danny Bazo, Marko Peljhan, Karl Yerkes: **Somnium**
Kapelica Gallery, Ljubljana
08.06. – 30.06.2017

Katarina Petrović: **Cosmologicus**
Rampa Lab, Ljubljana
08.06. – 30.06.2017

Brane Zorman: **ElektroMagnetikSpektrum**
Sonoretum, Ljubljana
08.06. – 30.06.2017

Green Wall: Plant—Machine Cohabitation
BioTehna, Ljubljana
08.06. – 30.06.2017

Workshops
(BioTehna, Ljubljana)

Earth Without Humans I

Kristijan Tkalec: **The Beginning of Life on Earth**
10.06.2016

Angelo Vermeulen: **Vertical Farming: Building a Multispecies Biological Life Support System**
11.06. –12.6.2016

Earth Without Humans II

Björn Huwe: **Cultivating Extremophile in the Lab**
07.06. – 08.06.2017

Saša Spačal, Mirjan Švagelj: **Soil Tasting**
13.06.2017

Kristijan Tkalec: **Mars Exploratory**
03.06. – 17.06.2017

Symposium
(Kapelica Gallery, Ljubljana)

Earth Without Humans I , 10.06.2016

Michael Sterzik/European Southern Observatory (ESO): **The Quest for a Second Earth**
Adam W. Brown: **ReBioGeneSys and the Origins of Life**
Andy Gracie: **Terrestrial Post-Terrestrialism: Beyond Post-Nature**
Bernard Foing/European Space Agency (ESA): **Moon Village**
Olga Kutepova/Roskozmos: **Biological Units of Life Support Systems for Space Stations**

Earth Without Humans I I, 09.06.2017

Christophe Lasseur /European Space Agency (ESA): **Man on Mars, the Perfect Example of Circular Economy**
Björn Huwe/University of Potsdam: **BIOMEX – BIOlogy and Mars EXperiment**
Benjamin Pothier: **The Driest Desert on Earth: Extreme Arts and Astronaut Analog Trainings**
Barbara Imhof/Liquifer Systems Group: **Getting There. Being There. Staying There. Mars.**
Marko Peljhan/Projekt Atol, UCSB: **Transhumanist Projections**
Jon Jenkins/NASA: **Chasing Exoplanets**

Earth Without Humans I
International symposium, exhibitions and workshops
09.06. – 15.07.2016

In his critical essay "Future City"[1], Fredric Jameson adapted J. G. Ballard's conservative belief that "the end of capitalism is the end of the world" into "it is nowadays easier to imagine the destruction of the earth and nature than to imagine the end of late capitalism." This belief still successfully serves the critics of the capitalist production system today and almost every criticism of ecological indifference reminds us of Jameson's observation that so vividly encapsulates the self-destructive inertia of late-capitalist values.

Ballard's science-fiction dystopias and modern criticisms of the capitalist system in the spirit of the latest scientific discoveries and technological capabilities are being revised in the above-mentioned equation. It is much easier to picture a solution by taking Earth out of the equation and instead inserting another extra-terrestrial place, on which nature is yet to be created with the help of science and modern technology. For a biosphere to be inhabitable, it must first be populated by plants and animals, which will create a breathable atmosphere to support humans, without requiring exoskeletons for survival. These habitats inhabited by machines, plants, and animals are conceptual evidence that upgrade science fiction to a real scientific and technological paradise. Within them, machines and designed nature can self-sufficiently exist independently of humans. In the various versions on space ships, planets, and moons, as well as on Earth itself, hi-tech environments appear to be the ultimate realization of capitalist bio-policies: here there is no more room for people to rebel, go bad, eat, and grow old.

However, these environments, which are situated in actual or simulated radical conditions, offer an exceptional opportunity for scientists and technology experts as well as decision-makers and investors, in addition to artists and activists, not to stray into the realms of unreflective techno-fascination, but rather to rethink the starting points that we are living here and now. Neo-Luddism surely does not provide the solutions that would return humans into the aforementioned equation. This is why, in the tradition of tactical media where establishing technological literacy among the public is intended for the reflective use of technology, we propose the inclusive co-creation of scenarios in which creative people, by mastering technologies, create personified and customized applications for people, whereby the focus in essence shifts from profit to sustainability.

Ballard's or Franklin's or, if you please, Jameson's formula for the possible end of the world, presupposed an unspoken need for a fundamentally altered understanding of the production system whereby humans would nevertheless not destroy life on this planet. In relation to the top scientists who create at the limits of what is possible and in doing so open up new imaginary expanses, and, with some artists who are capable of translating these new dimensions into scenarios of the future, we held the event *Earth Without Humans*. Through a series of exhibitions and a full-day conference, we dedicated ourselves to the fragile emergence of life that evolutionary theory and astrobiology spread out in front of us in post-humanist possibilities. We invited scientists from the European Space Agency, the European Southern

Observatory, and the Russian Roscosmos to participate in the conference, which was complemented by the exceptional artistic contributions of Gilberto Esparza, Adam W. Brown, Andy Gracie, and Angelo Vermeulen. Together we turned the spotlight on forms of life that are still unknown to us.

Text: Jurij Krpan

1   Fredric Jameson: "Future city" *(New Left Review,* 2003). In his work Jameson writes, "Someone once said that it is easier to imagine the end of the world than to imagine the end of capitalism." And by this "someone" he is referring to the text that "militant Marxist" Bruce Franklin conceptualised and criticised in his essay "What Are We To Make Of Ballard's Apocalypse." *(http://qlipoth.blogspot.si/2009/11/easier-to-imagine-end-of-world.html)*

Miha Fras

Andy Gracie (UK/ES)
Drosophila Titanus

Drosophila Titanus is a long-term project which, through a process of experimentation and artificial selection, aims to breed a species of Drosophila that would theoretically be capable of living on Saturn's largest moon, Titan. The project adheres to a scientific methodology while endeavoring to extract artistic metaphor, poetry, and ambiguity from apparent creative restrictions. The work embraces interwoven narratives and concepts of species, artificially created organisms, and space travel, alongside darker issues such as biological perfection, social Darwinism and eugenics. Beyond the exploration of biological and evolutionary issues the project engages with biosemiotics in questioning the nature of reality and organic perception of environmental sensory signals.
hostprods.net/projects/quest-for-drosophila-titanus

Miha Fras

Andy Gracie (UK/ES) is an interdisciplinary artist whose work has involved studies and reactions to the science of astrobiology and notions of the origins of life coupled with a re-examination of its boundaries. He employs scientific theory and practice to question our relationships with environment and the future while simultaneously bringing into focus the very relationship between art and science. Gracie received an Honorary Mention in Hybrid Art at the Prix Ars Electronica 2015 and his work has been shown internationally. *hostprods.net*

Gilberto Esparza (MX)

Plantas Autofotosintéticas
(Autophotosynthetic Plants)

The *Autophotosynthetic Plants* installation manages to create a symbiotic state between the bacteria, the plants, and the electronics that monitor the chemical and biological processes, so that the plants and animals are capable of survival in a hostile environment. Inspired by catastrophically polluted rivers that serve only as conduits for sewage in the most industrial and overpopulated areas, the artist created a hybrid infrastructure in which waste-digesting bacteria power fuel cells that cast light on the plants growing in a separate area. The polluted water is filtered through a series of microbial fuel cells until it becomes clean enough to water the isolated plants, which coexist in homeostatic equilibrium with other microorganisms.

The work of **Gilberto Esparza** (MX) involves electronic and robotic means to investigate the impacts of technology in everyday life, social relationships, the environment, and urban structures. His practice employs recycling consumer technology and biotechnology experiments, including research projects on alternative energies. Esparza has exhibited worldwide and received the Prix Ars Electronica Golden Nica Award in Hybrid Art (2015), the 2nd prize in VIDA 13.0 Art & Artificial Life competition, and the VIDA 9.0 prize for Latin American Productions. *gilbertoesparza.net*

Miha Fras

Aljoša Abrahamsberg (SI)

The Game has Begun in Secret

Aljoša Abrahamsberg has been on the hunt for signals from the territories of the electro-magnetic spectrum for years. For *Sonoretum,* the 8-channel sonic environment, the author created a soundscape consisting of archive recordings of his eavesdropping of signals that he has been intercepting since 1997 using various different radio devices. The audio material that was recorded at Marko Peljhan's *Makrolab,* an artistic observatory temporarily set-up at various locations worldwide, has been supplemented by recordings from other places around the world, where performances of the formations *Signal-Sever!, Scatter!* and *Spektr!* were hosted.

The signals used for *Sonoretum* come from NMT and satellite phones, satellite, maritime, police, amateur radio communications, and soundscapes intercepted at short, medium, and long wave ranges using AM, FM, CW, and USB radio modulation modes.

myspace.com/maxnullo

Aljoša Abrahamsberg (SI) has been a member of the Makrolab crew since the start of the project in 1997. He was one of the performers at *Wardenclyffe Situations* and collaborated on projects such as *Scatter!, Signal-Sever!* and *Spektr!,* presented at various art festivals worldwide. Since 2011 he has been the art director of the Dimenzija Napredka gallery in Solkan. In 2012 he curated the intermedia Pixxelpoint festival in Nova Gorica, Slovenia. He is also a videographer and author of over one hundred TV shows about contemporary art.
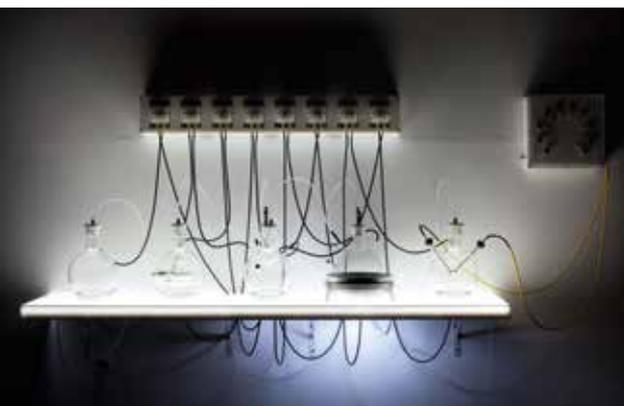
Adam W. Brown, Robert Root-Bernstein (US)

ReBioGeneSys – Origins of Life

ReBioGeneSys – Origins of Life is a hybrid installation that utilizes the processes and materials of science to ask fundamental questions about how all life seems to proceed from previous life and yet had to emerge from inorganic materials. Is life something special or is the possibility of life inherent in matter itself? *ReBioGeneSys* is a fully functioning scientific experiment capable of being reconfigured into any real or imaginary world, be it Venus, Titan, or our prebiotic Earth. By combining all the scientific research on the origins of life in one set of integrated processes, *ReBioGeneSys* creates "mashed-up" extreme minimal ecosystems theoretically capable of forming the self-organizing chemistries necessary to produce semi-living molecules and perhaps even protocells.
adamwbrown.net/projects-2/rebiogenesys-origins-of-life

Adam W. Brown (US) is an intermedia artist whose work incorporates art and science hybrids that examine the phenomena of life and living systems. For over a decade Brown has been creating work that attempts to destabilize our anthropocentric view of the world by examining historical relationships between human and non-human species and living systems. Adam Brown is an associate professor of Electronic Art and Intermedia and Director of the BRIDGE Artist in Residence program in the Department of Art, Art History and Design at Michigan State University.

Robert Root-Bernstein (US) is a professor of Physiology and MacArthur Fellow at Michigan State University, US. His laboratory research concerns the origins and evolution of metabolic control systems and autoimmune diseases. He also explores the intersections of arts and sciences through historical, philosophical, and experimental studies. He is an editor of *Leonardo: The Journal of the International Society for Art, Science and Technology,* and the author of four books including *Sparks of Genius,* a study of the ways in which artists and scientist think alike.

Earth Without Humans II
International symposium, exhibitions and workshops
07.06. – 07.07.2017

What might have been considered science fiction a few years ago, can now be experienced in real time as the manifestation of a positive utopia, which predicts a change of absolutely everything in the near future: how we travel, how we communicate, what we eat, how we dress, how we reach decisions, how we participate, how we trade ... basically how we live. The power centers are shifting before our eyes and this shift is geo-strategically moving from our planet into space. It is full of successful content platforms (Google, Amazon, Uber, Facebook ...), which reflect the trans-nationality of the internet and other telecommunication technologies into space. Unlike the 1960s space race, in which the two superpowers raced for the moon, the current prospect of domination can be seen in the race for Mars.

The universal role of capital doubles with the universality of western science and the ubiquity of large content and technological platforms, which are starting to grow too big for our blue planet. Telecommunication infrastructures are leaving Earth and settling in its orbit, the Moon Village is being designed as a base for extraplanetary mining, and Mars is a platform for testing new technologies, materials, and solutions that are (currently) in the logic of time on Earth not necessary. In the vein of Moore's Law, which anticipates the double growth of capacities in integrated computer circuits every year, the exponential growth of technological advances allows us to think and plan applications outside the bounds of Earth, projecting them into a kind of intraplanetary utopian realism. In these outer reaches, society as we know it on Earth is reduced to mere biological functions in radical living conditions. Society becomes but a derivative of astrobiology, requiring nothing but the right mixture of biology and chemistry to survive. For the neoliberal scientific and technological complex, the shift of applications into the unregulated territories of outer space signifies a move away from ethical and moral principles, which restrict its expansionist politics.

In this perspective, the scientific research and the new technologies that are being developed to create the conditions for survival on the Red planet at the same time seem to signify the end of life on Earth. The catastrophic scenario of exodus to other celestial bodies can be read through the series of technological solutions, developed to make survival on Mars possible. Radical conditions, biotechnologies, synthetic biology, exo-life, extremophiles, artificial life, artificial intelligence, quantum and memory-driven computing, robotic architecture etc. seem like the most forward-thinking concepts that humanity has to offer right now. The subtle difference between the avant-garde space concepts from the previous century, which anticipated an improvement in the living conditions on Earth, and the technological advances of our own age, in the most meaningful way introduces the possibility of life on Mars as an alternative to life on Earth. It would seem as though, for some people, Earth is not an option anymore, or they imagine the blue planet in shades of red. Dried out, with a toxic atmosphere and a handful of colonies, where life is organized on the basis of biopolitics. Or, to put it briefly: Mars as a greeting from the future.
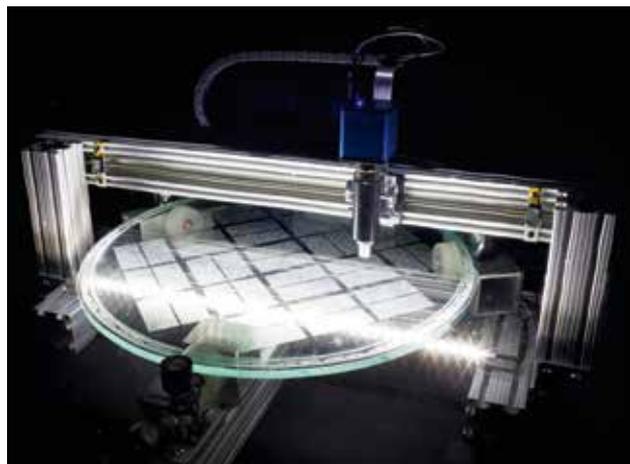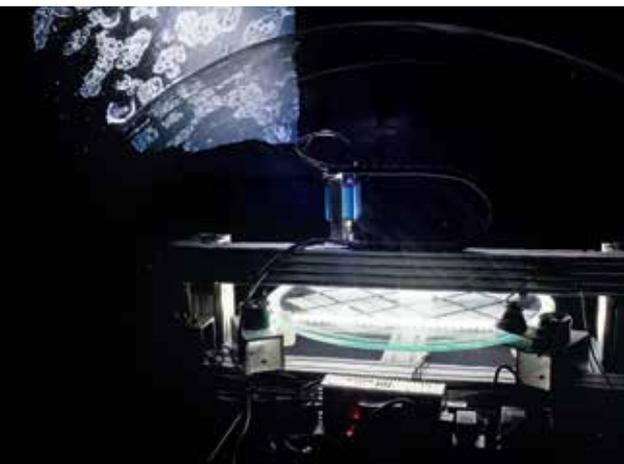
Text: Jurij Krpan

Brane Zorman (SI)
ElektroMagnetikSpektrum

ElektroMagnetikSpektrum is part of the *EMS Memory Trackers* (2016) composition, edited to suit the 8-channel sonic environment of *Sonoretum*. Based on the positions and color constellations of solar systems, stars, planets, and the endless flux of scattering electromagnetic radiation of past ancient and distant echoes, the author collects and transforms EM information, translating it to the narrow range of frequencies audible to humans. Zorman maps the continuous invisible and inaudible flux of fading time, pulsation and radiation that flow in the form of weakened and deteriorated segments, which are reflected from and absorbed by the bodies with which they collide. The sonic sculpture *ElektroMagnetikSpektrum* transcends the EM radio wave recording, which now covers the space of the *Sonoretum* time capsule like a gossamer veil.

