ROBOTS IN DISTRESS, BOREDOMRESEARCH (VICKY ISLEY & PAUL SMITH)

1/ *ROBOTS IN DISTRESS*: AN ARTIFICIAL LIFE ARTWORK

Robots in Distress is an artificial life artwork. In other words, it is not the recording of an animation but a dynamic autonomous and evolutive system.

The computer-generated simulation shows an underwater world full of plastic trash populated by little robots. Those robots are autonomous agents trying to communicate and survive in the environment.

The simulated robots are acting upon very limited capacities and rules: they can move upward, drift in the current, send a signal to the other members of the colony and receive theirs in order to adjust their position.

They are designed to recognize when their energy level is dropping which means that they will loose their agency.

The singularity of those robots is that through a simulated hormone that creates a feedback system and a simulated emotion for them, they are trained to recognize this loss of agency as valuable. Therefore, they can develop a kind of sense of despondency, recognize failure and give up.

Robots In Distress intends to explore not only the role of emotions in robotics but of negative ones.

The audio in *Robots in Distress* is in response to the virtual bots motion. There is a layered ambient soundtrack suggesting distant ships passing.

Interestingly, the created system does not allow to really tell between those robots that recognize their failure and those which don't.

2/ THE PROCESS AND METHODS BEHIND *ROBOTS IN DISTRESS*

The simulated A. Life work *Robots In Distress* has been created by boredomresearch as an echo and a response to the cognitive and emotional bio-inspired robotics researches that they discovered and experimented during their FEAT residency at the Karl Franzens University in Graz, Austria.

Robots In Distress is an artificial neural networks augmented by artificial hormone production to create autonomous agents with the potential for despondency.
It freely combines two methods explored by the Artificial Life Lab of the Karl Franzens University:

1. A concept of artificial emotions applied to cognitive robotics described in the article «First Investigations into Artificial Emotions in Cognitive Robotics» by Daniel Moser, Ronald Thenius and Thomas Schmickl, scientists at the A-Life Lab, Karl Franzens University.

Abstract: In nature, the combination of processes of emotion and cognition has a deep impact on type and quality of reaction to environmental stimuli. In this work, we want to test the feasibility of artificial hormones in artificial neural networks. We take a minimal evolving neural network and look into the implications and opportunities of extending this model of communicating nodes, with one virtual hormone gland. To explore the differences in behavior, that we expect to develop with this modification, we modify an already well established model, the Braitenberg Vehicle. These vehicles were faced with a simple energy gathering task. The behavior, efficiency and fitness of these vehicles in identical environment, with the artificial hormone active and inactive, is examined. It shows, that the implementation of artificial emotion leads to an increase in efficiency of the evolved solution.
Full text available at:
http://zool33.uni-graz.at/artlife/sites/default/files/Paper_MESROB_2016-Investigations_Artific._Emo.pdf

2. The BEECLUST algorithm, this algorithm that governs the optimal clustering of the autonomous robots is based on the observed behaviours of honeybees.
http://zool33.uni-graz.at/artlife/bee

3/ ECOLOGY, TECHNOLOGY AND BIOINSPIRED ARTIFICIAL CREATURES

Some of the Ideas behind *Robots In Distress*.

boredomresearch's creations have always been inspired by and are reflecting upon the natural environment that the artists explore in their computer simulations.
Robots In Distress builds upon this approach but the work has also been impacted by what the artists learnt and experienced during their residency in a lab that deals not only with simulated artificial life but also with physical robots, with the confrontation of biology, ecology and engineering, with sophisticated cutting edge research and the very simple test bots built out of discard material for proof of concepts.

The Waste Paradox: plastic as the problem and the solution

Plastic has obviously become one of the major pollutant, specially in waters, and the subCULTron research is precisely to build a swarm of robots to monitor those highly polluted subaquatic environments. The very principle of those robots is that some can break or be broken without a damage to the whole colony and the monitoring system. However, the broken ones will join the underwater junk.

boredomresearch is used to computer simulated worlds. During their residency, the artists experimented with physical robots and discovered that the scientists were testing their ideas on small crude machines made out of junk or mundane objects. So, they, too, built some robots made out of plastic waste, among which the plastic bottle that later inspired the design of their computer simulated robot population. In their *Leonardo* article, they write: «In building robots from plastic waste there appeared to us a synergy between the problems of human consumption that pollute the environment and the process by which we attempt to provide solutions».

