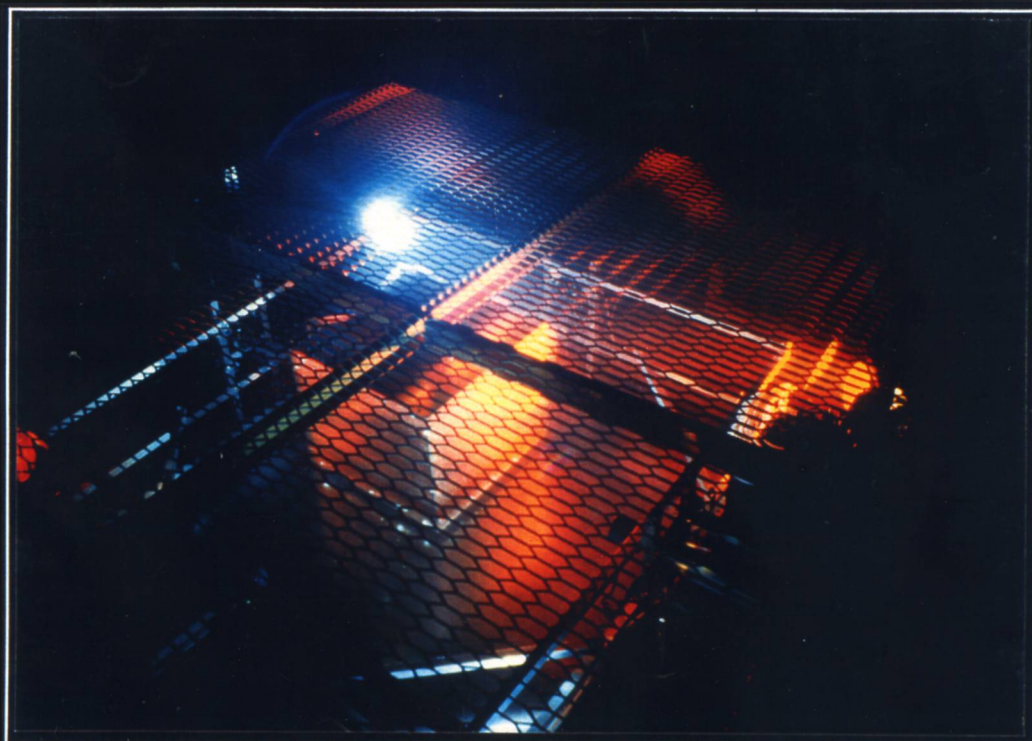




Created by
Louis-Philippe Demers
&
Bill Vorn

Montréal (Québec) Canada
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Robotics by
Louis-Philippe Demers
Bill Vorn

The Scavengers

NO MAN'S LAND

Interactive Robotic Installation

The concepts of NO MAN'S LAND follow the basis of our exploratory work on invented and immersive metaphoric environments thru the utilization of machines that produce movement, light and sound as their "living" functions or invented metabolisms. The installation invites the viewers to consider an invented habitat solely made for robots.

NO MAN'S LAND regroups 9 different robot species dispersed into the whole installation site. These species are composed of more than 50 independent robot-organisms cohabiting in the space. The viewers can walk freely around the robots, their presence being detected by a set of 64 sensors.

Each robot specie has a distinct structure and behavior and can be seen as a form and function relation based on their behaviors parameters: rhythm characteristics, complexity of motions, responsiveness and imbrication of medias. These species are:

The Herd - A group of eight long tubes flocking together.

The Attractors - A group of four swinging lights, suspended in the air.

The Parasites - A set of sixteen percussive units hook onto other machines.

The Prisonners - Two robots crawling on the floor retained by their cabling.

The Colony - Eight invisible machines living in a pile of metal junk.

The Flaunted - Eight suspended machines, dripping water to flaunt their mates.

The Scavengers - Two groups of scavengers fighting over a piece of metal.

The Untamed - Four robots frenetically banging their cages.

Technical Specifications

Dimension	8m (W) x 16m (L) x 4m (H)
Required Space	Black box with ceiling
Scaffolding	6 towers
Hanging Points	7 pipes between towers
Cargo Weight	1000 Kg
Required AC	60 A under 120 v @ 60 Hz
Compressed Air	5.6 SCFM @ 90 PSI
Sound Level	High (≈ 80 dB)
Insulation Required	Smoke generator in use
Set-Up Time	48 hours min.
Strike Time	24 hours



6585 Jeanne-Mance, unit 301, Montréal, Québec, CANADA, H2V 4L1

tel 514.495.7673 or 514.948.6491 fax 514.278.3857 email d356644@er.uqam.ca web <http://www.comm.uqam.ca/vorn/chaos.html>

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LOUIS-PHILIPPE DEMERS & BILL VORN

DESCRIPTION OF THE ARTISTIC
CONCEPT

Of Robotic Ecosystems.