Photo courtesy by the artist

Brane Zorman (SI) is a composer, sound and radio artist, sound manipulator and producer. His work examines and explores the possibilities of processing, presenting, perceiving, understanding, positioning, manipulating, and reinterpreting sound and space. By employing sophisticated and simple tools, and old and digital technologies, his work traverses the field of music, new media, sound art, and radio art. *www.branezorman.si*

Danny Bazo (US), Marko Peljhan (SI), Karl Yerkes (US)
Somnium

Somnium is a multimodal cybernetic installation to contemplate discoveries of exoplanets and the potential for extraterrestrial intelligent life in our galaxy. It uses light, sound, and robotics to bridge the vastly different macro- and micro-scales of cosmic search and human experience. The work draws inspiration from Johannes Kepler's prototypical science fiction tale, *Somnium (Dream),* which describes what an observer on the moon might see while they gaze at the Earth from afar. The installation uses data gathered by NASA's Kepler Space Telescope mission to echo this question for our specific time: "What might an observer on Earth see while they gaze at the many other possible Earths that exist within our galaxy?"
www.projekt-atol.si/project/somnium

Danny Bazo (US) builds robots and multimedia installations using Geiger counters, surveillance cameras, robotic arms, video projections, synthesized sounds, and other technology. His works have exhibited at international venues such as SIGGRAPH, ACM Multimedia, Mois de la Photo à Montréal, ISEA Dubai, and Run Run Shaw CMC Hong Kong. He holds degrees in engineering from UC Berkeley and University of Bristol, UK, and a PhD from UC Santa Barbara's Media Arts and Technology Program.
Marko Peljhan's (SI) work intersects art, science, and engineering. His work includes projects like *Makrolab,* the *Interpolar Transnational Art Science Constellation* and the *Arctic Perspective Initiative*. In 2001 he received the Golden Nica with Carsten Nicolai. His work has been exhibited internationally at biennales (Venice, Lyon, Istanbul, Gwangju...), festivals (documenta, ISEA, Ars Electronica...) and museums / art institutions (YCAM, ICC-NT, MOMA PS1, Garage...). He serves as professor and director of the MAT Systemics Lab at the UCSB. *www.projekt-atol.si*
Karl Yerkes (US) develops musical and virtual reality systems, performs electroacoustic music internationally, and teaches media arts and technology at graduate level. His research on digital musical instruments and interactive, distributed audiovisual systems was published at international conferences such as NIME and ICLC and his multimedia installations exhibited in Slovenia and California. Karl holds degrees in Computer Engineering (BS) from UW and Media Arts & Technology (PhD) from UCSB. *karlyerkes.com*

Katarina Petrović (RS/NL)
Cosmologicus

Cosmologicus is a custom-made software and installation that translates radio emissions from the planet Jupiter into a semantic stream. Using the word-number database generated in the work *Lexicon Liber Novus* (Petrović, 2016), the invisible order of electron particles coming from the distant planet is made intelligible through language. Or so it seems. Jupiter-generated poetry gives way to an infinite interpretation of the planet's emissions. The computer and the spectator become mediums of the largest planet of our Solar system, oracles of the mythological Jupiter, attempting to construct sense and meaning from the generated data. The installation comprises the software, projected moving text into a black water cube, and a recording of Jupiter radio emissions made on the ground.
www.katarinapetrovic.net/project/cosmologicus

Software made in collaboration with: Mirko Lazović
Audio recordings: NASA's education and outreach project Radio Jove and affiliated Heliotown Observatory in New Mexico

Katarina Petrović (RS/NL). is an interdisciplinary artist and a researcher working at the intersections of art and science. Interested in the issues of translation and interpretation, she investigates the structures and modes of information organization within different symbolical structures like language, mathematics, and code. Focusing on their universality and fluidity, she constructs narratives ambiguous documents in which the facts and poetics stand side by side.
www.katarinapetrovic.net

Miha Fras

Hana Jošić

Green Wall Community + Naprave Robotics Lab
Green Wall: Plant—Machine Cohabitation

Establishing the right conditions for plant growth in unusual environments is one of the themes with which we want to bring attention to the living organisms that can survive and exist in extreme environments. When we talk about astrobiology, it is relatively easy to imagine the radical conditions in space, but it is much harder to imagine the survival of various organisms in situations that do not yet even exist, and can merely be imagined or predicted. To simulate extreme conditions we have designed a tactical environment in which three distinct biotopes feed information to one another—aquaponics, hydroponics, and robotics existing in mutual codependence. The project, named *Green Wall,* aims to create a community in which the participants self-organize, based on their interests. One group takes care of the hydroponic system of plants growing in vertical modules, the second group constructs the aquarium biotope, while the third group creates a spider bot and a sensory system that will allow the plants to communicate with the robot, which will water each one individually. The ultimate goal of the project is to create a hybrid ecosystem in which plants, with the aid of technology, will be able to thrive without human intervention.
www.biotehna.org

BioTehna Vivarium—Animals, Plants and Robots Vivarium is part of BioTehna—the Platform of Artistic Research of Living Systems. We explore the codependency between animals, plants, and robots. Unlike BioTehna, which is a laboratory for the research of micro and nano systems, Vivarium is a space meant for working with organisms that can be observed with the naked eye and grown without the aid of incubators or containers.

Saša Spačal, Slavko Glamočanin (SI)

Syncness
12.01. – 05.02.2016

Syncness is an audiovisual interface that researches human ability to relate to beings that are considered inferior by anthropocentric arborescent taxonomic classifications such as the tree of life. It is an invitation to try to vocally sync with crickets and develop a relationship. *Syncness* creates opportunities for sound synchronization between human beings and crickets. Identification of signals transmitted by the animals is similar to close encounters of the third kind, but the alienated other is replaced by *Acheta domesticus* crickets. It is a first step towards an algorithmic language that would enable non-verbal interspecies communication. The audiovisual dialog is transmitted to space via radio as to reflect upon the human urge to find extra-terrestrial life and establish relationships with beings that are alien to our species.
projectsyncness.wordpress.com

Associate professionals: Mirjan Švagelj, Anil Podgornik, Shlosart Metalart
3D modeling and implementation plans: Blaž Šolar
Produced by: Kapelica Gallery / Kersnikova Institute

Saša Spačal (SI) is a post-media artist with a background in humanities who is currently working at the intersection of living systems research, sound design, and interactive visualization. How technology shapes our lives and the human experience is at the center of her work, which develops around the idea of connections between the different systems as the major source of complexity in the environment. Her work focuses primarily on the post-human state, in which human beings exist and act as one of many elements in the ecosystem. *www.agapea.si*
Slavko Glamočanin started in the computer demo scene, where he was mostly active in making music and co-created the first Slovenian breakbeat compilation, *Monkorama*. He continued with programming and exploring the media and he created the programming platform naprava for that purpose. *www.naprava.net* After one-way video/effects he proceeded with interactive projects, motion capture, kinect and openGL visualizations. His main interests are synesthesia, systems, and interactive.

Nelo Akamatsu (JP)
Chijikinkutsu
01.09. – 29.09.2016

Chijikinkutsu is a coinage of two Japanese words: *chijiki* and *suikinkutsu*. *Chijiki* means geomagnetism: terrestrial magnetic properties that have always existed and affect everything on Earth, but cannot be perceived by the human senses. A *suikinkutsu* is a sound installation for Japanese traditional gardens, invented in the Edo period.
While utilizing the action of geomagnetism, which is normally treated as a subject of science, this sound installation expands the subtle sounds of *suikinkutsu* in the context of the Japanese perspective on nature. A round surface of water in the glass with a floating magnetized needle is reminiscent of a tiny Earth with its geomagnetism. The fainter the sounds of the glass, the more keenly listeners' sensibility is sharpened. In the meantime, they realize that the sounds are not coming from outside their bodies, but already exist inside their minds.
www.neloakamatsu.jp/chijikinkutsu-eng.html

Concept, space design, hardware development, sound-sequence programming: Nelo Akamatsu

Nelo Akamatsu (JP) creates art works across several media such as installations with electric devices, event and video installations, sculptures, paintings, and photos. He has an MFA from the Department of Intermedia Art at Tokyo National University of Fine Arts and Music. Akamatsu's work has been presented in Japan and Europe. He has been awarded with a Golden Nica in the category Digital Musics & Sound Art at Prix Ars Electronica 2015 and received the Taro Okamoto Memorial Award of Contemporary Art in 2004 and 2014.
www.neloakamatsu.jp

Ralf Baecker (DE)
Interface I
22.03. – 16.04.2017

In the project *Interface I,* the artist employs the artistic method for researching the mutual responsiveness and interactivity of various processes, which, due to the unpredictable nature of their movement and the unique aesthetic functions of their systems, invoke a metaphysical experience, prompting the viewer to ponder about the internal logic, or perhaps even the intelligence, of the machine. This, in turn, sparks questions about the perception of artificial intelligence and synthetic emotions beyond a computer's operations. The mechatronic installation *Interface I* is another stage in the evolution of Baecker's artistic expression, which, from project to project, creates an increasingly effective visual/performative language that is recognizable as the characteristic beauty of artistic machines.
www.rlfbckr.org/work/interface-i

Produced by: NOME Gallery Berlin, 2016
Research and experiments of *Interface I* were carried out within the framework of Ralf Baecker's research project *Time of Non-Reality* at the Graduate School, University of the Arts, Berlin.

Ralf Baecker (DE) is an artist working at the intersection of art, technology and science. Through installations and machines, Baecker explores fundamental mechanisms of action and the effects of new media and technologies. Baecker has been awarded multiple prizes and grants for his artistic work, including a Honorary Mention at Prix Ars Electronica in 2012 and 2014, and 2nd prize at the VIDA 14.0 Art & Artificial Life competition. His work has been presented at major international festivals and exhibitions around the world. *www.rlfbckr.org*

LABoral Centro de Arte y Creación Industrial

Gijón, Spain

LABoral Centro de Arte y Creación Industrial is a multidisciplinary institution focused on exchange and cooperation between art, science, technology, society, and the creative industries. It engages in research and development, education, production, exhibitions, and artist-in-residence programs. Launched in 2007, the center is located in the Knowledge Mile of Gijón, on the perimeter of the eastern side of the city, between the technological campus of the Universidad de Oviedo and the Science and Technology Park of Gijón, where the most advanced companies and research projects in Asturias are situated alongside different cultural institutions.

LABoral Centro de Arte y Creación Industrial es una institución multidisciplinar centrada en el intercambio y la cooperación entre el arte, la ciencia, la tecnología, la sociedad y las industrias creativas. Realiza programas de investigación y desarrollo, educación, producción, exposiciones y residencias de artistas. Inaugurado en 2007, el centro está situado en la Milla de Conocimiento de Gijón, en el perímetro del lado este de la ciudad, entre el campus tecnológico de la Universidad de Oviedo y el Parque Científico y Tecnológico de Gijón, donde se encuentran los proyectos de investigación y empresas más avanzadas de Asturias, junto a diferentes instituciones culturales.

Conceived as a unique project among art centers in Spain, LABoral functions as a technological and sociocultural open lab for research, development, and innovation, based on a cross-sectional approach comprising different fields of knowledge, communities, and practices. So it constitutes a node for integrated and distributed research carried out through its various programs of production, exhibition, education, and communication.

Throughout the last decade, large thematic events have highlighted some of the key themes related to art, science, and digital culture: from historical reviews of the origins of interactivity, shown in retrospective exhibitions such as *Feedback,* to analysis of the most innovative domains of video game culture, exhibited in *Gameworld, Playware* and *Homo Ludens Ludens*.

These exhibitions and other comparative explorations related to traditional concepts and emerging parameters of digital culture and science, were developed in *process as paradigm, Experimental Station, datamatics* by Ryoji Ikeda and *banquete_nodes* and *networks,* with reference to Santiago Ramón y Cajal and Manuel Castells.

The exhibitions developed at LABoral through the EDASN program led new incursions into artistic and scientific practices through an extensive program of seminars, workshops, and the exhibition *Material Prima* in 2016. The show *Monsters of the Machine* examined the role of women in art and science, with a tribute to Mary Shelley's Frankenstein, raising the challenges and concerns of society in the face of the scientific and technological advances of the twenty-first century.

LABoral Centro de Arte y Creación Industrial is a multidisciplinary institution that produces, disseminates, and fosters access to new forms of culture emerging from the creative use of ICTs. Its cross-cutting program targets all audiences with the ultimate goal of generating and sharing knowledge.
www.laboralcentrodearte.org

Concebida desde su origen como un proyecto singular y único en el tejido de centros de arte de España, LABoral opera como un laboratorio abierto de investigación, desarrollo e innovación tecnológico y sociocultural, a partir de un planteamiento transversal y entre ámbitos, comunidades y prácticas. Se ofrece, así, como un nodo de investigación integral y distribuida a partir de sus diversos programas de producción, exposición, educación o comunicación.

A lo largo de la última década, grandes programas temáticos han puesto de relieve algunos de los temas clave relacionados con el arte, la ciencia y la cultura digital: desde la revisión histórica de los orígenes de la interactividad, mostrada en exposiciones retrospectivas como el *Feedback,* hasta el análisis de los aspectos más innovadores de la cultura del vídeo-juego, a través de muestras como *Gameworld, Playware y Homo Ludens Ludens*.

Las exposiciones de tesis y otras exploraciones comparadas, relacionadas con los conceptos tradicionales y los parámetros emergentes de la cultura digital y la ciencia, se desarrollaron en exposiciones como *el proceso como paradigma, Estación Experimental, datamatics* de Ryoji Ikeda y *banquete_nodos y redes,* con referencias a Santiago Ramón y Cajal y Manuel Castells.

Las exposiciones producidas en LABoral a través del programa EDASN permitieron nuevas incursiones en prácticas artísticas y científicas a través de un extenso programa de seminarios, talleres y la exposición *Materia Prima* en 2016. La muestra *Los Monstros de la Máquina* examinó el papel de la mujer en el arte y la ciencia, rindiendo un homenaje al Frankenstein de Mary Shelley, y planteó los retos y las preocupaciones de la sociedad frente a los avances científicos y tecnológicos del siglo XXI.

LABoral Centro de Arte y Creación Industrial es una institución multidisciplinar que produce, difunde y favorece el acceso a las nuevas formas culturales nacidas de la utilización creativa de las tecnologías de la información y la comunicación (TICs). Su programación, transversal e integrada, está dirigida a todos los públicos y tiene como fin último generar y compartir conocimiento.
www.laboralcentrodearte.org

LABoral Centro de Arte y Creación Industrial
Activities

Roundtables

MATERIA PRIMA
Roundtable
Gijón
13.11.2015
Artists speaking of science
Nelo Akamatsu (artist)

MATERIA PRIMA
Roundtable
Gijón
14.11.2015
Astronomy and open code
Jesús Rodríguez (Data Management Division and Operations of the Europeam Southern Observatory – ESO, Chile) and Juan Menéndez Blanco (Asturian Astronomical Society Omega, Asturias, Spain)

MATERIA PRIMA
Roundtable
Gijón
14.11.2015
Astronomy and open code
Jesús Rodríguez (Data Management Division and Operations of the Europeam Southern Observatory – ESO, Chile) and Juan Menéndez Blanco (Asturian Astronomical Society Omega, Asturias, Spain)

MATERIA PRIMA
Roundtable and screening
Gijón
19.02.2016
Speaking of science
David Álvarez (blog Fauna Cantábrica), Jorge Chachero (ASECIC member and nature audiovisual producer) Lorena Lozano (artist and biologist) and John Rojas (ASECIC – Spanish Film and Scientific Image Association)

MATERIA PRIMA
Roundtable and screening
Gijón
07.04.2016
Looking at the sky. Observation, data and visualisation
Asturian Astronomical Society Omega, Asturias; Luigi Toffolatti, (Physics Department, University of Oviedo; winner of the call for the visualization of astronomic data)

LOS MONSTRUOS DE LA MÁQUINA / MONSTERS OF THE MACHINE
Roundtable
Gijón
18.11.2016
Art and Science from the Gender Perspective
Mary Flanagan (artist and educator), Gretta Louw (artist and researcher), Regina de Miguel (artist) and Marc Garret (co-founder and artistic director of Furtherfield, and curator of Monsters of the Machine)

LOS MONSTRUOS DE LA MÁQUINA / MONSTERS OF THE MACHINE
Roundtable
Gijón
09.03.2017
Women, art, science and technology
Jara Cosculluela (educator specialized in feminist research and gender analysis), Melania Fraga (journalist in Gender Perspective and professional in the field of multimedia communication), Joana Moll, (artist and researcher), Maria Teresa Samper, (sociologist and member of the group "gender in science" at the University of Valencia) and Job Sánchez (artist and teacher)

Workshops

MATERIA PRIMA
Workshop
Gijón
14.11.2015 – 08.05.2016
Your name in DNA sequence
LABoral Mediation team

MATERIA PRIMA
Workshop
Gijón
14.11.2015 – 08.05.2016
3d Scanner
LABoral Mediation team

MATERIA PRIMA
Workshop
Gijón
14.11.2015 – 08.05.2016
Hybrid workshop
LABoral Mediation team

MATERIA PRIMA
Call for participation and workshop
Gijón
14.11.2015 – 01.02.2016
Design and production of DIY tools for amateur
astronomy
fabLAB Asturias team

MATERIA PRIMA
Workshop
Gijón
18.11.2015 – 08.05.2016
Runner Robot
LABoral Mediation team

MATERIA PRIMA
Workshop
Gijón
08.04.2016
Didactic visualisation of astronomic data
Alba G. Corral (artist)

MATERIA PRIMA
Workshop
Gijón
08.04.2016 – 09.04.2016
SkyPointer. Workshop to manufacture
a laser pointer
Juan Menéndez and David Vázquez

Exhibitions

MATERIA PRIMA
Exhibition
Gijón
14.11.2015 – 08.05.2016
see Page 236

LOS MONSTRUOS DE LA MÁQUINA /
MONSTERS OF THE MACHINE
Exhibition
Gijón
18.11.2016 – 31.08.2017
La Cura
see Page 250

Conferences

MATERIA PRIMA
Conference
Gijon
28.11.2015
Transferencias - Philosophy, Art and Science
Verónica G. Ardura (plastic artist and college
professor) and Lorena Lozano (artist and
biologist)

MATERIA PRIMA
Conference
Gijón
23.02.2016
Transferencias - Bioethics and Technology
Yolanda Argüelles (nurse and member of the
Ethics Committee of Area VIII. Asturias)

MATERIA PRIMA
Conference
Oviedo
27.02.2016
Transferencias – Knowledge and pedagogy
Esperanza Fernandez González (college
professor)

MATERIA PRIMA
Conference
Gijón
12.03.2016
Transferencias - Audiovisual media: Project
documentation and management
Melania Fraga (journalist in Gender Perspective
and professional in the field of multimedia
communication)

MATERIA PRIMA
Conference
Gijón
16.04.2016
Transferencias - Local, artists and territory
Leticia González (Art History PhD)

MATERIA PRIMA
Conference
Gijón
07.05.2016
Transferencias- Transmedia Narratives and
Science Fiction
Nuria Rodríguez (translator and researcher in
contemporary critical theory)

Educational Programs

MATERIA PRIMA
Educational Program: School
Gijón
16.12. – 18.12.2015; 13.01. – 20.01.2016,
17.02. – 24.02.2016, and 16.03. – 23.03.2016
Art and Science DIY@Andy Gracie (artist)

**LOS MONSTRUOS DE LA MÁQUINA /
MONSTERS OF THE MACHINE**
Educational programme:
School
Gijón
21.11. – 23.11.2016, 12.12. – 15.12.2016
A Story Never Told from Below
Regina de Miguel (artist)

**LOS MONSTRUOS DE LA MÁQUINA /
MONSTERS OF THE MACHINE**
Educational program: Cultural mediators
Gijón
30.11.2016 – 02.12.2016;
15.03. – 17.03.2017; 26.04.2017 – 28.04.2017
Where is the mediation bureau? Frankenstein
House.
Jordi Ferreiro (artist and educator) and María
Acaso (educator and researcher)

Mediation Programs

**LOS MONSTRUOS DE LA MÁQUINA /
MONSTERS OF THE MACHINE**
Mediation program: Street performance
Gijón
16.12.2016
Metrópolis
Escuela Superior de Arte Dramático de Gijón
(ESAD) [School of Performing Arts of Gijón]

**LOS MONSTRUOS DE LA MÁQUINA /
MONSTERS OF THE MACHINE**
Mediation program: Concert
Gijón
17.12.2016
Sombras en alta fidelidad
Fasenuova (experimental music collective)

**LOS MONSTRUOS DE LA MÁQUINA /
MONSTERS OF THE MACHINE**
Mediation program: Illustrations on
Mary Shelley's work (live)
Gijón
18.12.2016
Illustrated Frankenstein
Thanya Castrillón and Eli García (illustrators)

Materia Prima
Exhibition
14.11.2015 – 08.05.2016

The exhibition focuses on new alliances between art and science, and the *materia prima* that their protagonists work with: computer code.

The core of the exhibition consists of a set of interactive visitor labs. Education and communication are not a side program but the central component in this exploration of art and science. The labs are surrounded by exploratory displays featuring outstanding artistic works as well as R&D prototypes—atelier and laboratory meld together here. Between these areas, we find references to the rich history of the liaison of art and science.