Is there such a thing as «robust» technology and the principle of failure

In trying to answer the ecological and environmental issues we are facing, one of the answers is to propose new technological solutions. It is the idea that «progress» and (new) technologies will help us repair what has been destroyed and the problems we, as a specie, have created. Biomimetics and bio-inspired research is considered a good option as it is based on (living) principles that have proven their

robustness throughout evolution. The purpose of engineering being to provide (long lasting) solutions, trying to build robots that are «robust» is a logical approach.

The artists approach, however, has been to recall that technology can and does fail but, moreover, that failure could be as important to take into account as a principle in looking for solution as robustness.

In an interview with Richard Bright for the online magazine *interaliamag*, they write:
«The bio-inspired robots of subCULTron's Artificial Life Lab, in the Karl Franzens University Graz, are challenging existing paradigms in engineering. They consider the swarm as a powerful expression of natural robustness. Complex machines often fail with the loss of a vital part. In contrast a swarm can lose many members without even noticing. We share their passion for the not yet fully exploited potential of multi agent systems. We too were quick to recognise the poetic beauty of emergent behaviour. But the connection with robustness is worrying. There is deep concern about the archetypal swarm. A more than significant proportion of human food is pollinated by the honey bee. Continuing decline of wild species and alarming Colony Collapse Disorder indicates an organism under stress. So the question we have is: Should we respect bio-inspired fragility above bio-inspired robustness?

Current separation between art and science, encourages belief, that science 'should' provide increasingly complex solutions to increasingly complex problems; missing the reality that those problems are often the consequence of previous solutions. Could it be that our present environmental situation might be better served by a more comprehensive cultural consideration, inclusive of artistic sensibilities, comfortable with notions of fragility and imperfection.»
https://www.interaliamag.org/interviews/vicky-isley-boredomresearch/
July 2017

Negative emotions as a positive response
In their article for *Leonardo*, boredomresearch writes:
Following Marvin Minsky's argument that: "The question is not whether intelligent machines can have any emotions, but whether machines can be intelligent without any emotions" it is worthy to consider the significance of negative emotions in the human condition.
We argue that the role of negative emotions in humans remains unclear and therefore should not be excluded from consideration in advanced robotics. It is clear that negative emotion is central to the human condition, and may be important in our evaluation of complex long term environmental challenges.

They add:
So we propose that current paradigms aiming to address significant environmental concerns with technological solutions must recognise the reality of failure.

4/ A GLOSSARY OF ART & SCIENCE

ARTIFICIAL LIFE

Artificial Life, or A.Life, is a wide field of research that blossomed in the 1980's.

In the words of Christopher Langton, one of its most emblematic researcher, it does not deal with «life as it is» but «life as it could be». In 1989, he gave this definition: *Artificial life is the study of artificial systems that exhibit behavior characteristic of natural living systems. It is the quest to explain life in any of its possible manifestations, without restriction to the particular examples that have evolved on earth.*

Langton, C.G. (1989) «Artificial Life», in *Artificial Life*, Langton (ed), (Addison-Wesley:Reading, MA)

We can distinguish between two main historical trends in A-Life: the computer simulated one that creates computer environments and creatures and the physical one based on robotics.

It is interesting to notice that from the very begining in the '80's artists have been involved in exploring A. Life as an artform and have shared with the scientists discussions and ideas in numerous scientific or artistic conferences and exhibitions. Among some of the prominent artists having developed computer simulated worlds are the duo Christa Sommerer & Laurent Mignonneau or Karl Sims who is both an artist and a scientist.