Through robotic installations, we pursue our researches on intelligent environments and life embodiment into matter. We regard machines as distinct entities from us, as much as we consider ourselves distinct from nature. Machines, through the ages, can be seen as an inner intermediate dialogue, in which they appear as the physical rendering of abstraction and also as the comprehension of ourselves within the structure of the world.

First considered as the main intent of the human quest for its artificial double, machines now tend to become autonomous entities, leaning towards the behaviour of real living individuals.

We do not intend to simulate nor physically reproduce real life animals but we rather deal with simplistic behaviors engendered by primitive mechanical animats. Shapes move from primitive abstract objects (spheres, cylinders, sound, light) to kinetic and complex organisms as polymorphic patterns.

We present robotic machines not as specialized and virtuoso automata but rather as expressive animated artworks. We also explore the reformulation of sound and light applications by simulating organic and metabolic functions and by creating dynamic virtual architectures.

In addition to the intrinsic mechanical noise, loops and repetitive textures of both organic and metallic sound objects are part of the installations soundtracks, a collection of numerous heteroclit elements chosen for their evocative properties. The goal is to disfigure the inherent nature of the sound samples and to create an peculiar ambiance proper to the metaphoric habitat of machines.

Movement itself can be seen as the objective nature of the machine while its perception (from the viewer) as its subjective counterpart. The hyperreal simulacra of the robot world goes beyond the unreachable simulation of life on a computer screen. Robots are not only a virtual model, a pattern in space and time, but also a dynamic and evolving phenomenon embodied in matter.

The replication of machine-organisms is a fundamental concept. Ecosystems are obviously based on population (gender and number) and their complexity is obtained from multiplicity of the inherent interactions.

The perceived emergent behaviors of these machines produce a multiplicity of meanings based on single dynamic pattern of events. Real Artificial Worlds engender the paradox of simultaneous illusion and reality by a complete immersion of the viewer in a metaphorical but physically responsive environment.

Installations.

The installations are deployed in dark hazy spaces, in unusual architectural sites where the viewer is invited to consider an invented habitat solely made for the robot-organisms.

Each installation replicates elementary robot-organisms hence building a fictitious society or *robotic ecosystem*. By experiencing these environments with the entire body, immersed in this simulated world, the audience is more convinced of the simulacra.

Espace Vectoriel.

Espace Vectoriel paraphrases the mathematical term Vector Space in which information or behavior is expressed in terms of vectors: a raw representation of a more complex phenomenon.

The elementary units of this kinetic sculpture are revolving tubes (4' long) where speakers and light sources are located within their base. (See Fig. 2) Espace Vectoriel regroups eight robots deployed in an asymmetrical pattern over an area of 15'x20'. Viewers are surrounding the tubes and are tracked by eight sonar devices. Complex lighting patterns and sound textures are continuously evolving, creating hypnotic and organic impressions.

The Frenchman Lake.

The Frenchman Lake is built upon a network-society of sixteen submarine robot-organisms: an experimental aquatic ecosystem. Each entity contains a speaker, light sources, sensors, and cohabits in a common pond where viewers can circulate freely around. (See Fig. 3) The elaborate aquatic environment is the catalyst for new possibilities for sound and light diffusion.

The Frenchman Lake proposes a different experimentation of ecosystems. Based on a simpler motion of the robot mechanisms, the installation aim to produce an equivalent life-like illusion by

multiplying the sensing possibilities and also by increasing the number of individual units.

The Frenchman Lake is a desert lake in the Yucca Flat (Nevada, USA). This lake is among the first nuclear test sites and, even today, is still radioactive. Even under a calm and serene appearance, the valley drizzles with invisible "life"...

No Man's Land.

No Man's Land evokes through various robotic species, fictitious behaviors of an even larger robotic ecosystem. Here the robot-organisms are replicated in number and also in gender. The robotic genders are designed following their behaviors in the habitat and their are metaphors of natural societies: parasites, scavengers, overpopulation, flocks, etc.

The machines are reduced to their most nominal expression to implement their intended behaviors. A simple hammer machine becomes, at the same time, a rhythmic element and a parasite when installed judiciously on another robot-organism. (See Fig. 4) The behaviors are seen as a common thread for design of each of the robot-organisms.