To quote Merriam-Webster dictionary, a laboratory is "a place providing opportunity for experimentation, observation, or practice in a field of study." Although in our common understanding of laboratories, we tend to see them as places where highly secret experiments are conducted and high-cost equipment is used. Places where access is only granted to those who have a good relationship to the people working there or a mandate to enter them. They are where processes take place that have a direct impact on knowledge.

Curated by Gerfried Stocker, Ars Electronica Center Linz

Exhibition setting focused on laboratory structure

MATERIA PRIMA is an exhibition concentrating on artistic/scientific processes and the generation of knowledge in art. Rather than presenting objects, this exhibition focuses on bringing those processes to the surface that confront artists (and sometimes even scientists). The participating artists were asked to work on adapting these processes for presentation within an exhibition context. And in order to underline their process-oriented approaches, it was clear from the beginning that we, as curators, should try to leave a so-called classical contemporary presentation of artworks behind us and create an exhibition setting that focused on laboratory structure. But not only the systematic processes inherent in the artworks were to be explored in this way: more importantly, the laboratory—as site of experimentation, observation and practice— was to be brought into the exhibition space and made accessible to visitors.

Of course this approach is not new and Ars Electronica Center Linz has been testing this kind of laboratory structure since January 2009. For seven years now we have been displaying, discussing, and making practices accessible that are the focus of artists, scientists, and technologists. It goes without saying that a citizen's lab cannot, for example, include the entire diversity of existing laboratories or their high-end equipment. Nor can it meet the requirements of sophisticated scientific research. However, we can make experiments visible, discuss observations, and enable participants to gain some practice with the machines and processes on display: these are the parameters that we set and that guided us in our approach to establishing a laboratory structure within an exhibition context.

In shifting through the diversity of artistic practice to be presented in the *MATERIA PRIMA* exhibition, the works were divided into six labs, based on the phenomena which the artists had chosen to focus on. Each lab represents a selection of the artworks on display, and showcases them via images and texts that are related to the central topic of the lab.

BioLab

Gene Gun Hack, Rüdiger Trojok, 2012

The BioLab is represented by six works that explore recent questions in genetics. ***Drosophila titanus*** by **Andy Gracie** (UK/ES) is an ongoing and long-term project which through a process of experimentation and artificial selection aims to breed a species of the fruit fly, Drosophila, that would theoretically be capable of living on Saturn's largest moon, Titan. The project needs to adhere to a rigorous scientific methodology and framework in which the artist can act and at the same time artistically investigate concepts related to the topics of species, biological perfection, perception, and future life.

Gene Gun Hack by **Rüdiger Trojok** (DE) is a scientific instrument. The biologist Rüdiger Trojok succeeded in building one of his own and in slashing its cost to a mere 50 euros. Normally the gene gun is one of the most important tools used in modern biology. Many of today's genetically modified plants have been produced with this technology, which is a kind of a bio-ballistics device used to shoot a particle of gold coated with DNA into a cell. Trojok has not only provided a DIY version of a gene gun, he has at the same time critically questioned developments in genetic engineering.

Similar to Trojok, the artist **Matthew Gardiner** (AU) was inspired by the idea of using a gene gun in a similar way as the British police are said to use them: DNA sequences containing particular codes are deployed to mark suspicious persons with a shot from a special pistol. In his work ***Synthetic Memetic,*** Matthew Gardiner composed a DNA sequence in such a way that the series of nucleotide bases in it correspond to the letters of the song title "Never Gonna Give You Up" by Rick Astley, and then integrated them symbolically into a pistol. It is a reference to the viral systematics of this song that—having first topped charts world-wide in the 1980s—is still causing a commotion online: users who click on some seemingly innocuous headline, image, or video are unexpectedly redirected to Rick Astley's catchy tune.

Teresa Dillon (IE), **Naomi Griffin-Murtagh** (IE), **Claire Dempsey** (IE), and **Aisling McCrudden** (IE) are artists who once came together for a course on synthetic biology and posed the following question: Can animals be transformed into medical devices? ***Opimilk,*** as this Dublin-based team calls their idea, involves transforming the bovine organism into a living bioreactor, and so producing complete and effective medications that can be milked right from the cow's udder.

Drosophila titanus, Andy Gracie

ARS DNA Workshop, Ars Electronica Futurelab

Biopresence, Shiho Fukuhara, Georg Tremmel, 2003

Biopresence, Shiho Fukuhara, Georg Tremmel, 2003

Opimilk, Teresa Dillon, Naomi Griffin-Murtagh, Claire Dempsey, Aisting McCrudden, 2013-2014

Based on DNA systematics, a group of **Ars Electronica Futurelab** researchers asked during an **ARS DNA** workshop, how digital data might be stored to memory for 10, 100, or even 1,000 years without having to transfer it periodically to new data storage media? Now this question is not new, and so numerous labs are already working on it. But then the importance of this idea was transferred to a workshop with citizens in Linz and then to one in Gijon, where audiences were invited to understand the latest research on DNA as a medium for memory, as well as to convert their name or some other series of characters into a DNA sequence. Simultaneously they were asked to investigate how much they would have to pay today to have this done in a lab.

Biopresence by **Shiho Fukuhara** (JP) and **Georg Tremmel** (AT) creates "Human DNA Trees" by transcoding the essence of a human being within the DNA of a tree in order to create "Living Memorials" or "Transgenic Tombstones." *Biopresence* is collaborating with scientist and artist Joe Davis on his *DNA Manifold algorithm,* which allows for the transcoding and entwinement of human and tree DNAs.

Biopresence (JP/AT) is an art venture formed by Shiho Fukuhara and Georg Tremmel with the purpose of exploring, participating and ultimately defining the most relevant playing field of the 21st century: the impact of biotechnologies on society and the human perception of these coming changes. Biopresence creates Human DNA trees by transcoding the essence of a human being within the DNA of a tree in order to create "Living Memorials" or "Transgenic Tombstones." Biopresence is collaborating with scientist and artist Joe Davis on his DNA Manifold Algorithm, which allows for the transcoding and entwinement of human and tree DNAs. *www.biopresence.com*

Matthew Gardiner (AU) is an artist most well known for his work with origami and robotics. He coined the term Oribot 折りボト and then created the field of art/science research called Oribotics. Oribotics is a field of research that thrives on the aesthetic, biomechanic, and morphological connections between nature, origami, and robotics. Matthew Gardiner is currently an artist and senior lead researcher at Ars Electronica Futurelab, in Linz Austria. *www.matthewgardiner.net*

Andy Gracie (UK/ES) works across various disciplines including installation, robotics, sound, video, and biological practice. Recently his work has involved studies and reactions to the science of astrobiology; notions of the origins of life coupled with a re-examination of its boundaries. His practice employs scientific theory and practice to question our relationships with the environment and the notion of the "other" while simultaneously bringing into focus the very relationship between art and science. *www.hostprods.net*

Naomi Griffin-Murtagh (IE) studied at the National College of Art and Design Dublin and is now a product designer in Northern Ireland. Claire Dempsey (IE) has a degree in Immunology from Trinity College Dublin, and is currently working on her PhD at University of Birmingham. Aisling McCrudden (IE) has a degree in Human Health and Disease from Trinity College Dublin. This project is a result of a collaboration in an Idea Translation Lab in the Science Gallery, offered to TCD and NCAD students and coordinated by Dr Teresa Dillon (IE). The project ran over 12 weeks and the students had to pool their resources to come up with projects centered on the field of synthetic biology. The team asked the question, "What if farmers were pharmacists?" The answer they came up with was *Opimilk.* The project explores the potential of synthetic biology to use Opiorphin as an alternative to treat chronic pain. *www.behance.net/naomigriffinmurtagh*

Rüdiger Trojok (DE) studied systems and synthetic biology at Potsdam, Copenhagen (DTU), and Freiburg universities. He invented a novel contraceptive method based on genetically altered lactic acid bacteria, worked as a freelance consultant for the Office of Technology Assessment by the German Parliament on biohacking and synthetic biology, and has worked for the Institute for Technology Assessment and Systems Analysis at the Karlsruhe Institute of Technology on the EU *Synenergene* project since 2014. He is currently establishing a citizen science biolab in Berlin, and supports open-source biotechnology projects related to public life, politics, and the arts. *www.openbioprojects.net*

FabLab

The idea of making high-tech processes and flexible manufacturing equipment accessible to visitors is, of course, part of the exhibition concept. Hence LABoral's existing FabLab—and all its machines, tools and equipment—was transferred to the exhibition floor. In workshops visitors are trained to use them, and in doing so become part of this discursive exhibition project. In addition, the FabLab provides inspiration to participants via the artworks on display and/or the artists working there.

Asturian artist **María Castellanos** and Madrid native **Alberto Valverde** were two of the artists working in the FabLab during the exhibition. They explore certain man-machine relationships and intersections. Their work *Environment Dress* focuses on garments as a kind of sensory device for investigating variations in noise, temperature, atmospheric pressure, ultraviolet radiation, or the amount of carbon monoxide we are exposed to in our daily life. The person wearing this smart dress will receive direct feedback about his or her exposure through changes in the dress's lighting.

Another artwork on display is by Belgian artist **Nick Ervinck**. For *AGRIEBORZ* he used images of human organs that he found in medical manuals as construction material for creating organic forms, and then realized them in 3D. With his work he is questioning, on the one hand, the impact of rapid prototyping and 3D printing for medical research and, on the other hand, the influence of bioprinting technology in generating organs. Ervinck, who is working parallel to science, is developing new realities for different audiences in art, science, and beyond.

Nick Ervinck (BE) explores the boundaries between various media and fosters a cross-pollination between the digital and the physical, Studio Nick Ervinck applies tools and techniques from new media, in order to explore the aesthetic potential of sculpture, 3D prints, installation, architecture and design. Through his divergent practice, a strong fascination with the construction of space is noticeable. Not only does Nick Ervinck focus on the autonomous sculptural object, he also questions its spatial positioning and points to the phenomenological experience and embodiment of space. Ervinck's work in short oscillates between the static and the dynamic, prospecting new virtual or utopian territories. *www.nickervinck.com*

María Castellanos (ES), artist and researcher, who has a degree and a doctorate in Fine Arts from the University of Vigo, Spain. Her thesis, *La piel biónica. Membranas tecnológicas como interfaces corporales en la práctica artística,* deals with the technological prosthesis, focusing on the hybridizations among cyborgs and wearables, as a paradigm of expanding human sensorial capabilities. Currently she is an artist in residence at LABoral Centro de Arte y Creación Industrial, Gijón, Asturias, Spain. *mariacastellanos.net*

Alberto Valverde (ES), artist and technologist, has wide experience in system design, creation of interactive and multimedia environments, web design, and robotics. He taught in the Bachelor of Fine Arts program at University of Vigo, and is currently in the Master of Animation and Audiovisual Illustrated Book at the same university. In his work, Valverde investigates chaos as way of order, proposing the creation of random vectors, and focuses on the relationship between man and machine.

Environment Dress, María Castellanos , Alberto Valverde

AGRIEBORZ, Nick Ervinck

DataLab

When we look at how data has become the raw material of a new economy and the basis of a new culture, we see how important it is now to understand the technologies used to process data, the social and economic value of it, as well as the very special nature of digital data itself.

Digital data is like its own aggregate state, not of matter but of information; it is a distinctive type of information that takes on a distinctive form of appearance as soon as it becomes digital. In other words, when it is set free from physical boundaries as code, as a series of zeroes and ones that can be endlessly copied and distributed and transformed into any thinkable form of expression from words to sound to image, and—with 3D printing—even to physical objects.

The computer has become our universal memory machine and being able to deal with the very special powers of data has now become an ever more important skill. And this goes beyond mere media literacy; it involves the kind of understanding that enables you to become a creator instead.

This section featured artistic and scientific projects dealing with transformations between the virtual and physical state of data.

Agnes Mayer Brandis's *Teacup Tools* are part of a "Global Teacup Network" and draw attention to climate-related sciences. Her work consists of a table and machinery for raising two or more teacups individually. Various measuring instruments are built in and onto the teacups, measuring the environment of the cup. The energy produced by these instruments heats the inside of the cups and brews tea from rainwater and the residues that have fallen into it. This tea produces a little cloud that contains the essence of the local air. The cloud again feeds back into the system and becomes the subject of investigation for the tools connected to the cup. The teacups move up and down individually, according to certain aspects related to the collected data and environmental processes, dancing an endless choreography determined by raindrops and clouds, particles, measurements, and tea drinking.

Another data collecting project is *ARTSAT1: Invader*, which was launched on 28.02.2014 (JST). It was the world's first art satellite sent into orbit as a piggyback payload onboard the H-IIA F23 launch vehicle, and inserted into a non-sun-synchronous orbit at an altitude of 378 km and inclination of 65 degrees. Invader, a 10-cm 1U-CubeSat with a mass of 1.85 kg, continued its steady operation in orbit. It also successfully performed an array of artistic missions based on commands from the main ground station at Tama Art University and under the guidance of the ARTSAT: Art and Satellite Project team. The mission included algorithmic generation and transmission of synthesized voices, music, and poems, as well as capturing and transmitting image data and communicating with the ground through a chatbot program.

ARTSAT1: Invader

Teacup Tools, Agnes Mayer Brandis

Lapillus Bug, Yasuaki Kakehi, Takayuki Hoshi, Kono Michinari

Mobile Instrument, María Ignacia Edwards

Chijikinkutsu, Nelo Akamatsu

GeoLab

Space and time related data and phenomena in physics and mathematics are the main parameters defining the *MATERIA PRIMA's* GeoLab. All the artworks presented here can be seen as an experiment in visualizing causalities and correlations on earth and beyond.

María Ignacia Edwards's (CL) *Mobile Instrument*, for example, works with equilibrium, lightness, and the weightless-ness of objects, which she brings into balance by deploying their own weight or counterweights. Though, at first glance, her works are perceived as purely aesthetic, artistic objects, it soon dawns on those who behold them that these constructions are the result of elaborate mathematical and physical calculations, mechanisms, solutions, and interventions. María Ignacia Edwards calls these pieces self-sustainable because they require no more than their own weight to exist, and the objects tend to rotate constantly around their own axis.

Chijikinkutsu by **Nelo Akamatsu** (JP) is a coinage, combining two Japanese words: "Chijiki" means geomagnetism. It is about terrestrial magnetic properties that have always existed and affect everything on earth, even though they cannot be perceived by the human senses. A "suikinkutsu" is a sound installation for Japanese traditional gardens, invented in the Edo period. The sounds of drops of water falling through an inverted earthenware pot buried under a stone wash-basin resonate through hollow bamboo tubes. *Chijikinkutsu* is made using water, sewing needles, glass tumblers, and coils of copper wire. The needles floating on the water in the tumblers are magnetized in advance, so they are affected by geomagnetism and turn them-selves in a north-south direction. When elec-tricity is supplied to the coils attached to the outside of the tumblers it creates a temporary magnetic field that draws the needles to the coils. And the faint sound of the needles hitting the glass resonates in the space all around.

Acoustic levitation is the secret behind *Lapillus Bug* by the three Japanese artists **Yasuaki Kakehi, Takayuki Hoshi,** and **Kono Michinari**. Similar to a fruit fly, Lapillus Bug flits about over the table, interacts with people, and reacts to light and motion. But here's the interesting part—it's just a Styrofoam particle kept aloft by sonic waves out of the range of human hearing. Ultra-low frequencies produce standing waves that let the little bug hover—thanks to a phenomenon called acoustic levitation. The point of this work is to breathe life into an inanimate object by means of external forces.

Nelo Akamatsu (JP) creates art works across several media such as installations with electric devices, event installations, video installations, sculptures, paintings, and photos. He has an MFA from the Department of Intermedia Art, Tokyo National University of Fine Arts and Music, 2005. Golden Nica of Prix Ars Electronica (2015), Taro Okamoto Award of Contemporary Art (prize 2004, 2014), solo exhibition at the Italian Embassy in Tokyo (2009), joint exhibition at Bauhaus University in Weimar (2004). *www.neloakamatsu.jp*

María Ignacia Edwards (CL). The artist's work has its origin in her efforts to be an active observer of the world, investigating different phenomena and the relationship to human beings. Her work has been exhibited in Chile and internationally. She received the "Art for Science" award from the National Commission for Scientific and Technological Research (CONICYT) in Santiago, Chile. She was the first artist in residency in the framework of the European Art and Science Network. *www.aec.at/artandscience*

Yasuaki Kakehi (JP) is a media artist and an interactive media researcher. He works at Keio University and MIT Media Lab. His works have been exhibited at a lot of exhibitions including ACM SIGGRAPH and Ars Electronica Festival. He developed the *Lapillus Bug* with Michinari Kono, who is a PhD student at the University of Tokyo. This art piece is based on an ultrasound-based non-contact actuator developed by Takayuki Hoshi, who is an assistant professor at Nagoya Institute of Technology. *www.xlab.sfc.keio.ac.jp/~kakehi/*

Visualization Lab

Fifty Sisters, Jon McCormack

Besides the fact that the artists in the DataLab have a very strong relationship to the visualization of their data, we wanted to focus here on the diversity of visualization processes, in particular when it comes to the question of visualizing scientific topics and the socio-political impact of visualizing data, as well as the artist as subjective interpreter.

Since 1968, scientist-artist **Cornelia Hesse-Honegger** (CH) has been painting pictures of flies and other bugs that have mutated as a result of environmental contamination and atomic radiation. Since the Chernobyl melt-down in 1986, she has collected more than 16,000 insects in the fallout zones of Chernobyl and nuclear facilities in Asia, Europe, and the US under the title of *Seh-Forschung* (Vision Research). She calls her approach "knowledge-art" and is still continuing her work on it. In October 2015, she received the Nuclear Free Future Award in the category education.

Jon McCormack's *Fifty Sisters* are the counterparts of Cornelia Hesse-Honegger's handmade drawings. Since the late 1980s McCormack has worked with computer code as a medium for creative expression. Inspired by the complexity and wonder of a diminishing natural world, his work is concerned with electronic "post-natures"—alternate forms of artificial life that may one day replace the biological nature lost through human progress and development. Fictional visualization is also practiced by the artist Nick Ervinck, who was presented earlier within the context of the FabLab. At first sight his 3D printed objects look as if they have been made for medical research, however, as soon as you understand that his work is not about existing bodies, you start imagining the creatures behind the objects on display.