BRAITENBERG VEHICLE

Named after the cyberneticist Valentino Braitenberg, «a Braitenberg vehicle is an agent that can autonomously move around based on its sensor inputs». It is composed of a least one sensor connected to a wheel (an actuator). [...] «Depending on how sensors and wheels are connected, the vehicle exhibits different behaviors (which can be goal-oriented).»
https://en.wikipedia.org/wiki/Braitenberg_vehicle

BIO-INSPIRATION

Inspiration of solutions to technological problems, drawn from the solutions that evolution of living organisms has found for comparable problems. These solutions are (intermediate) results of iterated optimization processes that in some cases last for millions of years. They are often characterized by a remarkable elegance and efficiency. Bio-inspiration leads to a reproduction of biological mechanisms, but not necessarily to a reproduction of the biological implementation (i.e. embodiment).

(from the glossary of the Artificial Life Lab, Karl Franzens University, Graz, http://zool33.uni-graz.at/artlife/bee)

SWARM

In biology a temporal aggregation of conspecific individuals, usually moving in a coordinated manner. For honeybees the term usually refers to reproductive swarms which consist of up to several thousand individuals. In contrast to this interpretation, in artificial life any group of interacting agents is considered a swarm. In our experiments, we apply this looser definition to honeybees and robots and describe groups of at least two individuals as swarms. Swarms typically exhibit collective behaviour, often with emergent effects (swarm intelligence).
(from the glossary of the Artificial Life Lab, Karl Franzens University, Graz, http://zool33.uni-graz.at/artlife/bee)

ROBOTS IN DISTRESS, BOREDOMRESEARCH (VICKY ISLEY & PAUL SMITH)

1/ SUBCULTRON, A ROBOTICS FET OPEN PROJECT

2/ RESEARCH GOAL

1/ SUBCULTRON, A ROBOTICS FET OPEN PROJECT : SUBMARINE CULTURES PERFORM LONG-TERM ROBOTIC EXPLORATION OF UNCONVENTIONAL ENVIRONMENTAL NICHES

Robots in Distress is an artwork that has been created as part of the artists residency in the subCULTron consortium, one of the European Union Horizon 2020 FET/Open Future and Emerging Technologies projects.
FET Open supports the early-stages of the science and technology research and innovation around new ideas towards radically new future technologies.

subCULTron is combining biology and engineering to create a swarm of autonomous self-learning robots in a bio-inspired approach in order to monitor and perform in harsh environments such as the heavily human polluted Venice Lagoon.

(from the subCULTron documents)
This project is aiming at creating **the world's largest intelligent underwater monitoring system that coordinates, communicates and collects data autonomously**. It will do this via a society of self-organising underwater robots.

subCULTron aims to develop an autonomous underwater robotic society comprising of three swarms of bio-inspired robots that monitor the environment in a marine habitat.
The focus of the subCULTron project is on utilization of bio-inspired behaviours, cultural learning, swarm behaviours for increased stability and adaptability in harsh environments. Apart from contributing to the scientific community by developing novel bioinspired behaviours and implementing a real world application of a robotic swarm, the subCULTron system will also gather enormous amounts of environmental data which can be used to fine tune nature preservation policies, industrial techniques, etc.

Our heterogeneous system consists of 3 different agent types:
On the sea-ground, *artificial mussels* are the collective long-term memory of the system,