Concepts.

The conceptual framework of these researches is based upon Artificial Life, immersive environments, connectionism, reactivity and artificial behaviors (implanted and emergent). We present here, our interpretation of these domains in respect to our intentions of producing an aesthetic media out of machines.

Real Artificial Life as Invented Robotic Ecosystems.

Real artificial life is robotics. [Levy] The hyperreal simulacra of the robot world goes beyond the unreachable simulation of life on a computer screen. Robots are not only a virtual model (a pattern in space and

time) but also a dynamic and evolving phenomenon embodied in matter.

As far as we can observe in the architecture of living things, the whole is always greater the sum of the parts. In *Out of Control*, Kevin Kelly wrote: "An ecology of machines enhances the limited skills of dumb machines." [Kelly] Following this assumption, the installations evoke fictitious behaviors of a global robotic ecosystem through local interactions of minimal mechanical organisms. The underlying design of the whole system (an organism of organisms) is then founded on the characteristics of natural societies behaviors: chain reactions, propagation and aggregation compartments, herds and swarms, etc.

The machines can then be seen as virtual organisms that move and produce sound and light as the outcome of their invented metabolisms. In this sense, we do not intend to simulate or physically reproduce real life animals but we deal rather with simplistic behaviors engendered by primitive mechanical animats. This metaphor feeds on the organic sounds and movements in order to create an hybrid world between nature and the artificial.

These installations are about displacement of existing artifacts and expected life-like behaviors. [Laederach] It imposes our own perception of natural behaviors upon a society of mechanical, audio and visual elements.

The concept of *replication*, therefore a large number of machine-organisms, is fundamental to these projects. Ecosystems are obviously based on population (gender and number) and their complexity is obtained from multiplicity of the inherent interactions. [Lewin, Simon] Furthermore, the illusion of life would not be as convincing if there were only a few units, limiting the combinations of possible states of the system which are consequently perceived as behaviors.

Hypnotic and repetitive movement are easily foreseen with these machines. The kinetic art, itself, suggests that the real (as opposed to virtual) movement generates a response in us and that any movement outside our body is hypnotic. [Deschênes, Robillard] Rituals, hierarchy, chaos, aggregation, the collective versus the individual, are among the potential compartments addressed by the installations.

We can suggest that no prerequisite or imposed equivalence exists across the boundaries of life and its machine representation. Since one of the forefront aesthetic choices of these works is the evocation of life through an abstract, even displaced, bare inorganic skeleton, the machines are kept deliberately simplistic. Shapes move from primitive abstract objects (spheres, cylinders, sound, light) to kinetic and complex organisms (polymorphic patterns).

The installations also convey displacement of sensations, perceptions and expectations: duality, ambiguity and contradiction are part of the sculptures. The societies are conflicting in their aesthetics when not animated. For instance, if the objects are lying still in a particular pattern, the viewer perceives its own specific image. As they move and react, the initial perception is destroyed. What was first seen as the outside inert perception, the known experience of the objects, is continuously transformed.

Robotics, sound & light as an immersive media

In these installations, we must point out how much the environment/immersion is primordial to the success of the displacement and the illusion.

Immersion erases the distance between the artwork and the viewer. Immersion makes the frame disappear by integrating the viewer completely inside the work. This process tries to stimulate the viewer's senses to enhance receptivity and the illusion of reality.

Sound and light are natural immersive medias. They spread in all directions without the need to be artificially rendered in a virtual manner. Each organism of these installations emits sound and light on an individual and specific basis to produce a general polymorphic ambiance that entirely surrounds the viewers. As a result, the guests become part of an environment where every point of view has something new to offer.

The objects of kinetic art, machines and artifacts, feed on the concept of continuous transformation and participation of the viewer. The movement being the perceptible change of state of the object (sound, light, image, matter, etc), it is always perceived subjectively by each one of us. The movement itself can be seen as the objective nature of the machine while its perception (from the viewer) can be its subjective counterpart.

The audience is invited to explore these fictitious habitats, immersed in an strange and disconcerting world composed of machines and immaterial objects of light and sound. The ecosystems evolve around the viewers, constantly creating new virtual architectures within a fixed physical space.

In the usual format of presentation for installation works, the attention of the viewer is generally focused to the presented objects making the surrounding site disappear. While these objects may show some behaviors, they are exogenous entities in a silent environment.