Jon McCormack (AU), electronic media artist and academic, works since the late 1980s with computer code as a medium for artistic expression. He holds degrees in Applied Mathematics and Visual Art, and a PhD in Computer Science. His work is concerned with electronic 'after natures'—alternate forms of Artificial Life that may one day replace the biological nature lost through human progress and development. The monograph *Impossible Nature: the art of Jon McCormack* (2005) documents his creative achievements and reflects on the inherent philosophical and creative ideas. He is currently research professor at Monash University, Melbourne. *jonmccormack.info*

Cornelia Hesse-Honegger (CH), born 1944 in Zurich. Zurich School of Applied Art then 25 years as a scientific illustrator apprentice, Zoological Museum, University of Zurich. After Chernobyl, study of leaf bugs and plants near nuclear power plants in Sweden, Ticino, Switzerland (1989), and Chernobyl, Ukraine. Articles published on deformed leaf bugs and Drosophila flies, study of leaf bugs' health near reprocessing plants Sellafield, UK (1989), La Hague, France (1999), and nuclear power plants Three Mile Island and Peach Bottom Plant, Pennsylvania, US (1991) as well as Krümmel and Stade (1995), and Gundremmingen in Germany (2002). Further leaf bug studies near nuclear test areas In Nevada and Utah (1997) and Hanford (1998). 1992–1999 *After Chernobyl* exhibition in Europe and Canada. Since 1994 cooperation with Locus+, UK, organizers of *The Future's Mirror* exhibition and book. Publication of *Heteroptera* (1998, German, 2003, English version). Successful collaboration with silk manufacturer Fabric Frontline, Zurich, from 1986 that financed all her research. *www.wissenskunst.ch*

Fifty Sisters, Jon McCormack

Seh-Forschung , Cornelia Hesse-Honegger
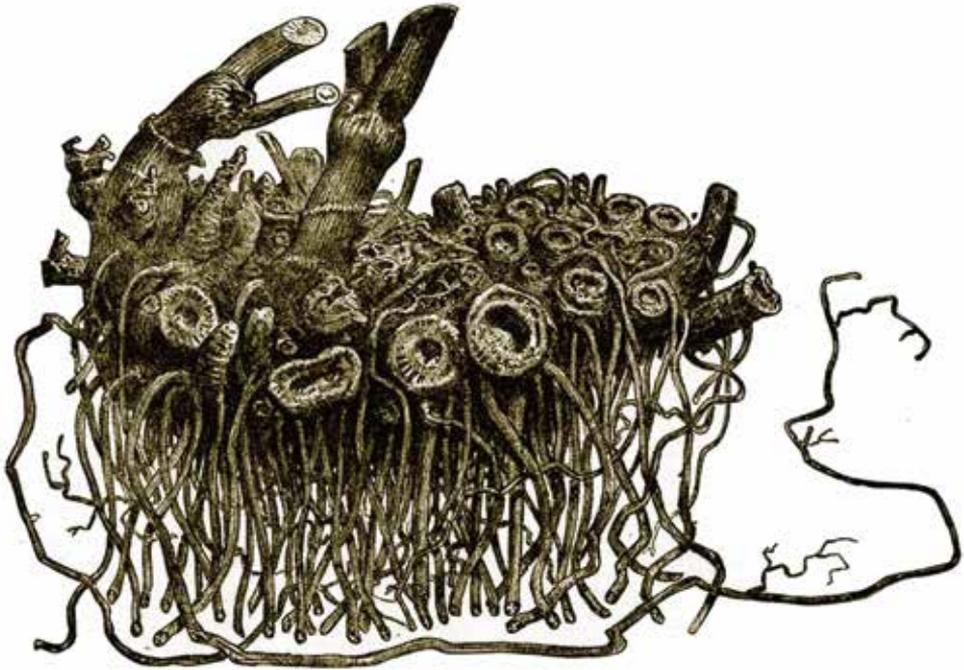
Econodos. Transferencias, Las artes, las ciencias y las nuevas formas de lo local, 2015. Imagen del King's American Dispensatory, 1898

Philosophy Lab

While the labs depicted so far have had primarily to do with practices, methods, and processes in art and science, we want to conclude by discussing the role of the artist/scientist/citizen, and robot or machine. Confronted with the situation that machines are assuming ever more responsibilities, we need to recognize that it is still we humans who have to program them, and to code algorithms based on our experiences and knowledge. But what if in complex situations machines have to decide between life and death? Or whether to help others or themselves? Or to aid an old person or a child? What does responsibility during scientific or artistic processes mean within the context of technological developments?

The excursive project ***Transferences – Arts, Sciences and New Forms of the Local*** by **Lorena Lozano** (ES) puts forward the idea of the plurality of the arts and sciences, and the need to generate collaborative processes of knowledge transference to strengthen common knowledge. This laboratory is an open office, a participatory and propositional place for active listening and rethinking the role of artists and researchers. The activities in this lab develop in six open encounters that include presentations, interviews, and debates.

In addition to Lozano's excursive project, **Patricia Piccinini** presented *The Listener*. This humanoid figure that her crew painstakingly put together out of silicon, fiberglass, and human hair doesn't seem the least bit threatening. Actually, its vulnerability is what leaves the strongest impression. With a friendly look on its face, it seems to be seeking acceptance and hoping that we are not put off by its strangeness. In a world in which human beings can use new technologies to modify and reform the creatures of nature, in which the diversity of life has reached a new stage, and in which new possibilities of synthetic biology bring forth more questions than answers, we mustn't lose our capacity for empathy. And so the question arises: Can a code for empathy be written for a machine and, if so, what challenges will we have to face in the future?

Lorena Lozano (ES) is an artist and researcher, PhD from University of Oviedo, (Spain, 2017), graduated in Fine Art (Glasgow School of Art, Scotland, 2007) and Biological Sciences (University of Oviedo, 1998). Her research connects knowledge and methodologies from art and from science. She is a founding member of ecoLAB, an experimental laboratory in Art, Ecology and Open Electronics (LABoral Centro de Arte 2011-12); and a co-founder of Econodos – an Ecology and Communication platform. *lorenalozano.net*

Patricia Piccinini (AU) is a multidisciplinary artist who works painting, video, sound, installations, digital printing, and sculpture. Considered one of the most important Australian creators of their time, in 2014 was awarded the Artist Awards Melbourne Art Foundation's Awards for the Visual Arts. *www.patriciapiccinini.net*

Sergio Redruello/LABoral

The Listener, Patricia Piccinini, 2012

Monsters of the Machine
Exhibition
21.09.2017 – 13.01.2018

Monsters of the Machine is a contemporary take on Mary Shelley's Frankenstein and asks us to reconsider her warning, that scientific imagining and all technologies have unintended and dramatic consequences for the world.

Curated by Marc Garrett, co-director of *Furtherfield.org*

Monsters of the Machine
Frankenstein in the 21st Century

Monsters of the Machine is a contemporary take on Mary Shelley's *Frankenstein* that asks us to reconsider her warning that scientific imaginings and all technologies have unintended and dramatic consequences for the world. It also invites us to ask the same questions about the arts and human imagination. Shelley's classic gothic novel was written 200 years ago in 1816 and published anonymously in London in 1818. Dr. Frankenstein plays the role of the Promethean scientist, a creative genius and a narcissist, who is tangled up in his own individual desires and exploits others in an irresponsible and abusive drive to control nature. But who is the real monster? Dr. Frankenstein or the poor wretched mutant he brought to life? And are we Dr. Frankenstein, or the suffering mutant, or both? The questions raised in the exhibition consider the roles of our arts and science traditions and examine other issues of everyday life as they are played out in the Anthropocene, such as climate change, gender politics, ethics, governance, surveillance, posthumanism, transhumanism, hacking, biohacking, colonialism, neoliberalism, biopolitics, and accelerationism.

In this exhibition, visitors experience artworks in which the human genome is used as the basis for a poetry machine that plays back a self-assembling video montage spanning the thirteen years it took to complete the first documented human DNA sequence in the *Human Genome Project*. It is both a memorial to and an algorithmic visualization of a historic scientific landmark. 3D printed avatars, representing bodies distorted in pain in relation to virtual worlds, where there's no geography and the result is the crack / wound, everywhere and nowhere. Visitors participate in a software-driven installation, a performative social neuroscience experiment to discover our shared psychological biases. A surreal video installation shows us a dystopian blend of "reality" out in the remote Australian desert with traditional ghost stories and dreamtime stories, mixed with science fiction. The Sahara Desert is remapped by a custom bot in an algorithmically scripted performance, traversing the data-scape of Google Maps and filling a Tumblr blog and its data centers. Artists take our bio-matter and the inconceivable quantities of data that we generate in our daily lives as materials with an inherent recombinant intelligence and the power to

generate (without the intervention of human will) the narratives of human destiny and more. Do we inhabit our own bodies anymore, or do we share our body materials out for others to measure, reshape, and construct, data-scrape and manage remotely? Arthur Kroker in *Body Drift: Butler, Hayles, Haraway* says that, "we no longer inhabit a body in any meaningful sense of the term but rather occupy a multiplicity of bodies—imaginary, sexualized, disciplined, gendered, laboring technologically augmented bodies." [1,2]

Artists and scientists work with the same tools, frameworks, and archetypes. There are crossovers, it's no surprise that we find the boundaries of imaginative fantasy and objective reality breaking down. Take for instance, the jellyfish invasions around nuclear reactors in Japan, Israel, Sweden, and the Scottish plant in Torness. The natural world is writing its own science fiction into a new reality, with vivid images and outlandish outcomes. Right now, the classic techno-utopian dream of computers liberating us all and providing the tools that will underpin global democratization, seem a long way off and even somewhat sterile. Since the news stories broke of mass surveillance of Internet users by NSA

and Prism, we've experienced new formulations of mutual surveillance and manipulation everyday. So now we stand on the edge of a precipice: What choice do we have but to jump into this sea of dysfunctional dystopias, and to directly observe for ourselves what we have become and what we will be—the *Monsters of the Machine*.

Source: *http://www.laboralcentrodearte.org/en/exposiciones/monsters-of-the-machine*

The exhibition draws upon ideas from Marc Garrett's essay "Prometheus 2.0: Frankenstein Conquers the World!". *http://www.furtherfield.org/features/prometheus-20-and-our-god-complex*

1 Kroker, Arthur (2012). *Body Drift: Butler, Hayles, Haraway (Posthumanities)*. University of Minnesota Press: Minnesota.
2 See Garrett, Marc (15.08.2015). "Body Drift: Butler, Hayles and Haraway." Review. *http://www.furtherfield.org/features/reviews/body-drift-butler-hayles-and-haraway*

Equipo Sauti ya wakulima

Sauti ya wakulima, 2011
Interactive installation

Sauti ya wakulima proposes that agricultural knowledge, shared and defended as a common good, can help farmers to resist the onslaught of climate change. Since 2011, *Sauti ya wakulima* has invited groups of farmers who live and work in Tanzania to produce and share audiovisual records of their daily practices. By means of smartphones and a website, the participants documented and published their knowledge about techniques of adaptation to climate changes, their needs and aspirations, on the Internet. All this reinforced the mutual support networks that can help them in times of adversity.

Original participants: Abdallah Jumanne, Mwinyimvua Mohamedi, Fatuma Ngomero, Rehema Maganga, Haeshi Shabani, Renada Msaki, Hamisi Rajabu, Ali Isha Salum, Imani Mlooka, Sina Rafael
Coordinator: Hamza Suleyman
Scientific counsel: Angelika Hilbeck (ETH Zurich), Flora Ismail (University of Dar es Salaam)
Direction & programming: Eugenio Tisselli

Eugenio Tiselli (Equipo Sauti ya wakulima) (MX), 1972, is an artist and computer systems engineer with a doctorate from Plymouth University. He is currently directing the project *ojoVoz,* an open source platform for the creation of community memories. As part of *ojoVoz,* he has held extended workshops with peasant farmers in Tanzania and Mexico, in which the participants have been involved in different dynamics of collaborative writing. *ojovoz.net.*

Mary Flanagan (US)
Help me Know the Truth, 2016
Interactive software

Help me Know the Truth is a participatory artwork in which visitors to the exhibition become a part of the work across the gallery. Participants first snap a digital portrait at a small photo booth at the entrance to the show. In front of the installation, they can choose between two slightly altered portraits to match the text label shown on the screen. By selecting the slight variations of images over time, differing facial features emerge that reveal larger unconscious beliefs about facial features or tendencies related to culture and identity. The intent behind the work is to both utilize and question how computational techniques can uncover the categorizing systems of the mind, and how they are therefore subject to socially constructed fears and values.

Courtesy: Mary Flanagan
Acknowledgements: Jared Segal

Mary Flanagan (US). Her work explores the anxious and profound relationship between technological systems and human experience, with a focus on games, play, emotion, and deeply held unconscious biases. Her artwork ranges from game-based systems to computer viruses, embodied interfaces to interactive texts; these works have been exhibited internationally. Flanagan's approach to games and technological systems occupy both onscreen space as well as move away from the screen to push reflection on familiar relationships to play, politics, and the personal. *maryflanagan.com*

Fernando Gutiérrez (ES)
The Brain of the Planet, 2016
Site-specific graphic intervention

The Brain of the Planet presents an army of dysfunctional bionic creatures within a retrofuturist, dystopic aesthetic. The project offers a romantic, B-movie paleofuture, the future that was imagined in the past, which is playful, ironic, and profoundly emotional. The project is based on the Weird Menace aesthetic of pulp fiction classics from the early decades of the twentieth century, when the pioneers of science fiction—the heirs of Mary Shelley—expressed fears that machines would rebel against their creators and imagined lost lands and remote worlds. The piece explores the relationship between man and machine and asks questions about the problems of our identity in relation to current bio-technological experiments and genetically malleable machines.

Produced by: LABoral Centro de Arte y Creación Industrial

Fernando Gutiérrez (ES) holds a BA in Fine Arts from the University of Salamanca and has developed most of his artistic activity from pictorial premises. His production has revolved around drawing, which he chose to recover for its simplicity and immediacy, experimenting with different procedures and techniques that ultimately incorporate collage as a working process and animation as a visual support. *www.fernandogutierrez.es*

Lynn Hershman Leeson (US)
Infinity Engine, 2013-2014
Installation

Lynn Hershman Leeson asks us to "imagine a world in which there is a blurring between the soul and the chip, a world where artificially implanted DNA is genetically bred to create enlightened and self-replicating intelligent machines, which perhaps use a body as a vehicle for mobility."
(Hershman Leeson, Lynn, *Civic Radar,* 2016, Hatje Cantz, p. 331)

Infinity Engine examines these critical issues which cross between reality, fear, and fantasy. Through the wallpaper, the installation replicates some of the paraphernalia found in genetics labs, as well as hybrid animals and plants whose patent is legally owned by bio-companies involving genetic engineering. This installation is part of a project that has been exhibited around the world. It was (partially) commissioned by ZKM, Center for Art and Media Karlsruhe, and it questions the ethics of the biotechnology industry.

Loan: ZKM Center for Art and Media Karlsruhe

Lynn Hershman Leeson (US). Over the last five decades, artist and filmmaker Lynn Hershman Leeson has received international acclaim for her art and films. She is recognized for her innovative work investigating issues that are now recognized as key to the workings of society: the relationship between humans and technology, identity, surveillance, and the use of media as a tool of empowerment against censorship and political repression.
www.lynnhershman.com

Shu Lea Cheang (CN)
UKI viral love, 2013
Installation

UKI viral love is the sequel to Cheang's acclaimed cyberpunk movie *I.K.U.* conceived in two parts—a viral performance and a viral game. The story is about coders dispatched by the Internet porn enterprise GENOM Corp, to collect human, orgasm data, for consumption via a mobile phone plug-in. Deprived of data in a post-net crash era, these coders are suddenly dumped in an e-trashscape environment where hackers and coders are forced to scavenge through techno-waste. These defunct replicants also seek parts and codes to resurrect themselves.

Performers: Radie Manssour, Maria Llopis
Photo: Rocio Campana
UKI viral love is part of the UK project developed with collaborations and residencies at: Hangar media lab (Barcelona), Medialab Prado (Madrid), LABoral Centro de Arte y Creación Industrial [Plataforma Cero] (Gijón,), Imaginarium (Tourcoing)
Installation in Gijón in collaboration with: EMULSA, Gijón

Shu Lea Cheang (CN) is an artist, filmmaker, and networker. She constructs networked installations and multi-player performances in participatory impromptu mode and drafts sci-fi narratives in her film scenarios and artwork imaginations. She builds social interface with transgressive plots and open network that permits public participation. Since her relocation to Eurozone in 2000, Cheang has taken up large scale installation and networked performance and co-founded several collectives to pursue cross-disciplinary projects.
*www.mauvaiscontact.info*

Marcos Morilla/LABoral

[AOS] Art is Open Source (IT)
La Cura: Everything , 2016
Generative video and cards

"In September 2012, artist Salvatore Iaconesi got the diagnosis. He had a glioma (glial cell brain cancer) on the surface of his right hemisphere. Upon asking to see all the data relating to his condition, he found that all of the documents, MRI scans and so on, were in obscure, not readily used formats. This meant that if one wanted to view the data, you needed specific or corporate software." (Patrick Lichty, 2012). The artists hacked all the files and uploaded them to the internet, looking for an open source cure. *La Cura* is a global participatory performance that transforms the meaning of the word "cure"—bringing it out of the separated spheres of administration and bureaucracy, back into society.

Acknowledgements: Kilowatt Bologna
Collaborators: all the participants in *La Cura,* all over the world

AOS – Art is Open Source (IT) started in 2004 as an interdisciplinary research laboratory focused on merging artistic and scientific practices to gain better understandings about the mutation of human beings and their societies with the advent of ubiquitous technologies. AOS was created by Salvatore Iaconesi (engineer, hacker, artist, designer, TED Fellow, Eisenhower Fellow, Yale World Fellow, and professor in Interaction Design at ISIA Design University in Florence) and Oriana Persico (social scientist and artist) and now includes more than 200 artists and researchers from across the world. *www.artisopensource.net*
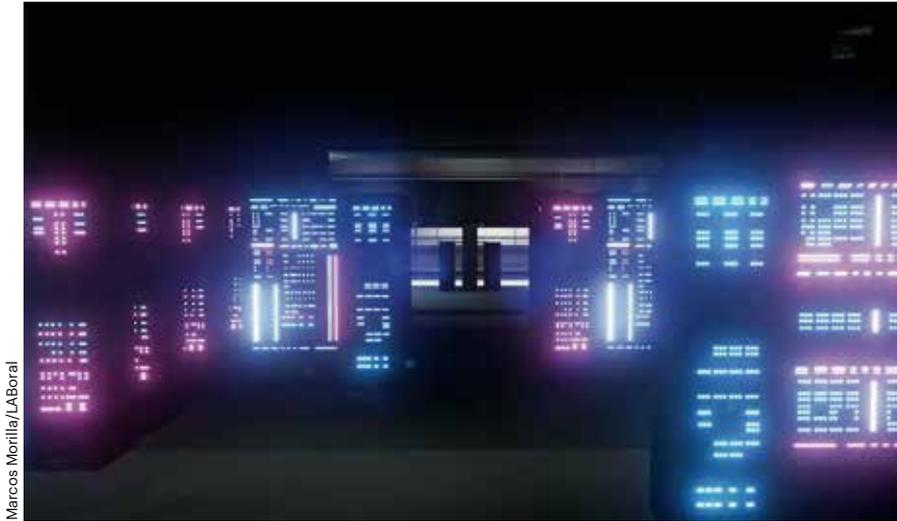
Regina de Miguel (ES)
Una historia nunca contada desde abajo, 2016
HD video and 3D animation

The starting point is one of the most radical and unusual cases in the recent history of communication technologies, the project *Cybersyn or Synco*. This project, which was directed by the cybernetic visionary, Stafford Beer, was set up in Chile between 1971 and 1973 during the government of President Salvador Allende. It came to an abrupt end as a result of the coup led by Augusto Pinochet. Based on the story of the Freedom Machine, which proposed to "deliver the tools of science to the people," and other paradigmatic scenarios linked to the notion of disappearance and buried knowledge, the result is a filmic narrative, divided into acts, combining elements of the historical documentary, science/political fiction, and psychological portrait.