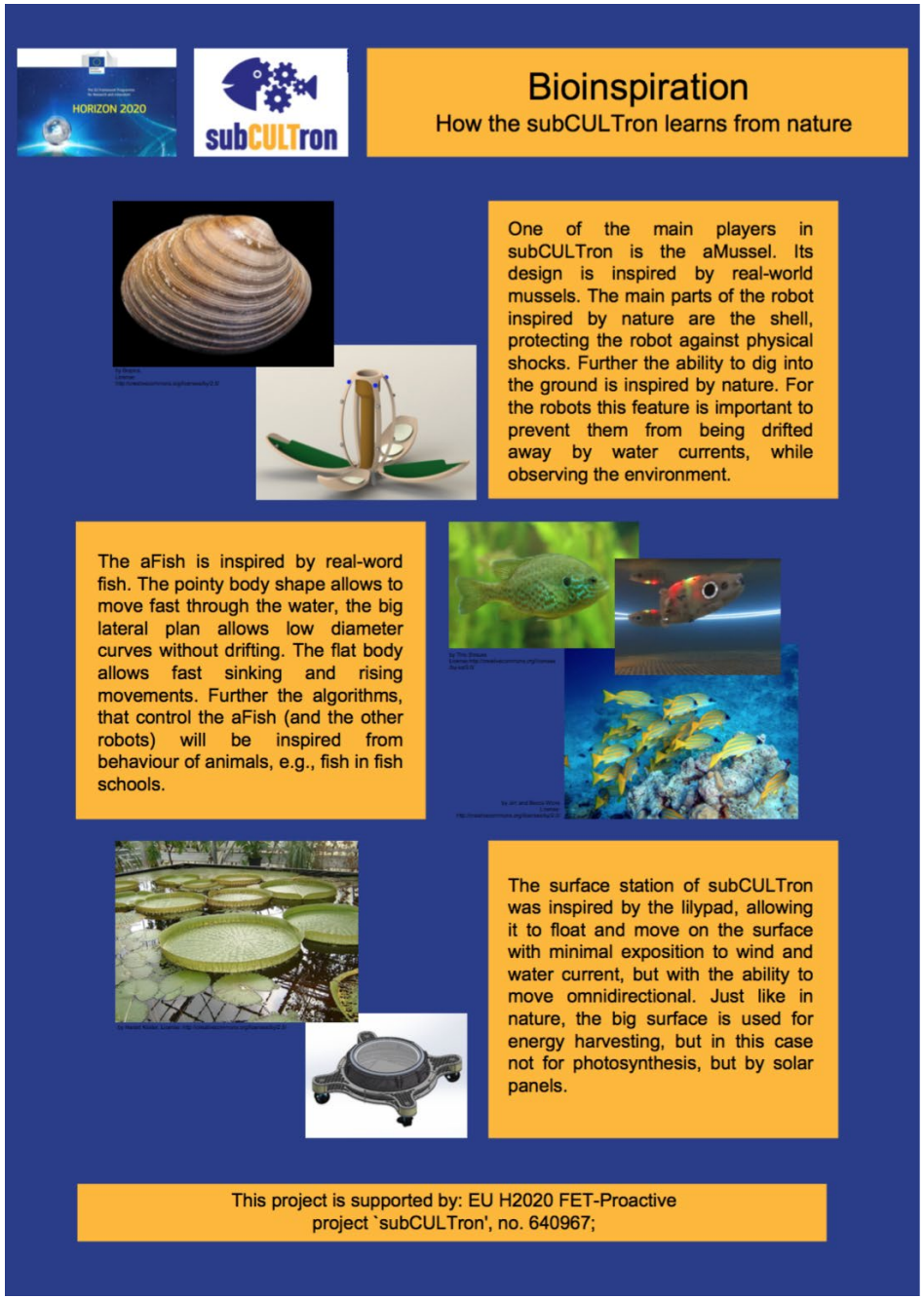
subCULTron

allowing information to stay beyond the runtime of other agents, thus allowing to continue learning from previously learned states. These mussels monitor the natural habitat, including biological agents like algae, bacterial incrustation and fish.

On the water surface, *artificial lily pads* interface with the human society, delivering energy and information influx from ship traffic or satellite data.

Between those two layers, *artificial fish* move/monitor/explore the environment and exchange info with the mussels and lily pads. Artificial mussels are novel class of underwater agents.