In creating intelligent habitats, we promote an endogenous situation where the viewer is immersed within the site. The viewer is not only presented to a central object but involved within a whole environment which, in turn, becomes the object. The transformation of an inert site into a reactive *locus* will force the viewer not only to consider a society of machines but also an habitat made for machines where their sole presence will disrupt the system and engender reactions.

Challenging the sensations of the audience rather than subjugating its intellect is among the goals of these researches.

Reactivity.

Interaction is usually associated to the direct control of the viewers over the systems. These installations can be categorized as reactive rather than interactive. [Prince, Drogoul & Ferber]

In the reactive model of man-machine interaction, the viewers do not gain control at their leisure and will over the self-steering system but, instead, influence the unfolding of high level events (expressed by its behaviors) through their simple presence and movement.

In many ways this communication scheme seems closer to the relationship between living organisms and their environment compared to the usual interactive model found in hypermedias where the system is usually waiting for a command from the user in order to react.

In a reactive context proper to autonomous systems, the objects react at their own will, between them and without the presence of any viewer. Interaction starts at the lower levels of the structure (between task-action agents deep inside the program core) and evolves in complexity up to a close relationship with the nearby environment.

From a theoretical point of view, the systems have their own inherent compartments without any external input from the environments. However, this determinism can be constantly altered by random changes in the outside world perceived by the sensory devices.

Connectionism.

The robot-organisms have no local (or minimal) processing capabilities, consequently the parallelism is simulated

inside the computer through various objects representing the organisms inputs and outputs. These objects are linked together on different layers by behavioral rules, similar to a neural web. [CMJ, Rowe, Reynolds]

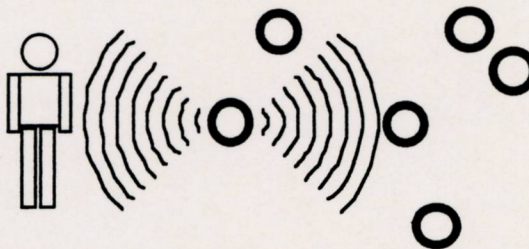
Each entity expresses simultaneously an independent comportment (altered by its direct perception) and a dependent behavior (as a result of its connection with one or many other machines). This kind of network permits the system to simulate

individual reactions between objects and to induce group and social behaviors on a larger scale. (See Fig. 1)

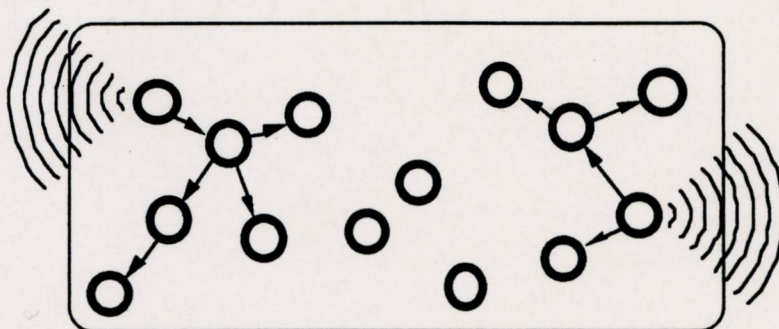
Communication and control are achieved through a network of parallel distributed units. The links between each unit are dynamically allocated according to the current state of these units and the respect of specific rules embedded in the main program.



Possible connections and relations between units.



Viewers detection and sensing among the ecosystem.



Group behaviors and underlying connectionism.

Figure 1. Connectionism.

Implanted and emergent behaviors.

Implanted behaviors are individual reactions engendered by simple rules and conditions intentionally programmed in the system. They are easy to anticipate because they are a direct response to a precise triggering cause. Low-level agents are responsible for producing these comportments.

Emergent behaviors are group reactions engendered by the sum of all the individual reactions. They are much more difficult to foresee because they depend on a global interpretation of an exponential number of possibilities. These comportments are derived from the dynamic and complex interactions between low-level task agents. [Emmeche, Langton et al.]

For example, in The Frenchman Lake, the presence of a viewer may "intimidate" one of the organisms and make it react immediately (it dives or it springs out of the water). But this reaction will trigger another one from the neighboring organisms which will trigger another one, and so forth... (See Fig. 1 b,c) The overall result will produce either a chaotic effect (randomly dispersed) or a more ordered pattern which will slowly take shape, looking like a real mass movement (swarm or aggregate). This can be expressed in various ways by robotic movement, sound texture and rhythm, and light variation.

From Concepts to Realization.

In this section, we review the installations and their physical rendering of the concepts via specific topics: robotics, sensing, sound, light, control and behaviors.

Robotics.