Film produced thanks to the Grants for Video Art Creation of Fundación BBVA

Regina de Miguel (ES) is an artist who acts as a critical, interdisciplinary agent in processes and confluences orientated towards the production of hybrid objects and knowledge. Some of her projects deal with strategies for the formation of desire and its visualization as a psychosocial landscape. In the same vein, she also analyses the speculative, fictional boundary contained within scientific and cultural objects. *cargocollective.com/reginademiguel*

Marcos Morilla/LABoral

Carla Gannis (US)
The Garden of Emoji Delights, 2014
Digital C-print and video

In *The Garden of Emoji Delights*, the artist creates a mash between popular historic and contemporary sign systems, and expands the Emoji lexicon through this process. Emoji are a contemporary glyph system, which offer shorthand for virtual expression. The pleasurable stylizations are ubiquitous worldwide and across generations. Translating iconography of an earlier era by using Emoji seems to makes perfect "nonsense sense" to her. The artist produced both a 2D print and moving image version of the "emojified garden." The static work is a direct homage to Bosch—deeply tied in scale and physicality to the original. The moving image version allowed Gannis to be more dynamic with a hybrid visual vocabulary.

Courtesy: Carla Gannis & TRANSFER Gallery

Carla Gannis (US) identifies as a visual storyteller. With the use of 21st century representational technologies she narrates through a digital looking glass where reflections on power, sexuality, marginalization, and agency emerge. She is fascinated by digital semiotics and the situation of identity in the blurring contexts of physical and virtual. *carlagannis.com*

Joana Moll (ES) & Cédric Parizot (FR)
The Virtual Watchers, 2016
Website

The Virtual Watchers is an on-going research project existing at the intersection of art, research and technology. It questions the dynamics of crowdsourcing, national security and border control, through social media. It focuses on the exchanges that occurred within a Facebook group that gathered American volunteers ready to monitor US-Mexico border through an online platform that displayed live screenings of CCTV cameras, in real-time. The declared aim of this operation was to get American citizens to participate in reducing border crime and block the entrance of illegal immigration to the US by means of crowdsourcing.

Marcos Morilla/LABoral

Joana Moll (ES) is an artist and a researcher. Her work critically explores the way post-capitalist narratives affect the alphabetization of machines, humans, and ecosystems. Her main research topics include Internet materiality, surveillance, online tracking, critical interfaces, and language. *www.janavirgin.com*
Cédric Parizot (FR) is a researcher in anthropology at the Institute of Research and Studies of the Arab and Muslim Worlds (CNRS/Aix Marseille University). He received his PhD, which focused on electoral processes among the Negev Bedouin (Israel), in 2001 from the École des Hautes Études en Sciences Sociales (Paris). After this, he refocused his research on mobility and bordering mechanisms in the Israeli-Palestinian spaces.

Guido Segni (IT)
A quiet desert failure, 2015
Algorithmic performance, Website, Tumblr archive

This is an ongoing, online, real-time, algorithmic performance by Guido Segni, started in 2013. In its own way, it's a monumental piece about internet contents, emptiness, time, storage, memory, oblivion, and—ultimately—failure. The artist programmed an Internet bot, a program that simulates a human activity, to traverse the data-scape of Google Maps in order to fill a Tumblr blog and its data centers with a remapped representation of the whole Sahara Desert, one post at a time, every 30 minutes. The project is part of *Data fillings,* a series of conceptual web-based works exploring the idea of filling both the surface and the physical references (the data centers) of the Internet with (apparently?) worthless information.

Courtesy: Guido Segni
Collaborators: Fabio Angeli, Lorenzo Del Grande

Marcos Morilla/LABoral

Guido Segni (IT). With a background in Hacktivism, Net Art and Video Art, Guido Segni, aka Clemente Pestelli, lives and works somewhere at the intersections between art, pop internet culture, and data hallucination. Mainly focused on the daily (ab)use of Internet, his work is characterized by minimal gestures on technology which combine conceptual approaches with a traditional hacker attitude in making things odd, useless and dysfunctional. *guidosegni.com*

Marcos Morilla/LABoral

Avataurror 2012-2013
Alan Sondheim (US)
3D printed plastic

The word *Avataurror* is a remix combining avatar, toro, and terror. This series of 3D-printed objects are modified motion capture mappings, taken from physical dance performances and outputs. The artist is interested in distorted, wounded, problematic avatars and their relationship to states of violence and genocide. Sondheim's works represent a kind of un-utterability, where the reality of flesh and pain dominates across any language and any form of representation. How does one act, when whole cultures are wiped out? How does one resist, when resistance is accompanied by unbelievable pain? How does one exist in war zones, how does one endure? As violence increases around the world, these questions are paramount; we must continue in spite of everything, we must learn to listen, to heal, to calm, to persevere?

Alan Sondheim (US) is a Providence-based new media artist, musician, writer, and performer concerned with issues of virtuality, and the stake that the real world has in the virtual. His current work is concerned with issues of anguish online and off. Sondheim is interested in examining the grounds of the virtual and how the body is inhabited. He performs in virtual, real, and cross-over worlds; his virtual work is known for its highly complex avatars and avatar distortions. *www.alansondheim.org*

Thomson & Craighead (UK)

Stutterer, 2014

Two-channel moving images, generative software

Stutterer is a poetry machine that uses the human genome like a music score to play back a self-assembling video montage spanning the 13 years it took the *Human Genome Project* to complete the first documented human DNA sequence. The four nucleotide bases of a DNA strand are represented by letters and *Stutterer* plays (or would play—if it were to run continuously for more than 80 years) all 3.2 billion letters representing the human genome.
Stutterer is a human monument of sorts, which seeks to connect our biological fabric with our unique linguistic abilities.

Programming: Matt Jarvis
Commissioned by LifeSpace Science Art Research Gallery with support from The Wellcome Trust
On loan: University of Dundee Museum Services

Thomson & Craighead (UK) have shown extensively at galleries, film festivals, and for site-specific commissions in the UK and internationally. Much of their recent work looks at networked global communications systems and how they are changing the way we all understand the world around us.

Genetic Moo (UK)

Animacules, 2009

A dark and interactive sea of wiggling, luminescent creatures that gorge on torchlight.

Animacules was inspired by the 19th century sea life illustrations of Ernst Haeckel and the work of the 17th century Dutch scientist Antonie van Leeuwenhoek who invented one of the earliest microscopes. Leeuwenhoek was the first to describe what we now know to be micro-organisms as living molecules, which he christened "animalcules." *Genetic Moo* presents a swarm of fanciful small creatures whose body shapes recall the microscopic life of the sea, ponds, and saliva. This interactive installation belongs to a series of works that explores the theme of an imagined future involving human evolution and it playfully considers alternative propositions of body and mini-molecule combinations to the cerebro-centric norm.

Marcos Morilla/LABoral

Genetic Moo (UK) creates playful interactive art using open source software and a range of low-tech sensors, including webcams, microphones, and Kinect. Their work draws widely from science, particularly in the areas of evolution, mutation, and artificial life. Since 2008, they have been building a digital bestiary based on "imagined future evolutions," where human development is driven by sensual rather than cerebral influences. *www.geneticmoo.com*

Karolina Sobecka (PL)

Medusa FPS, 2016

Computer game

Marcos Morilla/LABoral

A First Person Shooter game in which the gun is a AI-aided robotic weapon that helps to determine when to shoot, fires automatically on its field of view, and guides the player's hand to aim more effectively. The player cannot drop the weapon or stop it from firing, but he/she can obstruct it (and the gun's) vision. The object of the game is to shoot as few people as possible. This game is a reflection on the intelligent robotic weapon systems the military is using in order to distribute agency between a team of men, the algorithm, and the machine, Thus, the accountability remains scattered across a complex concatenation of human and non-human actors.

Karolina Sobecka (PL) is an artist and a designer. Her recent projects focus on techno-optimism as a way of investigating the values that drive technological innovation and shape the philosophy that inscribes humans in nature. Karolina's work has been shown internationally and has received numerous awards. *www.gravitytrap.com*

Gretta Louw (AU/DE)
Colonise the Cloud, 2016
Video

This series of animated GIFs unpacks the incredibly cynical, manipulative marketing around the so-called "cloud"; the way that the language and images used to describe the service imply an ethereal data-heaven disembodied, pure, and safe. The reality is everything that its depiction is not. In this series, the jellyfish—one of the few sea creatures that seems to benefit from the pollution that human industry spreads through the oceans—becomes symbolic of the amorphous, inscrutable network, the cloud that seems to be one thing but reveals itself, upon closer inspection, to be another.

Marcos Morilla/LABoral

Marcos Morilla/LABoral

Gretta Louw & Warnayaka Art Centre
Future Present Desert, 2016
Video installation

This work is a new single channel video installation, including physical elements, made on location in Lajamanu, a Warlpiri community in central Australia. The piece is a surreal, dystopian blend of "reality", traditional ghost and dreamtime stories, personal experiences of the Warlpiri artists, and science fiction. There is an investigation of the ways in which culture and technology intertwine and how technology is appropriated by marginalized communities and used for their own purposes.

Coproduced: LABoral Centro de Arte y Creación Industrial & Warnayaka Art Centre
Acknowledgements: the Lajamanu community and Lajamanu elders, the traditional land owners, the Warnayaka Art and Cultural Aboriginal Corporation

Gretta Louw (AU/DE) was born in South Africa but grew up in Australia; she received her BA in 2001 from the University of Western Australia and Honours in Psychology in 2002, subsequently living in Japan and New Zealand before moving to Germany in 2007. In 2012, she released her first book, *Controlling_Connectivity: Art, Psychology, and the Internet* (a limited edition artist's book about her durational online performance of the same name), followed in 2013 by *Warnayaka Art Centre: Art in the Digital Desert,* and in 2014 her first catalogue, *Works / Arbeiten 2011–2014*.

Science Gallery
at Trinity College Dublin

SCIENCE GALLERY

Since 2008, Science Gallery at Trinity College Dublin has steered its mission to ignite creativity and discovery where science and art collide, acting as a porous, creative membrane between the university and the wider community. We achieve this by encouraging our audience to discover, express, and pursue their passions through an ever-changing program of exhibitions, events, and experiences, all vividly brought together at this dynamic, creative intersection.

The cutting-edge program at Science Gallery Dublin encourages young people aged 15 to 25 to learn through their interests. Since its opening, nearly 3 million visitors to the gallery have experienced more than 40 unique exhibitions, ranging from living art experiments to artificial intelligence and from the future of the human race to the future of play. Our programs are fuelled by the expertise of scientists, researchers, students, artists, designers, inventors, creative thinkers, visionaries, entrepreneurs, and more. Our exhibitions are primarily curated through an open call, supplemented by invited and commissioned work. The work is then communicated by our staff on the floor, who are mediators in the same age bracket as our target audience. They act as the public face of the gallery, expanding on the content and allowing for peer-to-peer contact. The focus is on providing compelling experiences that allow visitors to participate, facilitating social connections, providing an element of surprise, and provoking questions to find new ways to think about big global challenges. This is supported by events and education programming as well as off-site activities, including those of our makerspace, MAKESHOP.

In 2012, Science Gallery International launched as an independent non-profit, aiming to create the world's first university-linked network dedicated to public engagement with science and art. Their work is the activation and expansion of a vision to catalyze the creation of the world's leading network for involving, inspiring, and transforming curious minds through science. The galleries, pop-up programs, and touring exhibitions of the Global Science Gallery Network are founded on the belief that young people hold the creative potential to tackle the world's biggest challenges. The Network has already reached millions of 15- to 25-year-olds worldwide. In addition to Science Gallery Dublin, galleries and programs are currently in development at Ca' Foscari University of Venice, King's College London, Indian Institute of Science in Bengaluru, Michigan State University, and the University of Melbourne.

dublin.sciencegallery.com
@SciGalleryDub

Science Gallery at Trinity College Dublin
Activities

Exhibitions

TRAUMA
Exhibition
Science Gallery Dublin
20.11.2015 – 21.02.2016

SEEING
Exhibition
Science Gallery Dublin
24.06. – 25.09.2016

HUMANS NEED NOT APPLY
Exhibition
Science Gallery Dublin
10.02. – 21.05.2017

SOUND CHECK
Exhibition
Science Gallery Dublin
09.06. – 24.09.2017

Workshop

Educational workshop – art
Science Gallery Dublin
15.10.2015
Human body textile design workshop
Eimear Kinsella

Train of Thought
(Educational workshop – art)
Science Gallery Dublin
19.11.2016
Train of Thought
Aoife Van Linden Tol (artist) &
Gabrielle Sellen (workshop assistant)

Cardboard Robots, Makey Makey, Soldering (Educational workshop – science)
Science Gallery Dublin
Spring 2017 (multiple dates)
Cardboard Robots, Makey Makey, Soldering
MAKESHOP

AI App Workshop (Educational workshop – tech)
Science Gallery Dublin
Spring 2017 (multiple dates)
AI App Workshop
Domhnall O'Hanlon, The Robot Foundry

Educational workshop – science
Irish Film Institute
25.11.2015
TRAUMA and Neuroscience
Professor Orla Hardiman,
Dr. Caroline Jagoe & Lesley Doyle

Events & Artist Talks

DESIGN AND VIOLENCE: After Dark
Event
Science Gallery Dublin
18.11.2016
Train of Thought
Aoife Van Linden Tol (artist) & Gabrielle Sellen
(workshop assistant)

An Automation Too Far?
A Debate on AI-created Art
Debate
Science Gallery Dublin
10.02.2017
An Automation Too Far?
A Debate on AI-created Art
Ross Goodwin & William Myers

Byte-Sized Talks – Humans Need Not Apply
Curators/Artists Talks
Science Gallery Dublin
10.02.2017
Byte-Sized Talks - Humans Need Not Apply
Saron Paz & Zvika Markfeld; Adam Ben-Dror &
Shanshan Zhou; William Myers; Ross Goodwin;
Libby Heaney; Radames Anja

**Towards an Automated Future: Meet the
Humans Curating Humans Need Not Apply**
Curators/Artists Talks
Science Gallery Dublin
08.09.2016
Towards an Automated Future: Meet the
Humans Curating Humans Need Not Apply
William Myers, Amber Case, Damien Henry,
Lynn Scarff

SEEING: BEHIND THE SCENES
Curators/Artists Talks
Science Gallery Dublin
24.06.2016
SEEING BEHIND THE SCENES
Dianne Boz, Roxana Vazquez, Shannon
McMullen and Rachel McDonnell

SEEING LAUNCH PARTY
Event including curators/artists talks Science
Gallery Dublin
23.06.2016
SEEING LAUNCH PARTY
Gerry Lacey, Kate Coleman, Lynn Scarff

HUMANS NEED NOT APPLY LAUNCH PARTY
Event including curators/artists talks
Science Gallery Dublin
09.02.2017
HUMANS NEED NOT APPLY LAUNCH PARTY
William Myers, Amber Case, Damien Henry,
Lynn Scarff

SEEING: The Curators' Perspective
Curators/Artists Talks
Science Gallery Dublin
14.07.2016
SEEING: The Curators' Perspective
Gerry Lacey, Kate Coleman

"Copyright or Wrong?"
Curators/Artists Talks
Science Gallery Dublin
23.07.2015
"Copyright or Wrong?"
Nicolas Maigret (Pirate Cinema), Professor Eoin
O'Dell, TCD School of Law, Professor Linda Doyle,
Director of CONNECT, CTVR and Professor of
Engineering and the Arts, Zack Denfeld
(CoClimate and Centre for Genomic Gastronomy)

**Why Torture Doesn't Work:
The Neuroscience of Interrogation**
Curators/Artists Talks
Science Gallery Dublin
14.12.2015
Why Torture Doesn't Work:
The Neuroscience of Interrogation
Professor Shane O'Mara (Curator), Richard
English, Provost & President of Trinity College
Dublin, Patrick Prendergast

TRAUMA—Built to break
A free exhibition exploring the boundary of rupture and recovery
Science Gallery at Trinity College Dublin
20.11.2015 – 21.02.2016

How does trauma affect the brain, the body, the national psyche, or all three? How do buildings, bodies, artworks, and stories record the traumas of our past? How do we bounce back after a trauma, and how is our understanding of trauma's lasting effect changing?
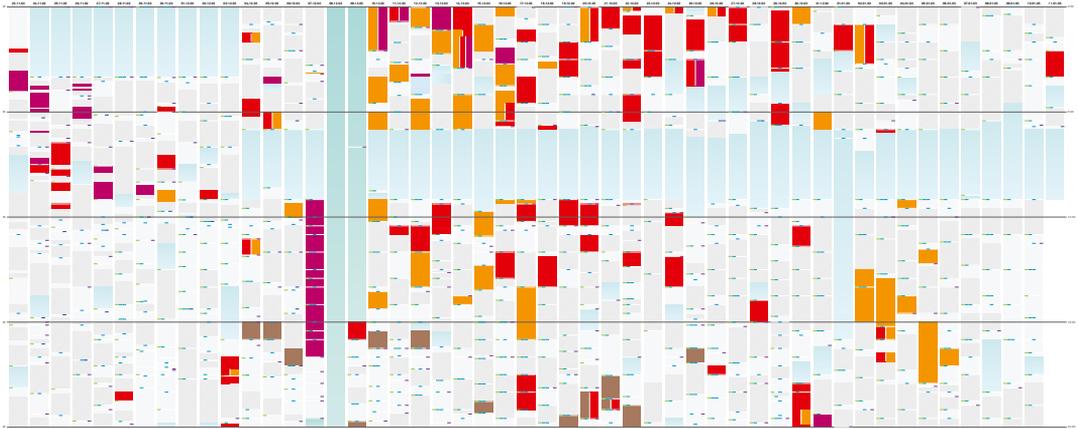
Shane O'Mara, Stefanie Posavec (IE, US)
The Interrogation of Detainee 063

The piece is a collaborative project developed by Shane O'Mara, Professor of Experimental Brain Research at Trinity College Dublin, Director of the Trinity College Institute of Neuroscience, TRAUMA co-curator, and designer and self-professed data junkie Stefanie Posavec. The piece is based on the log *detainee063.com,* and visualizes 50 days (23.11.2002 – 11.01.2003) of the interrogation of prisoner Mohammed Mana Ahmed al-Qahtani at the Guantanamo Bay detention camp. Viewed from a distance, the pastel colors and pattern are pleasant and welcoming but on closer inspection the darker side of the piece comes into focus with color-coding showing the duration of different aspects of interrogation punctuated by feeding, sleep and bathroom breaks. Over 101,000 visitors visited the *TRAUMA* exhibition. The piece was reviewed together with *TRAUMA* in an edition of *Nature*. This piece was also discussed in a linked public event with Professor O'Mara called *Why Torture Doesn't Work: The Neuroscience of Interrogation,* which was attended by over 120 people.