One is obviously interested in motion that provides speed, strength, accuracy, repeatability and ease of control. Unfortunately, all of these characteristics

come with a price tag that makes the replication concept a prohibitive approach. Consequently, we have to relax all these constraints and still make the affordable industrial equipment work for us...

We can classify the various motion induction tools available into: DC motors, stepper motors, linear or rotary actuators (hydraulic, pneumatic) and solenoids. [Craig, Jones & Flynn] All of these construction blocks are present in the three installations.

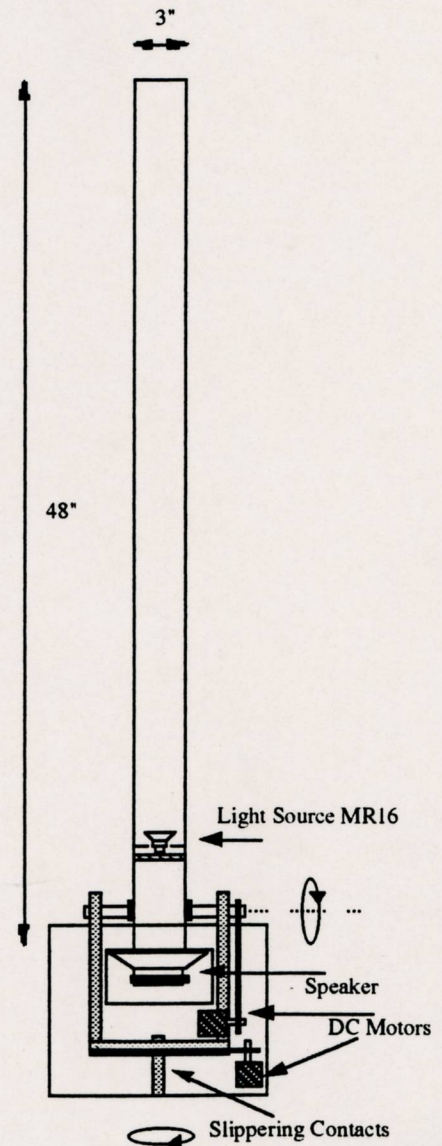


Figure 2. Espace Vectoriel Robot.

In Espace Vectoriel, the motorized tubes are approximately 4 feet long and 3 inches wide. They have two degrees of freedom: continuous 360° rotation and 170° tilt. Two DC motors assembled in a fork configuration provide the necessary movements. (See Fig. 2) Slipping contacts assure proper electrical connections to the light, speakers and motors while providing infinite rotation. The full pan rotation was a prerequisite in the desired motions; enforcing any envelope on the tube course would decrease its organic feel. Each unit has a servo control system that processes high level commands from the master computer.

When the tube is almost horizontal, it takes a considerable amount of strength in the system in order to bring back the tube to a more vertical position. Gearboxes and counterweights had to be included in the design. Steppers motors were discarded due to their lack of strength and jogged movements.

Each unit of The Frenchman Lake is an hemispherical shell containing a speaker, a light source and sensing device. (See Fig. 3) The shell is obviously a transparent and protective membrane against the water while permitting the sound, light and sensor to reach the outside world. The shell is articulated vertically (spanning across the water surface) by a pneumatic actuator anchored at the bottom of the basin.

Actuators are simple mobile mechanical pieces (linear motion) similar to an organic tendon or muscle capable of being digitally controlled. Actuators implanted with pneumatic components can operate underwater, provide great strength (300 lb..) and impressive speed (1f./sec). Hydraulic actuators were discarded due to their costs and their lack of speed. However, they offer better accuracy and strength. The positioning of each unit is made through specialized computer interfaces for pneumatic valves control.

Solenoids come in various motions: revolving, linear actuation, holding forces, etc. They are electromagnetic components, permitting more precise synchronization and speed. However, they are not as strong as other motion tools and imaginative constructions have to be derived to transfer their courses into desired movements.