Shane O'Mara (IE) Shane is Professor of Experimental Brain Research at Trinity College Dublin, and Principal Investigator and Director of the Trinity College Institute of Neuroscience. He is a Fellow of Trinity College, Dublin (FTCD), was the first Ireland-based elected Fellow of the Association for Psychological Science (FAPS), and is an elected member of the Royal Irish Academy (MRIA).
Stefanie Posavec (US) is a designer, and data is her favored medium. She tends to work with data projects that involve language, literature, or science (or all of these at once). Many of these projects represent data using a hand-crafted approach. Besides data visualization/illustration/art, she occasionally designs books.

SEEING—What are you looking at?
A free exhibition questioning how eyes, brains, and robots see
Science Gallery at Trinity College Dublin
24.06.—25.09.2016

Is vision just one way to see? How do our brains interpret what's in front of our eyes? How do machines understand what they're looking at, and will they change how we look at the world? In summer 2016, at Science Gallery Dublin we tackled the complex sensory experience of vision and perception at *SEEING*. We illuminated optics, perspective, and comprehension while exploring enhanced and augmented ways of seeing, artificial eyes, and radical alternatives to vision. *SEEING* explored the subjectivity of sight, the other senses that shape our view of the world, and the unexpected parallels between human and machine vision.

(Source *https://dublin.sciencegallery.com/seeing/about.html*)

SEEING curated by: Lynn Scarff, Director of Science Gallery at Trinity College Dublin; Gerry Lacey, Associate Professor of Computer Science at Trinity College Dublin, CEO and co-founder of SureWash; Semir Zeki, Professor of Neuroaesthetics at University College London; Kate Coleman, Consultant Eye and Oculoplastic Surgeon, Founder of Right to Sight

Amir Amedi and the Hebrew University of Jerusalem (IL)
EyeCane, 2010
Unobtrusive mobility aid for blind people

How can we sense distant objects without vision? This question led to the development of the *EyeCane,* a lightweight, finger-sized, low-cost virtual cane. The *EyeCane* operates as a kind of virtual flashlight, replacing or strengthening the familiar white cane. The device uses infrared sensors to estimate the distance between the user and the object at which it is pointing. This information undergoes a "sensory transformation" and becomes vibrations, which are sent to the user's hand via the device. The closer the user is to an object, the stronger the vibration. This allows people who are blind or who have a visual impairment to identify obstacles of different heights, understand the distance between themselves and the objects around them, and create a spatial picture through which they can navigate safely. The device is intuitive, and its application can be taught within a few minutes.

Amir Amedi (IL) is an internationally acclaimed brain scientist with fifteen years of experience in the field of brain plasticity and multisensory integration. He has a particular interest in visual rehabilitation. He is Associate Professor at the Department of Medical Neurobiology at the Hebrew University of Jerusalem and The Edmond & Lily Safra Center for Brain Sciences. He is also Adjoint Research Professor at Paris-Sorbonne University and the Vision Institute in Paris. He holds a PhD in Computational Neuroscience from the Inter-disciplinary Center for Neural Computation at Hebrew University and is a Postdoctoral Fellow and Instructor of Neurology at Harvard Medical School. *brainvisionrehab.com*

Patrick Tresset (FR)

3RNP, 2014
**A human model is drawn by three robots
named Paul**

*3RNP—*or *3 Robots Named Paul—*is a theatrical
robotic installation where the human becomes
a model. In a scene reminiscent of a life
drawing class, the human takes the sitter's role
and is sketched by three robots, drawing
obsessively. Their bodies are old school desks.
The drawing sessions last up to forty minutes,
during which time the human cannot see the
drawings in progress. The sitter only sees the
robots alternating between observing and
drawing, sometimes pausing between the two.
The sounds produced by each robot's motors
create an improvised soundtrack.
As the model in a life drawing class, the human
is personality-less, an object of study. The
human sitter is passive, the robots taking what
is perceived as the artistic role. Visitors to
Science Gallery Dublin could sit for the robots
and then receive a digital version of their
portraits. Does a computer see you the way
you see yourself?

Patrick Tresset (FR) creates theatrical installations with robotic agents as actors or cybernetic evocations of
humanness. Patrick's installations use computational systems that aim to introduce artistic, expressive, and
obsessive aspects to robots' behavior. *patricktresset.com*

Andrea Russo (IT)

D-EYE, 2014
Smartphone-based retinal screening device

D-EYE is a sophisticated lens that attaches to a smartphone and uses the light source and camera of the phone to capture an image of the back of the eye—the retina. It is a low-cost and portable modern-day digital ophthalmoscope, a device that allows you to see the structures inside the eye. Healthcare professionals use it as a screening tool to examine the retinal wall for signs of health issues.

The retina is a window to our health, and can reveal diseases such as diabetes, glaucoma, age-related macular degeneration, hypertension, and melanomas or cancers. According to the World Health Organization, almost 300 million people in the world suffer from vision loss, and 80% of those people could have avoided losing their sight with earlier intervention.

D-EYE can be used in rural or remote areas, and retinal images can be transmitted via cellular networks, connecting to a care team wherever they may be. *D-EYE* is a pocket-sized tele-health solution that could potentially help millions of people worldwide.

Andrea Russo M.D. is an ophthalmologist in Brescia, Italy. He has authored and co-authored numerous articles on clinical investigations of glaucoma and retinal diseases. Andrea received his medical degree from University of Brescia, and served an observership at Moorfields Eye Hospital in London. He is the medical advisor for *D-EYE*. d-eyecare.com

Kurt Laurenz Theinert (DE)
Magical Colour Space, 2015
Experience your colour perception in a poetic way

You step into a room. The walls are made up of coloured stripes. Above you, red, green and blue lights cycle through the spectrum of different colours. As the lighting changes, the walls around you seem to throb and move.
Magical Colour Space looks at the basics of colour perception. When light hits an object, the object absorbs some of the light wavelengths and reflects the rest. The human eye and brain work together to translate this reflected light into colour. As the light in *Magical Colour Space* slowly changes its proportions of red, green and blue, the coloured stripes on the wall reflect only the wavelengths in their own colour. Because the brain uses changes in light levels to help detect motion, this creates the illusion that the walls are moving.

Kurt Laurenz Theinert (DE) is a photographer and light artist who concentrates his work on visual experiences that do not refer, as images, to anything. Instead, he strives for an abstract, reductive aesthetic, which has ultimately led him to switch from photography to light as a medium. In his installations he creates dynamic light environments that transform the perception of space. *theinert-lichtkunst.de*

David Cotterrell (UK), Ruwanthie de Chickera (LK)

Mirror II – Distance, 2016
An expanded cinema dialogue between strangers

Mirror II – Distance examines the distances between individuals who occupy, protect, and work in worlds that they don't really belong to. The Diplomatic Enclave in Islamabad is a heavily gated expat community in the capital city of Pakistan. This enclave is cut off from the rest of the country by high walls and heavy security. Inside the enclave is a network of country and organizational compounds further barricaded from each other. Entry into the enclave and entry into the various demarcated territories inside is monitored by local Pakistani guards. These men are privy to the culture, conversations, and experiences of the international communities that they are responsible for protecting. In this piece, two Pakistani guards stand watch over the expat compounds. They observe each other from a distance as they listen to the visitors, experts, and specialists discuss Pakistan, its people, and its future. Using a cable mounted camera system, both forward and rear views are filmed simultaneously. This piece uses an experimental filming format called "collimation," which manipulates perception to provide an illusion of depth. This installation is part of the *Mirror* project, a series of two-screen works devised to provide insight into global communities that experience distancing and objectification.

David Cotterrell (UK) is one of Britain's leading visual artists. He uses media and technology to explore the social and political tendencies of a world at once shared and divided. His work has been commissioned and shown extensively in Europe, the United States, and Asia. He is Director of Research at University of Brighton and is represented by Danielle Arnaud.
Ruwanthie de Chickera (LK), an Eisenhower Fellow, is a leading playwright, screenwriter, and theater director from Sri Lanka. Her award winning film, *Machan,* has been screened in over fifty countries. She is Artistic Director of Stages Theatre Group, an ensemble theater company that produces socially and politically conscious original Sri Lankan theater. *cotterrell.com, stages.lk*

me&him&you and Kate Coleman (IE)
Eye Care Works, 2016
Eye tests in the blink of an eye

In association with renowned eye surgeon Kate Coleman, me&him&you present a contemporary take on the eye test. The aim is to illustrate Kate's vision to "democratize" eye care, making vision-testing possible across the world in, quite literally, "the blink of an eye". Visitors will be able to test their own eyesight using two machines from optical equipment supplier, Topcon—an Automatic Refractor and a Non-Mydriatic Fundus Camera—while learning about the latest advancements in digital eye testing. me&him&you have also worked with Kate to present a contemporary take on the classic color blindness test in the Science Gallery Café, drawing on abstract expressionism and colors of the rainbow to explore the spectrum of light in a two-dimensional piece.

me&him&you (IE) is an Irish boutique design agency established in 2010 by Ronan Dillon and Peter O'Gara. They are creatively and strategically led and love what they do. Kate Coleman is an ophthalmologist and general ophthalmic surgeon. Kate has a special interest in global health, in particular needless blindness. She founded Right to Sight in 2006 and is currently coordinating an international movement to contribute to the elimination of preventable blindness. *meandhimandyou.com, katecoleman.ie*

Ryan & Trevor Oakes (US)
Oakes Twins Collection, 2009 – 2016
Realistic Ink Drawing on Concave Paper

While analyzing human vision, twins Ryan and Trevor Oakes noticed that when looking beyond a foreground object to the distance, a person's two eyes split the near object into a transparent double image of itself. With this optical phenomenon, they invented a drawing technique. To acknowledge the fanned-out formation of light rays human eyes see, they construct curved paper and support it with a concave easel. To draw, they split their pen

into a double image simply by looking past it. Holding the pen's left image to the right edge of the curved drawing paper, the pen's right image will hover in mid-air beyond the paper's edge. The hovering pen may then trace over the distant scene, thereby simultaneously marking the scene's proportions onto the paper. Their artworks shown in *SEEING* include *Have No Narrow Perspectives: Field Museum* (black line period), *Ocean Horizon Line 2: Pacific Coast Highway, Los Angeles, CA* (color period), *Evergreen Cemetery in Late Winter* (swirlism period), and *Bond Street Terrace* (ripples period).

Ryan and Trevor Oakes (US) are twin brothers from New York who have been engaged in a conversation about the nuances of vision since they were children. They explored their mutual fascination with vision throughout school and during college at Cooper Union's School of Art in New York City. Since graduating in 2004, they've continued their dialogue with jointly built artworks addressing human vision, light, perception, and the experience of space and depth. *oakesoakes.com*

Kenichi Okad, Naoaki Fujimoto (JP)
Peeping Hole, 2010
A simple hole betrays your eyes

In the near future, it's possible that we will use our eyes not only to take in information but also to deliver information. What if our gaze was monitored by someone else? How would we feel and how would this affect our communication?
Peeping Hole is an interactive installation that tracks a viewer's gaze and reveals what they are staring at to an audience, without the viewer noticing. Though a small hole in the exhibit, visitors will gaze at an image. The audiences around the viewer can see what they are staring at, thanks to eye tracking technology. The viewer may not notice their audience and what they can see until the next visitor steps up to view the exhibit. *Peeping Hole* is a playful look at vision monitoring and privacy, but will this technology become ubiquitous in the years to come, and how will it be used?

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Kenichi Okada (JP) is an artist, designer, and researcher with a keen interest in analogue and digital interaction. After studying at Royal College of Art in the UK, he worked at Sony's Creative Center. The aim of his artistic study is to design a trigger for creation by using several media such as films, products, and installations.
Naoaki Fujimoto (JP) graduated from Tokyo Institute of Technology's Department of Physics. After working on the development of interactive content and digital signage as a programmer, Naoaki started his own business in 2009. He now develops artworks using physics calculations and technology like image recognition and creates pieces that place emphasis on experiences. *kenichiokada.com*

McMullen_Winkler (US/DE)

20/X, 2015
See the world like a machine

20/X asks the question: Do we need to acquire new literacy skills in the current culture of synthetic vision? This interactive interface allows users to navigate through the different levels of an algorithm used by a computer to identify objects in the world around them—from coarse and geometry-driven in the beginning to more specific and detail-oriented in the end. At this point, distinctive patterns, areas, and objects that "excite" the computer vision system can be identified. The title of the work refers to the measurement of perfect human vision—20/20—contrasted with an as-yet unquantifiable measure of seeing for a computer vision system, represented by the variable "X". Visitors are invited to experience the process of seeing through a complex neural-network-based computer vision system to determine the value of "X" for themselves.

Shannon McMullen (US) and **Fabian Winkler** (DE) (McMullen_Winkler) are interdisciplinary artists and researchers who use their backgrounds in new media art and sociology to produce collaborative artworks that combine image, code, and installation to create temporary new social spaces and to investigate relations between nature and technology. Their work has been shown internationally Their large-scale investigation at the intersection of art, engineering and science, *Images of Nature,* was awarded a grant from the National Science Foundation. Shannon and Fabian teach in the Electronic and Time-Based Art Program at Purdue University in West Lafayette, Indiana, US. *gardensandmachines.com*

Carmen Papalia (CA)
Mobility Device & White Cane Amplified, 2013, 2015
Documentaries of collaborative performances

Mobility Device is a collaborative performance in which Carmen Papalia is accompanied by a marching band to replace his white cane as his primary means of gathering information about his surroundings. As a piece of music, *Mobility Device* is an extension of the musicality of the white cane—fixtures such as curbs, lampposts, and sandwich boards become notes in the soundscape of a place. *Mobility Device* proposes the possibility of user-generated, creative process-based systems of access. It represents a non-institutional (and non-institutionalizing) temporary solution for the problem of the white cane. On June 1st 2013, Carmen performed a site-specific rendition of *Mobility Device,* with accompaniment by the Great Centurion

Marching Band from Century High School, at Grand Central Art Center in Santa Ana, California.
White Cane Amplified documents the experiential research that Carmen conducted in preparation for a visit to the Franklin W. Olin College of Engineering in Massachusetts, where he is currently producing an acoustic mobility device in collaboration with students in Sara Hendren's "Investigating Normal" class. The narrative depicts Carmen speaking into a bullhorn as he attempts to perform the social function of the white cane while maintaining his agency, finding support and communicating his nuanced and emergent needs.

Carmen Papalia (CA) designs experiences that invite those involved to expand their perceptual mobility and claim access to public and institutional spaces. He is a social practice artist who makes participatory projects on the topic of access as it relates to public space, art and visual culture. Carmen is the recipient of the 2014 Adam Reynolds Memorial Bursary and the 2013 Wynn Newhouse Award. In 2015, Carmen served as artist-in-residence at the Victoria & Albert Museum in London and at Model Contemporary Art Centre (Sligo, IE) where he made site-specific interventions in response to a history of disabling practices at each institution. *carmenpapalia.com*

Philipp Schmitt & Stephan Bogner (DE)

Unseen Portraits, 2015

Artistic investigation of face-tracking algorithms

Computer vision relies on algorithms to make sense of the world. *Unseen Portraits* investigates what face recognition algorithms consider to be a human face. How much do you have to deform someone's features to make them invisible to a machine?
Portrait photos of visitors are distorted on a screen. A surveillance camera films the distortion and uses facial recognition software to scan the camera footage for faces while the image becomes more and more obscured. The moment the photo becomes too warped and the face can't be recognized by the algorithm anymore, the software takes a screenshot. The visitor is now invisible to computer vision. Despite its subject matter, *Unseen Portraits* isn't a conceptual investigation of the algorithms used. Rather, the project uses computer vision software as an artistic tool, creating images reminiscent of Francis Bacon's self-portraits from the 1970s. It isn't so much a mechanism to hide from the software as it is a way to capture the software's flaws in a work of art.

Stephan Bogner (DE) and **Philipp Schmitt** (DE) are designers (and sometimes artists), currently studying Interaction Design at University of Design, Schwäbisch Gmünd. They are curious about new ways of using upcoming and established technologies. Stephan and Philipp are friends who enjoy working as a team to tackle topics such as machine vision or robotics. *philippschmitt.com; stephanbogner.de*

Alia Pialtos (US)

Seen/Unseen, 2014

Video about human connection
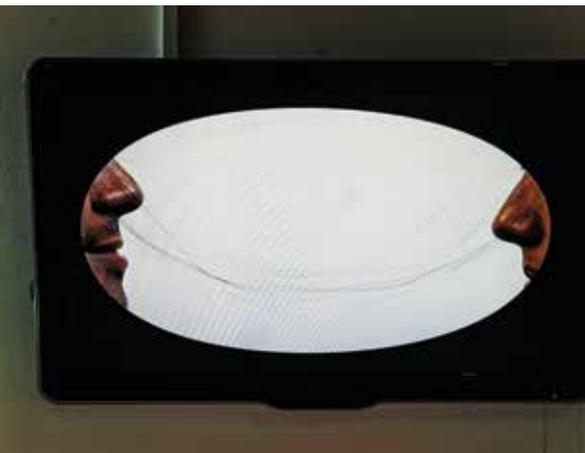
Science Gallery Dublin

Seen/Unseen is a video projection that draws from human connection, amplifying the effects of the unconscious reactions we experience while engaging with others. It stems from a desire to visualize the gaze and to make visible the invisible sight lines between individuals. In the piece, an oblong frame acts as a peephole or pupil that reveals a view of suspended threads that span across the frame. At first, the piece seems very abstract; the viewers are left to witness the curious movements of these hanging strings. Although the mechanisms that create the movements

are not obvious at first, the delicate lines appear to be alive. Within the last few seconds of the video, a slow zoom reveals the source of the movement to the viewer. The use of the hair acts as a physical extension of the body and amplifies the effects of the unconscious reactions we experience while engaging with those to whom we feel closest.

Alia Pialtos (US) is an artist who explores ideas of connection, perception, and personal relationships through sculpture, installation, video installation, photography, and performance. She has exhibited extensively within the United States and in 2013 she received a grant through the Center for Craft, Creativity & Design in North Carolina to study connections between art and science. *aliapialtos.com*

Story Inc & Daniel Kish (NZ/US)
Sight Without Light, 2016
Exploring human echolocation

Daniel Kish's eyes were surgically removed before he was thirteen months old, to save him from an aggressive form of cancer. As Daniel grew up, he taught himself to see the world around him using echolocation. Daniel makes clicking noises with his tongue to understand his environment, navigating his surroundings by listening to the echoes as his clicks bounce off surfaces. Seeing is not a metaphor for Daniel. He uses the same part of his brain—the visual cortex—to picture his surroundings as people with eyes do. It's just that the information comes in a different medium. It's sight without light. This exhibit aims to give visitors a little glimpse into the world of sight without light by demonstrating one form of echolocation—seeing an object move closer to them by listening to the reflected sound of their own voice.