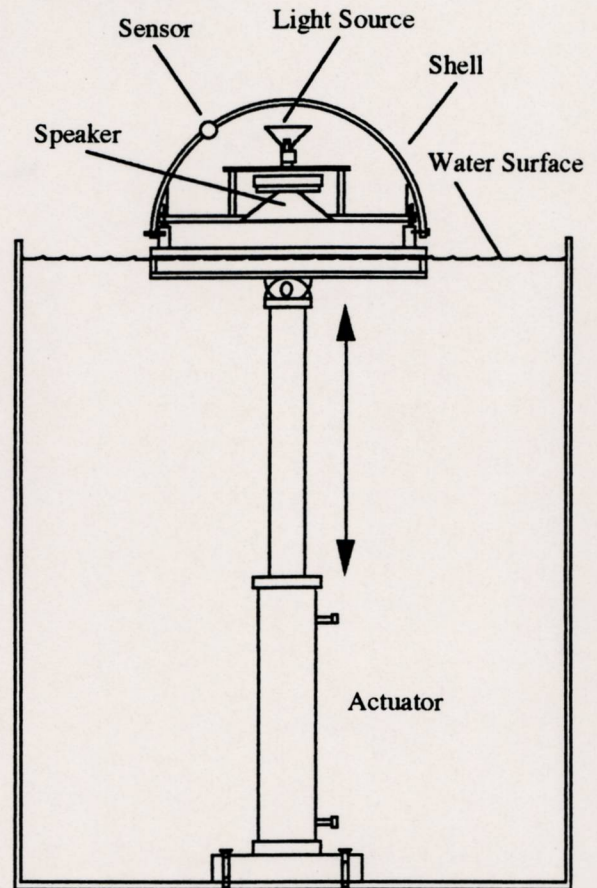


Figure 3. The Frenchman Lake Robot.

In No Man's Land various species of machines are built using minimal designs and organisms states. For instance, some robots rely only on their mechanisms to produce sound (percussions) or light (sparks). (See Fig. 4) The spectrum of actions is then quite reduced and we have to push even further the number of units to implement complexity.

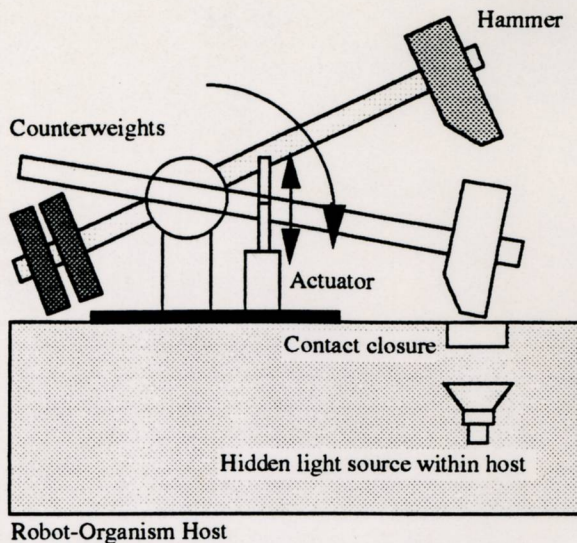


Figure 4. *No Man's Land Parasite.*

Solenoids are a prime tool for implementing much of the species. Their simple control (on/off), their velocity and size enables us to build smaller machines in a larger number while offering the necessary synchronization for complex rhythmic patterns. The design of each species is closely linked to its intended compartments and is covered in the following section on behaviors.

To summarize, the machines themselves can be seen as a form and function relation based on their behaviors prerequisites: rhythmic characteristics, complexity of motions, responsiveness, and imbrication of medias (sound, light, sensor) within the organism physical structure.

Sensing.

In order to perceive the changes in the environment, the systems possess a series of sensing devices distributed in the space and on the robot-organisms. Even though, the coupling of local sensing transducers and a robot-organism seems to be the natural choice, different paradigms can be applied to achieve a proper perception from the ecosystem.

The sensing has to be non intrusive and non encumbering. Following the

immersion principles, the audience can not be constrained to wear homing devices or manipulate some tele-operating apparatus; it has to move freely in the space.

Furthermore, any sensing device that impedes any restrictions on the medias (sound frequencies, light levels, machine motions, etc.) has also to be discarded. Non intrusive interaction will integrate with the movements, the medias and the behaviors regardless of the methods and devices.

In Espace Vectoriel, eight ultrasound sensors are located on the periphery of the group and algorithms can determine the position of several people surrounding the robots at once. (See Fig. 5) These telemetric devices were selected because they offered the least sensing points for a maximum coverage; their working envelope also matched the path taken by the viewers. This scheme works best when the sensor shells are hidden, trying not to grasp the viewers attention and also preventing any misinterpretation about the presence of a suggested control device.

Proper perception does not necessarily rely on such high level quality of the sensing data. Infrared sensors, for instance, can only detect the presence of viewers within their envelope. The inherent simplicity of this device signal states (on/off) enables us to deal with a large amount of sensory units: up to 128 independent sensing channels are being used.

The Frenchman Lake and No Man's Land propose that if these sensors are adequately distributed in the space, they can achieve equivalent perception with simpler primitives. To each robot-organism will correspond at least one sensing device. The space will also house several sensing points to extend the sensory perception of the whole installation. These devices will also monitor the activity (heat/light) from the other organisms.

propagate from underneath its structure. Speakers are covered with waterproof shielding and fixed in the shell casing. The aquatic environment leads to experimental diffusion of the sound: through the water, at the surface level and outside the water.

In No Man's Land, the sound is mostly produced by the robotic organisms themselves; synchronized hammers banging on metal objects, heavy structures pushed on the floor by pneumatic arms, solenoids releasing and clicking, motors drilling and grinding, etc.

Lighting.

The subsequent lighting of each installation is a conglomerate of interrelations between the medias and the desired behaviors. Unlike theatrical lighting, the outcome of the whole system is not predefined or recorded. [Demers]

The lighting has the power to reveal to the viewer's eyes what the ecosystem wants to exhibit through selective reinforcement, deliberate darkness, displacement, etc. For example, a pulsating light can be seen as warning signal, still, buried in a robot and coupled with sound and movement, it can be perceived as a breathing. The lighting also reflects the state of the organisms, the ecosystems and the distribution of the viewers.

Each light location and focus then match a specific purpose: overall ambiance, robot-organisms limbs, enhancement of sound or movement. The light source can also vary in its characteristics: cold, warm, stroboscopic, sparking, harsh, soft, etc. The individual light levels are digitally controlled and all crossfades and states are generated by the MIDI dimmers linked to the master computer.

In Espace Vectoriel, lighting can be seen as the extension of the tubes. The light beams created and articulated in the space enhance the movement of the society.

Inside each robot's transparent shell of The Frenchman Lake is an halogen light source fixed to the internal frame above the reversed speaker, and pointing towards the top of the structure. The light source buried inside the robot shell improves the living aspect of this organism.

The basin offers a dynamic reflection and refraction surface by nature and also by the waves induced by the movements of the robot-organisms. The deployment of the lighting apparatus is designed to accentuate these effects and also to take advantage of them.

In No Man's Land, to complement sound generating organisms, we can find light emitting species. They react to specific stimuli by producing either sparks or stroboscopic effects as an outcome of their behaviors.

Control.

Even if each robot-organism is conceptually independent, they are all ruled by one single master computer. Inside this computer, virtual links from the sensors and connection channels are established, therefore implanting an apparent individual behavior for each organism. This architecture enables us to control all the medias and robot-organisms independently in a synchronous manner.

The master computer manages, stores and generates the various stimuli, medias, choreographies, scenarios and behaviors. The electronic sounds, light levels and robotics are all controlled individually via the object-oriented interactive programming environment MAX and external C code.

MAX patches (program scripts) were derived to control sound samplers, MIDI lighting dimmers, custom made DC servo controllers, sonar to MIDI transducer, switches to MIDI transducers, pneumatic valves, solenoids, strobes and smoke generator.

The structure of the control programs are also related to the subsumption approach [Brooks]. Rather than describing the behaviors with a series of scripts and actions that includes all the possible decision paths, they are specified in a local and contextual manner. For instance, a behavior might be ruling the overall system while some isolated triggered behaviors might supersede some global actions.

The programming and design of the behaviors is laid out as an iterative process, trying to match a conceptual model into a *physical* audio-visual result. Dealing with this situation, the structure of the programs has to be derived in a way to permit quick alterations and numerous explorations.

Specific tasks within installations are also implemented. For example, in *Espace Vectoriel*, the robots know where they are physically located in the space and mathematical models permit the tube to point out at a specific location. The master computer then processes a higher level of models and curves, leaving the high bandwidth feedback to each unit. In *The Frenchman Lake* and *No Man's Land*, part of the implementation of the behaviors is carried out through cellular logic. [Langton]

Behaviors - Espace Vectoriel.

This installation implants organic, chaotic, flocking and propagating behaviors. The organic comportment wants to evoke slow and hypnotic movements of living organisms. We derived an algorithm that randomly generates pan&tilt, tempo, pitch and light with a distinctive reaction of a particular tube when a viewer is in its vicinity. The tube then performs a responsive routine around the viewer's position.

The chaotic behavior gives a flavor of organization within disorder. It deals with automated rhythms generation mapped onto sound, light and movement. The

position of the viewer's relative to each tube alters eight seeds to the tempo generators while always giving a coherent global structure.

With the flocking and the propagating behaviors, the installation simulates herd and aggregation comportments. In the former case, the group performs erratic and sudden movements targeted to the most crowded area of the space while the latter propagates sound and light in a chain reaction originating from a viewer disruption.