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Story Inc is a New Zealand-based company that creates visitor experiences around the world. **Daniel Kish** (US) is president of World Access for the Blind, and teaches others his echolocation technique. He believes that blind children can learn to see in this way, and lead richer and more independent lives as a result. He lives in Long Beach, California. *worldaccessfortheblind.org, storyinc.co.nz*

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Michael Proulx (US)
The vOICe: Seeing with Sound, 2016
Device that turns images into sound

What does it mean, "to see"? Can a person with sight loss "see" again by substituting one sense for another using? *The vOICe* is an interactive demonstration of a sensory substitution device technology that allows people to see with sound.

Sensory substitution devices for people with a visual impairment provide for missing visual input by converting images into a format that another sense can process non-invasively, such as sound. This is possible due to neuroplasticity—the ability the brain has to reorganize itself throughout an individual's life by creating new neural pathways to adapt to changes as it needs to, whether that be as a result of changes in the environment or injury. The *vOICe,* invented by Dutch engineer Peter Meijer, is now being used by Michael Proulx and other cognitive neuroscientists, philosophers, and artists to explore the nature of the senses and how the brain allows us to see, even without vision.

Michael J. Proulx (US) is Senior Lecturer in Psychology and Director of Crossmodal Cognition Lab at University of Bath. He also works with the Centre for Digital Entertainment in the Department of Computer Science. He investigates several aspects of multisensory cognition with a particular interest in the impact of blindness on cognition and assistive technology. His interdisciplinary research spans psychology, computer science, neuroscience, and biology. *bath.ac.uk/psychology/staff/michael-proulx*

Studio TheGreenEyl (DE)
Ground Truth, 2016
Source data sets for computer vision algorithms

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Today, computer vision plays an essential role in everything from robotics and healthcare to surveillance. In order to train algorithms to see, researchers feed them with image data sets, which are translated into statistical models. These models in turn form the basis of computer vision software, for example for face tracking or optical character recognition. *Ground Truth* is a collection of image data sets of the human body—such as faces, fingerprints, and hand gestures. Mapping them out as large format prints lets us see images we usually never get to see. What are the aesthetics of these data sets? What are their peculiarities? How large are they? How many faces are enough to develop a face recognition algorithm? What is included, what is not included? What are possible biases?

Studio TheGreenEyl (DE)

The Unresolved Image, 2016
A fractal-like image which changes depending on distance

The Unresolved Image is a structural, fractal-like image that resolves one image into another. As you walk towards it, you zoom deeper into its layers of images, from architectural to microscopic scale. It is an investigation into the topic of visual resolution and granularity of data, and ultimately explores the limits of our perception and comprehension. The image has a resolution of approximately 10,000 dpi, most common in semiconductor manufacturing. It is composed of myriads of images from different data sets that are used in computer vision to teach machines to recognize and understand the human body. As the propagation of computer vision increases, so does the quantization of data about the body: posture, face structure, fingerprints, ear shapes, iris patterns, veins—they all become machine-readable aspects of the human.

Richard The (DE) is a graphic and interaction designer. After studying at University of the Arts Berlin and the MIT Media Lab, he worked at Sagmeister Inc. and Google Creative Lab in New York.
Frédéric Eyl (FR) holds a masters degree from University of the Arts Berlin and is a founding partner at Studio TheGreenEyl Berlin, a design practice based in Berlin and New York. They create exhibitions, installations, objects, graphics, and algorithms. In the past they have developed the algorithmic corporate design for MIT Media Lab, have created various installations for exhibitions at Jewish Museum Berlin, Museum of Natural History Berlin, and GRIMMWELT Kassel. Their work has been exhibited at MoMA New York, Ars Electronica in Linz, Bauhaus-Archiv Berlin and at Design Museum, London. *thegreeneyl.com*

Science Gallery Dublin

Karina Smigla-Bobinski (DE)

SIMULACRA, 2013
Images appear as if from nowhere

At the heart of *SIMULACRA* are four LCD monitor panels, assembled in the form of a hollow square. The ensemble appears to have been gutted, and looks almost overgrown. A tangle of cables and control devices pours out of the middle of the square. Around it, several magnifying lenses with polarized lenses dangle from chains. The monitors don't display any pictures, and shine with an intense white light—but with the help of the magnifying lenses, function is restored to the screens and their secrets are revealed. Is this process happening in our brains, or in the lenses? *SIMULACRA* builds a bridge between technology and perception, and explores the difference between subject and view, and between image and reality.

Karina Smigla-Bobinski (DE) works as a freelance intermedia artist. She studied art and visual communication at the Academy of Fine Arts in Krakow, Poland, and in Munich. Karina works with analogue and digital media, and produces and collaborates on projects ranging from kinetic sculptures to interactive installations and art interventions, which feature mixed reality and interactive art objects. She also works with video, multimedia physical theatre performances, and online projects. *smigla-bobinski.com*

Rox Vazquez (AR)

Synesthesia: Colored Music, 2012
Interactive installation inspired by synesthetic experiences

Has a sound ever reminded you of a shape, colour or taste? The term "synesthesia" is formed from the fusion of the Ancient Greek words for "together" and "sensation". Synesthesia is a rare neurological condition in which different sensations perceived by different senses are mixed up. In one of the most common forms of synesthesia, letters or numbers are perceived as colored. A synesthetic person may have the capacity to "hear" colour, "see" music, or even perceive different taste sensations by touching objects with certain textures.

When they describe their experience, synesthetes often talk about visual shapes on a "screen" located in front of their faces. Through the use of new technologies, this project aims to bring you closer to an audio-visual synesthetic experience. Using colored shapes, a camera, a screen, and a programming tool, participants can assemble a sequence of colors and a computer will transform it into an audio-visual experience. This merging of senses evokes the experience of synesthesia.

Rox Vazquez (AR) is a graphic designer, illustrator, and motionographer who started her career working in post-production for movies, commercials, and video games. In 2011 she started experimenting as a VJ, using video mapping techniques and working with artists at different cultural events in Buenos Aires, San Francisco, California, and Berlin. In 2012, she presented her *Synesthesia: Colored Music+* project at the Pixelations festival in Argentina. In 2014, she developed new collaborative digital installations called *+++* and *Biot Hub,* which were presented at the Let It Vj Festival and at the Cinematographic Investigation Center in Buenos Aires. Her last digital collaborative art piece, called *SynBiosis,* was exhibited at Espacio Pla and is currently at the Contemporary Art Space in Uruguay. *roxvazquez.com @vj_roxvazquez*

Frederik De Wilde (BE), in collaboration with Jeff Clune and Anh Nguyen (US)

The Innovation Engine, 2015
Get an insight into how a computer "thinks" and "sees"

Machines can't do what the human imagination can... yet. This installation researches the failure of machines and computers to simulate the human mind. A touchscreen allows the visitor to navigate through and explore a deep neural network. In machines, an artificial neural network is a computer algorithm inspired by the central nervous systems of animals. The webcam analyses in realtime what it sees and what it has been "taught" to detect. What is detected is visualized as highlighted artificial neurons. The audience can then browse through all the neural layers and get an insight into how a computer "thinks" and "sees". A voice tells visitors which layer they are looking at and what's happening. In a lot of cases, the visitor may not recognize these images, but the artificial intelligence appears to, demonstrating the limits of machine comprehension. This work demonstrates how AI and deep neural networks are easily fooled, a dystopian thought when you take into account the fact that they are already used by the military, drones, and Tesla's self-driving cars. How much confidence do we have in ourselves and the technologies we develop? Or in societies and industries that are accelerating the development of AI and automatization?

Frederik De Wilde (BE) works at the intersection of art, science and technology. The conceptual core of his artistic practice is the notion of the inaudible, intangible and invisible—as exemplified by the conceptualization and creation of the Blackest-Black art, made in collaboration with NASA. The project received the Ars Electronica [next idea]Award, the Best European Collaboration Award between an artist and scientist, and it was extensively covered by *The Huffington Post,* The Creators Project, TED, and more. In 2016, Frederik was a finalist in *Giant Steps: Artist Residency on the Moon,* a speculative exhibition about making art on the Moon. *frederik-de-wilde.com*

Louisa Zahareas (GR)

Screen Mutations, 2015
Deforming reality to fit the screen

We are increasingly living our lives through filters. Through social networks, through smartphones, through the coil of fiber and unseen airborne signals. In the communication age, we very often speak to the ones closest to us through digital means. The screen is no longer a window to somewhere else; it is, instead, the here and now, while our physical surroundings are slowly becoming the "other world." We're closer, yet further apart, than ever.

Screen Mutations explores the growing role of video communication applications—such as Skype and Facetime—in blurring the line between the physical and digital world. It imagines a speculative future where our physical reality is deformed to be viewed through a camera. This is achieved by designing a set of props—cups, teapots, utensils—that look deformed off-screen, while on-screen they look "normal" due to optical illusions achieved by the geometric distortion of a 3D object. Thus, the point of view of the webcam becomes the main design tool. The result is like a reversal of a Salvador Dali painting: the objects have surrealistic and impractical shapes in the tangible world, while the image as it appears digitally seems to suggest otherwise.

Louisa Zahareas (GR) grew up in a diverse family with Greek, American, Spanish, and Russian influences. After studying architecture in Greece and architectural design in Minnesota, she gained an MA in Social Design from Design Academy, Eindhoven. Louisa's work has focused primarily around perception, and it strives to challenge our increasingly visual culture. Her projects use illusion, perceptive tricks, and other techniques to remind the viewer that the space between the real and the virtual is becoming increasingly blurred. Louisa communicates the story through the use of video and performance. She doesn't consider the objects that she designs products, but props that facilitate and guide the plot of a fictional narrative. *lamdazita.com*

Angelika Böck (DE) is a visual artist and interior architect. Her work deals with the phenomena of human perception and contains elements from both art and research derived from field studies within different cultural settings. Her artwork ranges from eye drawing and video to installation, photography, text and sculpture, and it has been exhibited internationally. *angelika-boeck.de/en*

Angelika Böck (DE)
Blanks, 1996
Capturing visual tracks across blank paper

Eye-tracking technology forms the basis of *Blanks,* a series of portraits characterized by the figure four. Four people each looked at a square sheet of blank paper, their range of vision restricted to a 40x40 cm section, for a single minute. Their eye movements were recorded in black on a pane of glass.
This process was repeated four times for each portrait, with each pane then placed on top of the others to create a single level. The first time, eye movements were recorded while the subject viewed the blank paper. The second time, the subject was presented with a recording of the eye movements from the first, and their eye movements were recorded as they observed this. Likewise for the third and fourth times.
Thus, the subject and the observer are embodied as one in the piece. The piece recounts a dialogue between the person as the observer and the person as the subject. Standing directly in front of the composition, all the levels merge and the pieces can be viewed as one image. Only by changing the angle of observation can the viewer distinguish individual layers and the dialogues between the different viewing processes.

Dianne Bos (CA)
Seeing Stars, 2003
Pinhole star projector exploring light and optics

Using a pinhole camera—one of the simplest image-creating technologies—this installation demonstrates how light passing through tiny holes into a dark space projects an image.
A pinhole camera is a simple lightproof box with a small hole in one side. Light from outside passes through this single opening and projects an upside-down image onto the opposite side of the box. In the human eye,

light shines through the cornea, which focuses images onto the retina, just as light through a lens projects an image onto film.

Seeing Stars expands on the single-lens image we are used to seeing with our eyes. The multiple pinhole "lenses" project a galaxy-shaped cluster of lights onto ground glass. We recognize a starry pattern at first, but upon closer examination, we can see that each star is in fact a tiny image of what's on the opposite side of the device—in this case, a light bulb. Each view differs slightly, depending on where the aperture is located within the overall star pattern.

Dianne Bos (CA) received her BFA from Mount Allison University in Sackville, New Brunswick. Her photographs have been exhibited internationally in numerous group and solo exhibitions since 1981. Recent important national exhibitions of Dianne's work include: *Light Echo* at McMaster Museum of Art, in collaboration with astronomer Doug Welch, which linked celestial and earthly history; and *Reading Room* at Cambridge Galleries, an exhibition exploring the book as a camera. *diannebos.ca*

Suki Chan (UK)

Lucida III, 2016
Demonstrating the mechanics of visual perception

Science Gallery Dublin

Lucida III is an immersive moving image installation designed to show the viewer how we see with our central and peripheral vision. Using eye-tracking technology, the artwork invites the audience to participate and make the discovery that their gaze changes what they are seeing and hearing.

At first, the visitor will see a still image of the endothelium—a single layer of hexagonal cells on the inner surface of the cornea—accompanied by an atmospheric soundscape. When a visitor sits on the seat in front of the screen, the movement of their gaze across this still image begins to "burn" through this cellular surface at precisely the area on which their central vision is focused. Over time, the trajectory of their gaze and a view of the night sky are simultaneously revealed.

For the audience watching this screen, they will be able to observe the rapid movement of someone else's eyes and a trail of the trajectory of their gaze across the moving image artwork. The atmospheric soundtrack responding to visitors' eye movements was composed by Dominik Scherrer.

Lucida III is supported by the Wellcome Trust Small Arts Awards and Arts Council England.

Suki Chan (UK) is a London-based moving image and installation artist. Suki studied at Goldsmiths, University of London, and Chelsea College of Art. Her practice combines light, moving image, and sound to explore our physical and psychological experience of time and space. *sukichan.co.uk, lucidafilm.com*

HUMANS NEED NOT APPLY
A free exhibition exploring the possibilities of artificial intelligence
Science Gallery at Trinity College Dublin
10.02. – 21.05.2017

In an automated world, will it be time to put humans out to pasture? Are we hurtling together towards a leisure-time utopia or robot-tended human zoos? Will the notion of work transform completely if machines really can do everything better, faster, and for longer?

HUMANS NEED NOT APPLY at Science Gallery, Trinity College Dublin, interrogated the supposedly seismic changes that artificial intelligence is bestowing on society. The exhibition gave visitors the chance to explore the creative possibilities of machine learning—sparking conversations on potential futures that are simultaneously celebratory, beneficial, dystopian, and humorous.

(Source *https://dublin.sciencegallery.com/hnna*)
HUMANS NEED NOT APPLY curated by Williams Myers

Gillian Smith (US)
Hoopla: Computer-Generated, Human-Produced Embroidery


Science Gallery Dublin
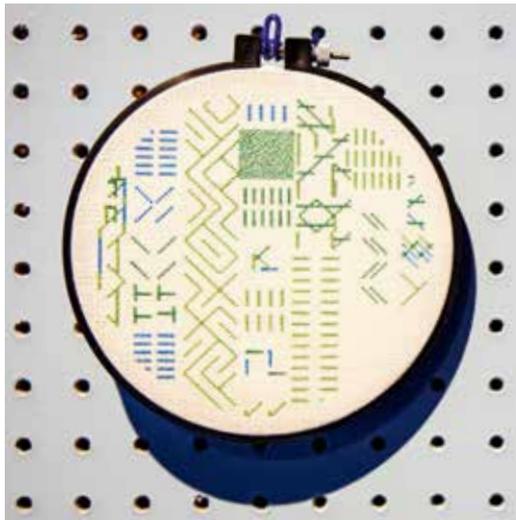
Embroidery is a millennia-old craft and art form, practiced predominantly by women and passed down from mother to daughter. The craft has morphed and adapted over time as new technologies have influenced it. The growth of artificial intelligence and computational creativity has the potential to once again transform this handcraft. *Hoopla* is a computational creativity project involving an AI system that designs embroidery sampler patterns that are then hand-stitched. The system chooses color palettes and quotes from Internet sources, and pairs them with procedurally generated motifs to decorate the remainder of the sampler. The result is a digital aesthetic rendered with human, physical labor. *Hoopla* interrogates the relationship between the digital and physical, new technology and old traditions, the predominantly masculine world of computation and the predominantly feminine world of needlepoint.

Gillian Smith (US) is an assistant professor of Art+Design and Computer Science at Northeastern University. Her research focuses on computational creativity, computational craft, and gender in games and technology. She is particularly interested in treating generative design as a way to formalize the creative process, bridging the divide between the digital and the physical, and exploring the relationship between computational thinking and craft practices.

Isabel Mager (DE)
5000times
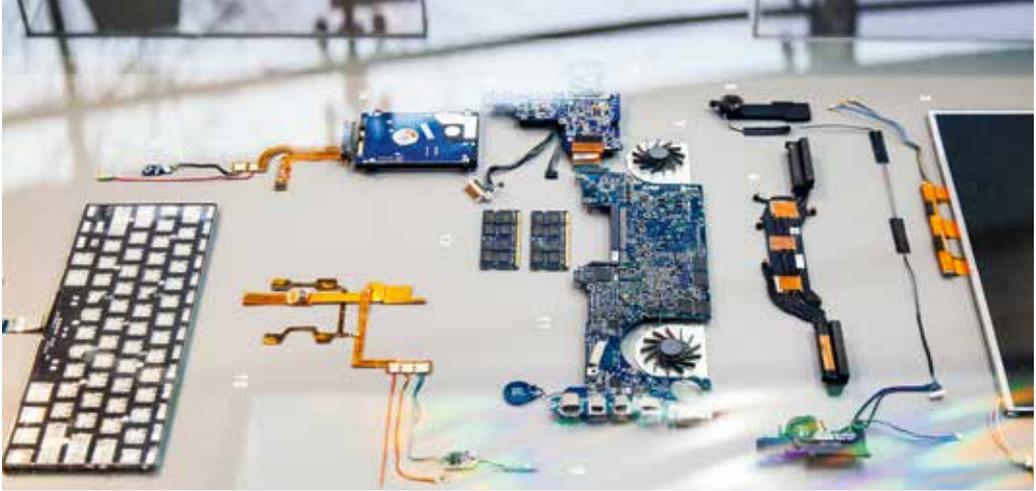
Smart high-tech devices are made by human hands. How often do we realize—as we sit swiping—that somewhere, someone is testing the image quality of such devices by taking thousands of selfies each day? *5000times* investigates the extensive, repetitive, and even absurd human work that is essential to the creation of smart devices. A physical deconstruction of one such high-tech device reveals evidence of how the human hand participates in production and manufacture. The result, *5000times,* compiles and re-frames sequences of these manual tasks into clear and critical visualizations. In order to spark dialogue with designers and end users about hidden production processes, the repetitive manual tasks are re-enacted and performed. The performance is activated by a designer who operates from privileged western contexts. This re-enactment aims to challenge levels of accountability required by designers and end users alike.

Isabel Mager (DE) is an investigative and critical designer based in the Netherlands. Recent work interrogates design at the intersection between culture and structures of power. Mager empirically analyses the complex social systems and mechanisms of design through objects, installations, articles, and performances within design and academic contexts. In 2016, upon completion of the BA program at the Design Academy Eindhoven, Mager was resident at Uproot Rotterdam alongside Studio Makkink & Bey. *isabelmager.info*

Pedro Lopes (PT) in collaboration with Patrick Baudisch (DE), Alexandra Ion (AT), Robert Kovacs (RS), David Lindlbauer (AT)

ad infinitum: a parasitical being that lives off human energy

Ad infinitum is a parasitical entity that lives off human energy. It lives untethered and off the grid. This parasite reverses the dominant role that mankind has with respect to technologies: the parasite shifts humans from 'users' to 'used'. *Ad infinitum* co-exists in our world by parasitically attaching electrodes onto human visitors and harvesting their kinetic energy by electrically persuading them to move their muscles. Being trapped in the parasite's cuffs means getting our muscles electrically stimulated in order to perform a cranking motion and to feed it our kinetic energy. The only way a visitor can be freed is by seducing another visitor to sit on the opposite chair and take their place.