Behaviors - The Frenchman Lake.

The *Frenchman Lake* basically manifests the same kind of comportments; slow and quiet organic movements, frenetic and chaotic activity, swarming group motions. However, the larger number of units induces a more apparent cohesion of the whole system. Some behaviors, like propagation or aggregation, are then easier to apprehend from the audience point of view.

Figure 1 exemplifies various connection schemes of the organisms interaction. Upon detection of a viewer (local agent) and depending on the current global behavioral rules, the unfolding of actions can adopt several patterns: conversation across the pond, chain reaction fading away, transmission of reactions to neighbors.

Behaviors - No Man's Land.

In the *No Man's Land* installation, the robot-organisms species are classified by their shapes, functions and behaviors. Here is an indicative list of targeted behaviors:

"Parasites" are laid out all over the space and are likely to be found on other robot-organisms. It is a simple percussive mechanism with variable speed. For instance, the tempo of a parasite can be derived from the neighboring parasites or altered by a viewer's proximity. Fur-

thermore, closure switches are installed at the percussive points to trigger other medias (lights per se) incorporated within the host. (See Fig. 4)

"Scavengers" seem to fight for a large chunk of a dead animat; they are large and make a lot of noise. The dead animat is depicted by a steel cube (2'x2'x2') simultaneously pushed around by four pneumatic actuators. The scraping surfaces of the cube and the floor will generate a uncomfortable rhythmic pitch. Light sources are embedded into the cube to underline sudden movements of the cube and the scavengers.

The "Ravens" are hanging down from the ceiling and move vertically while attempting to catch metal objects on the floor. They retract to their upward position when detecting the presence of viewers. A speaker is fixed at the extremity of the ravener's tentacle and amplifies the sound of its own movement. The objects on the floor are hiding light emitting sources installed beneath them.

The "Overpopulated" are very small entities found everywhere in the ecosystem, in every hole and every corner of the place. They manifest a strong tendency to hide themselves and they produce blinding and noisy chain reactions when a viewer is walking too close. These animats then generate their own sound (by percussive impacts) and emit violent light pulses (by stroboscopic flashes).

"Captives" are crawling randomly on the floor while being retained by their own wires and cables. They integrate all the medias in their body (a speaker, a light source, sensors and electromechanical devices). It looks like they want to break loose and to run away from the inquisitive viewers.

In Retrospect.

Through these installations, we pursue our researches on intelligent environments and life embodiment into matter.

We intend to present robotic machines not as specialized and virtuoso automata but rather as expressive artworks. We also explore the reformulation of sound and light applications by simulating metabolism functions and by creating dynamic virtual architectures.

In fact, Real Artificial Life is more than an immersive media, it is a world on its own.

Acknowledgments.

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Real Artificial Life as an Immersive Media

Louis-Philippe Demers
6585 Jeanne-Mance, Unit 301
Montréal, Québec
Canada
H2V 4L1

Tel: 514.495.7673
Fax: 514.278.3857
email: lpdemers@kunstmacchina.com

Bill Vorn
5565 Clark
Montréal, Québec
Canada
H2T 2V5

Tel: 514.948.6491
Fax: 514.278.3857
email: d356644@er.uqam.ca

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Abstract.

This paper presents concepts and realization of interactive robotics, sound and light installations. Aesthetics of these kinetic environments are discussed regarding artificial life as an immersive media. Robotic ecosystems principles are exposed through connectionism, subsumption and reactive man-machine dialogue. Three pieces are exemplified with implementation and technical overview of their respective systems. Emphasis is made on the installation's behaviors and their design process.

abstraction and also as the comprehension of ourselves within the structure of the world. [DeMarinis, Horn, Hulten]

This paper refers to three robotic installations: Espace Vectoriel, The Frenchman Lake and No Man's Land. The exposed concepts of these installations are the basis of our exploratory work on invented and immersive metaphoric environments via the utilization of machines, referred in the text as robot-organisms, that produce movement, light and sound as their "living" functions or invented metabolisms. These works propose *real artificial life as an immersive media*.

Introduction.

"The machine must become a work of art! We shall discover the art of machines." - Bruno Munari, Manifesto of Machinism, 1952.

We regard machines as distinct entities from us, as much as we consider ourselves distinct from nature. Machines, through the ages, can be seen as an inner intermediate dialogue, in which they appear as the physical rendering of

The presentation is structured in two major sections: introduction to concepts followed by their pragmatic application in the installations. To situate the context, a brief overview of each piece is first introduced.