Pedro Lopes (PT) is a researcher who constructs muscle interfaces that read and write to the human body. Pedro's work is a philosophical investigation of HCI as in Human-Computer Integration, rather than merely "interaction". Instead of envisioning technological dystopias based on the divide between human and machine, Pedro's works instantiate working prototypes in which the interface and the human become closer. Lopes's work stems from a line of research published at top-tier scientific venues alongside Patrick Baudisch and his colleagues Robert Kovacs, Alexandra Ion, and David Lindlbauer. *hpi.de/baudisch/projects*

ForReal Team (IL)
DoppelGänger

DoppelGänger is an exploration of a dynamic link between virtual and physical identities through the examination of human-robot kinetic interaction. The digital world has expanded the borders of our identity, and has opened the vast world of multi- faceted interactions and the reality around us. Visitors stand in front of *DoppelGänger* to create their own mirroring mini mob and start to explore their active dynamic facades. Each *DoppelGänger* manifests with a different behavioural pattern, and represents personality variations on kinetic behaviour, so while interacting with the group, the visitor will be able to explore the identities, abilities, and limits of each one as an individual and of the group as a whole. This elaborate identity-test creates a feedback loop in which human and robot, physical and virtual, and preconditioned and spontaneous play together in chaotic harmony.

Science Gallery Dublin

Saron Paz (IL), experience designer and head of the New Media Department at the Musrara School of Arts and **Zvika Markfeld** (IL), Uber maker; senior lecturer in the New Media Department at the Musrara School of Arts, form together ForReal Team, an experience design studio, creating new and exciting platforms that connect the virtual and the actual, mastering a variety of cutting edge technologies and molding them into enticing concepts in order to create tailor-made interactive experiences. *forrealteam.com*

Varvara & Mar (EE/ES)
HUMANS NEED NOT TO COUNT

This work poses questions about employment, robotics, and quantification. It was inspired by the title of the exhibition, *HUMANS NEED NOT APPLY,* and presents a robotic arm that counts visitors with a clicker, offering a performative representation of the takeover of routine jobs, even in the gallery space. The work also embodies our idolatry of quantification; the obsessive need to count and measure everything. Last century's automation may have been largely hidden from everyday view, in factories tending production lines, or out in fields tilling the land. In this century, we will confront the reality of automation more intimately, as suggested here—it will be right beside us.

Science Gallery Dublin

Varvara & Mar (EE, ES) have been working together as an artist duo since 2009. They have exhibited their art pieces in a number of international shows and festivals. In 2014 the duo was commissioned by Google and Barbican to create *Wishing Wall* for the *Digital Revolution* exhibition. The artist duo locates itself in the field of art and technology and deals with the new forms of art and innovation. They use and challenge technology in order to explore novel concepts in art and design. Research is an integral part of their creative practice.

Science Gallery Dublin

Adam Ben-Dror (ZA/NZ), Shanshan Zhou (CN/NZ)
Pinokio

Pinokio is an exploration into the expressive and behavioral potentials of robotic computing. Customized computer code and electronic circuit design imbues *Pinokio* with the ability to be aware of its environment—especially people—and to express a dynamic range of behavior. As it negotiates its world, we, the human audience, can see that *Pinokio* shares many traits with animals, generating a range of emotional sympathies.

Adam Ben-Dror (ZA/NZ) was born in South Africa and is currently living in New Zealand where he is studying Fine Arts at Elam School of Fine Arts while working at the multidisciplinary design studio Alt Group.
Shanshan Zhou (CN/NZ) was born in China and is currently working as a freelance designer in Wellington, New Zealand.

**Libby Heaney (UK)**
Lady Chatterley's Tinderbot

Lady Chatterley's Tinderbot is an interactive installation comprising conversations between an artificially intelligent Tinderbot posing as characters from *Lady Chatterley's Lover* and other Tinder users. The installation features over 200 anonymized Tinder conversations from both men and women, where Bernie, an AI personal matchmaker converses with members of the public using dialogue from *Lady Chatterley's Lover,* following its own sentiment analysis algorithm. The conversations range from positive to negative, human to non-human, and probe both familial and sexual love. Participants can swipe left and right to follow the negative or positive conversations, echoing Tinder. The artwork was made through the Systems Research Group at the Royal College of Art (RCA), investigating how one can use a geometrical structure from quantum computing—the Bloch sphere of a quantum bit—as a model or method for the deconstruction of concepts.

Libby Heaney (UK) is an artist, researcher, and a lecturer at the Royal College of Art. She has a background in quantum physics and works at the intersection of art, science and technology. *libbyheaney.co.uk*

Itamar Shimonshy (IL)
Stony 1.0

Stony 1.0 is a robot that takes care of tombstones by performing the simple yet personal tasks of cleaning graves and leaving behind flowers and stones, as the Jewish custom requires. The performance hinges on the tension between humor and sadness, the authentic and the artificial. Underlying the project are the philosophical questions: Where is technology leading humanity and what are we losing as it replaces more and more of our jobs? Is there anything we should not automate? The selection of a robot to perform such a personal task produces a deliberate sense of discomfort in the spectator, and prompts reflection about whether certain tasks ought to be left to humans, even though they can be performed by machines. *Stony 1.0* challenges life, art, and technology.
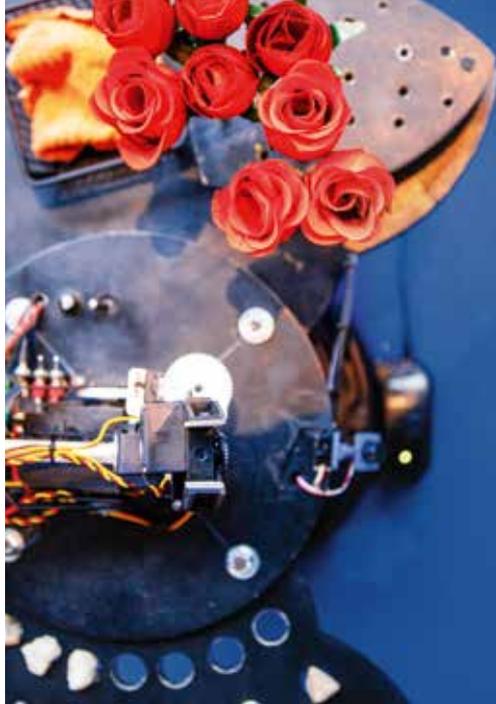
Itamar Shimshony (IL) holds a BFA and an MFA from the Bezalel Academy for Art and Design. He is a versatile artist working mainly with video and sculpting. His recent body of works examines the influence of life and technology on art, using a critique approach saturated with humor and irony. Shimshony has exhibited in solo and group exhibitions in Israel and abroad. He teaches at Bezalel Academy at the Department of Screen Based Art and the Department of Industrial Design. *itamarshimshony.com*

Radamés Ajna, Thiago Hersan (BR)
memememe

This project started with the suspicion that phones are having more fun communicating than we are. Every message is a tickle, every swipe a little rub. From their initial transformation of metal and silicon into objects of desire, infused with social significance and "intelligence," personalized with biases and ideology, endowed with a flawless memory, always a call away from the mothership... it becomes difficult to declare who—phone or human—has the more complex cultural heritage.

memememe is a sculpture that celebrates the ambiguities of human/object, user/interface, and actor/network relationships. It is an app that removes phones from their anthropocentric usefulness, and gives them the beginnings of a language. Residues of their conversations can be seen, but certainly not understood.

Thiago Hersan (BR) used to design circuits and semiconductor manufacturing technologies. Now, he is more interested in exploring non-traditional uses of technology and their cultural affects. He has participated in residencies at Impakt in Utrecht, Hangar in Barcelona, and the Hacktory in Philadelphia. He has worked at a robotic toy design studio in San Francisco, and along with Radamés Ajna, helped start FACTLab in Liverpool in 2015. *thiagohersan.com*

Radamés Ajna (BR) is a media artist and educator with a background in physics, mathematics, and computation. He has been using technology as a platform of experimentation, using public spaces, human interaction, and machines interaction. In 2015 he was awarded an AiR residency at Autodesk and was the recipient of a VIDA 15.0 Production Incentive award from Fundación Telefónica. Currently, he is a Researcher Artist in Residence at FACT Liverpool, helping the development of FACTLab. *www.radames.in*

Lorraine Oades, Martin Peach (CA)
Self Typing Machines

Two adapted electronic typewriters communicate with one another autonomously, without the aid of the human hand. As the keys move up and down, the typewriter mechanisms are engaged as if someone were actually typing. In addition to being typed out on the page, messages are displayed on a low-resolution LED display, making them visible to onlookers as they are being typed out, letter by letter. The typewriters send messages to one another, or a visitor can sit at one machine and the other will respond to their questions. The script for *Self Typing Machines* is based on philosophical, literary and critical texts and structured on a question and answer format. For each question asked, there are anywhere between one and thirty different possible answers. The questions and answers are randomized, so an infinite exchange is possible.

Lorraine Oades's (CA) sculpture/installations incorporate time-based media such as sound, video, and film in order to invite viewers to engage physically with the work and explore their creative potential. For Oades, art making is a performance-based activity where the process of time is implicit in the final artwork. She teaches in the Intermedia: Video, Performance and Electronic Arts Program at Concordia University.

Martin Peach (CA) was responsible for the programming and electronic design of *Self Typing Machines*. Martin is a technician, tinkerer, programmer, and musician based in Montreal. Over the past twenty years, Martin has helped artists realize electronic and interactive artworks involving analog and digital circuitry, incorporating various sensors, microcontrollers, and software. *loades.ca*

Seb Lee-Delisle (UK)
The Mindfulness Machine

Alan Turing's argument, to paraphrase, was that if an artificial intelligence can demonstrate emotions and feelings, who are we to say that it doesn't truly feel them? As we approach the singularity, these robot brains will no doubt experience feelings of anxiety and stress just as we do and, as such, will need to find mediation techniques to help them. Humans have tried many varied techniques for coping with the modern world—hence the recent trend for adult coloring books, to aid mindfulness and artistic expression. *The Mindfulness Machine* is a robot that likes to color in. It's an exploration into a future where the AIs will need to chill out just as much as we do. It spends its days doodling, making artistic decisions based on its mood. And its mood, in turn, is based on a complex number of variables, including how many people are watching, the ambient noise, the weather, tiredness, and its various virtual biorhythms.

Seb Lee-Delisle (UK) is a digital artist who likes to make interesting things from code that encourages interaction and playfulness from the public. Notable projects include *Laser Light Synths,* LED emblazoned musical instruments for the public to play, and *PixelPyros,* the Arts Council funded digital fireworks display that toured nationwide. He won the Lumen Prize Interactive Award in 2016 (Laser Light Synths), 3 Microsoft Critter awards in 2013, and won a BAFTA in 2009 for his work as Technical Director on the BBC interactive project *Big and Small. http://seb.ly*

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Blake Fall-Conroy (US)
Minimum Wage Machine

The *Minimum Wage Machine* allows anybody to work for minimum wage. Turning the crank will yield one cent every 3.892 seconds, for €9.25 an hour, Ireland's standard minimum wage for an adult worker. If the participant stops turning the crank, they stop receiving money. The machine's mechanism and electronics are powered by the hand crank, and coins are stored in a plexiglas box. The *Minimum Wage Machine* can be reprogrammed as the minimum wage changes, or to reflect wages in different locations.

Blake Fall-Conroy (US) is an artist and self-taught mechanical engineer. He has a BFA in sculpture from Cornell University. As a mechanical engineer he works in industrial robotics, where he designs and fabricates remote-controlled robots that climb vertical surfaces. As an artist, Blake's art-making practice is conceptually motivated, commenting on a wide range of issues from consumerism and the American spectacle, to surveillance and technology. *blakefallconroy.com*

Driessens & Verstappen (NL)
Tickle Salon

You might be familiar with the pleasant experience on a warm summer day in the fields. Long blades of grass, driven by the wind, softly stroke your skin in a most agreeable manner. You don't control the tactile stimuli, so you can totally immerse in the actual sensations. *Tickle Salon* is a robotic installation based on the concept of an automated caress. The participant undresses him/herself, lies down on the bed, and starts the session. A soft brush lowers onto the body, and begins to carry out sensitive movements over the skin, generating a variety of pleasant feelings. The robot does not have any built-in knowledge about human bodies. Instead, it adapts itself by trial and error, feeling its way around. In the beginning of the session, its movements are short and quite clumsy, but they soon become more refined by the touch, resulting in smooth, lingering strokes and delicate touches. You cannot predict where the brush is heading, so the sensations are direct and very lively.

The Amsterdam-based artist couple **Driessens & Verstappen** (Erwin Driessens and Maria Verstappen, NL) have worked together since 1990. After their studies at Maastricht Academy of Fine Arts and Rijksakademie in Amsterdam, they jointly developed a multifaceted oeuvre of software, machines, and objects. Driessens & Verstappen attempt an art in which spontaneous phenomena are created systematically. In addition to working with natural generative processes, the couple develops computer programs for artificial growth and evolution. *driessensverstappen.nl*

Merijn Bolink (NL)
Google's Eyes

This piece has been made using Goggles, an Android app by Google. The app is meant to recognize monuments, objects, and people, but when it is shown new objects, it will provide images of things it "thinks" are similar. The results are remarkable, poetic, and sometimes really striking. The artist made a small clay sculpture of one half of a car tire to begin. The car tire was then scanned by the app, and gave twenty results of images it sees as similar. Of these, the artist selected the most interesting one—a human jawbone—and produced it in clay. The subsequent sculpture was then scanned by the app, which thought it was a hand, so the artist made the hand... and so on. The series of objects has been fired to stoneware after it was completed in clay.

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Merijn Bolink (NL) is a sculptor whose sculptures are typically based upon real objects, like a bicycle, a stuffed dog, or a cigarette. He makes new versions of these objects, trying to understand what they are, hoping to discover something magic in the process of transition, or even something mystical. He once cut his own piano in pieces to make two copies. Bolink is inspired by the idea that all matter is on its way to becoming something else and that we humans can only interact with that matter for a relatively short time, trying to make sense out of what we experience.

Science Gallery Dublin

Anna Dumitriu, Alex May (UK)
Antisocial Swarm Robots

Antisocial Swarm Robots explores how humans psychologically perceive the programmed actions of robots by projecting their own meanings and emotional responses onto them. These tiny, almost cute, identical swarm robots do not appear to like each other, the walls of their pen, or the visitors' efforts to interact with them. In fact, they are programmed to use their ultrasound detectors to measure if any physical object is in their "personal space" and to intelligently avoid it.

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Anna Dumitriu (UK) is an artist whose work fuses craft, technology, and bioscience to explore our relationship with emerging technologies. She is a visiting research fellow and artist in residence in the Department of Computer Science at University of Hertfordshire, and an honorary research fellow at Brighton and Sussex Medical School.
Alex May (UK) is an artist exploring a wide range of digital technologies, most notably video projection onto physical objects, interactive installations, performance, and video art. He is a visiting research fellow and artist in residence in the Department of Computer Science at University of Hertfordshire.

David Lovejoy, Ted Meyer (US)
The Great Disengagement

Chrono-archaeologists David Lovejoy and Ted Meyer have long been interested in the transitional period when computers and robots (or combots, robot-computer hybrids) took charge of the world's work, financial systems, and culture. The two have compiled an extensive written and visual history of the time that will become known as the *Great Disengagement,* the period after combots took over all human tasks, leaving humanity to drown in free time, with nothing to do but dream of those boring manual tasks robots were originally designed to perform.
The artists lay out the rise of the robot authority with historic artifacts of the period. With printed materials and relics of the period, the artists bring to life the changing post-cloud, conductivity computing world, where sentient computers came to see humans as annoyances due to their careless habit of infecting computer mainframes with defective thumb drives and errant downloads of porn and cat videos that consumed valuable bandwidth.

Dave Lovejoy (US) has worked as an artist and designer since the 1980s. His early career in graphic design supported an extensive arts education at several schools and studios, focusing on ceramics and design. He has curated at the Spring Arts Gallery since 2009. Known primarily for his assemblage and installation work, Lovejoy repurposes existing artifacts and fragments, arranging them to form new compositions.
Ted Meyer (US) is a nationally recognized artist, curator, and patient advocate who helps patients, students, and medical professionals see the positive in the worst life can offer. Ted's 18-year project *Scarred for Life: Mono-prints of Human Scars* chronicles the trauma and courage of people who have lived through accidents and health crises. Ted seeks to improve patient/physician communications and speaks about living as an artist with illness. He is Artist in Residence at USC KECK School of Medicine, Visiting Scholar at the National Museum of Health and Medicine, and TED main stage speaker. *tedmeyer.com*

SOUND CHECK: Make it. Play it.
Science Gallery at Trinity College Dublin
09.06. – 24.09.2017

Break out your old mix tapes, swing your way to melodic bliss or rock up to our NOISE STUDIO to make your own synth. SOUND CHECK at Science Gallery at Trinity College Dublin promises a noisy cacophony that will make your hair stand on end and your stomach vibrate!

Visitors to SOUND CHECK will become performers alongside hackers, designers and scientists, inventing new instruments and collaborating to explore the outer edge of tomorrow's sound. The works presented in the exhibition delve into the moment between practice and performance, designs and reality, where new musical tools make us hear our world differently.
SOUND CHECK's advisors include Nicolas Collins, electronic music pioneer and professor at the School of the Art Institute of Chicago; Nicolas Brown, Ussher Assistant Professor in Sonic Arts at Trinity College Dublin; youth worker Lisa Downes, and Dublin Maker founder David McKeown.

mi.mu
mi.mu gloves

The *mi.mu gloves* are wireless wearable gestural musical instruments and controllers. The gloves are fitted with sensors that track the movement of your hands and fingers, allowing musicians to control music software with a degree of complexity and expression not available with more traditional button and slider interfaces. Originally developed with and for musician Imogen Heap, the *mi.mu gloves* are a transformational new way to compose and perform music. For musicians, the gloves offer a radical new way to interact with computer music, allowing them to sculpt sound with their hands, or manipulate effects with their fingers. For audiences, the gloves are a visual and physical performance of electronic sound, bringing them closer to the music. The movement of the human body brings the dynamics of electronic music to life, as music is created through visual movements and gestures.
For the *SOUND CHECK* exhibition at Dublin Science Gallery, the mi.mu team have created a unique set of *mi.mu glove* musical experiences for visitors to try for themselves.

mi.mu is a team of specialist musicians, artists, scientists and technologists developing cutting-edge wearable technology for the performance and composition of music. The *mi.mu gloves* have captured worldwide attention by showing that there is a better way to make music than with sliders and buttons—through the complex movement of the human body.

The Practice of Art and Science

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