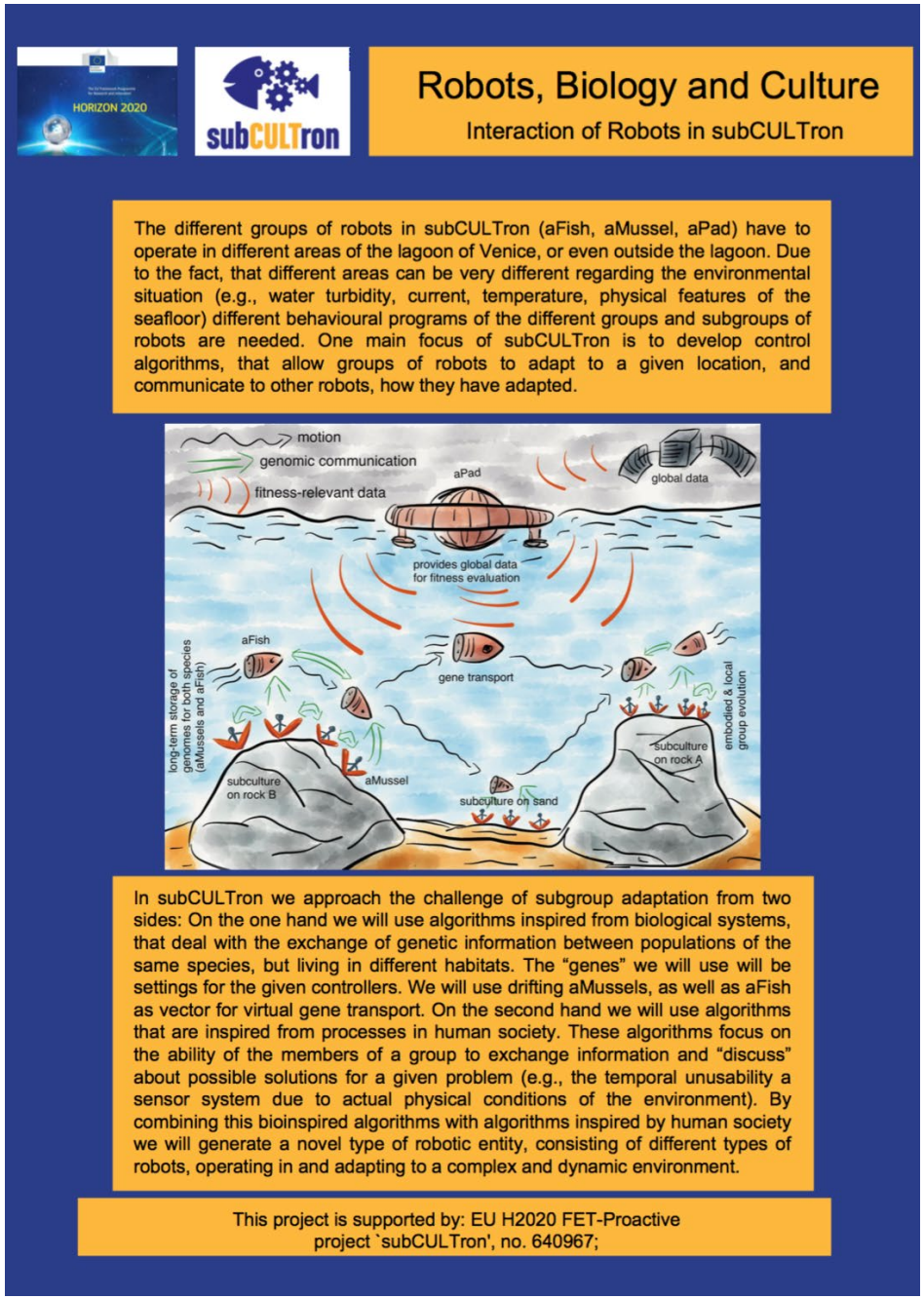
We aim to push forward the edge of knowledge with novel sensors (electric sense/electro-communication), novel bio-inspired algorithms (underwater hives) and novel energy harvesting in underwater scenarios.



"In a few words, what we are trying to do is to go beyond the logic of individual complex machines, like many underwater robots are today, to deploy a collective cognitive system with high potential for learning and self-adaptation. This might actually prove an effective approach to work in marine environments which are very dynamic and require adaptive capacities to be explored in their complexity" summarizes scientist Thomas Schmickl.

The subCULTron project is conducted in consortium with eight partners spread across five countries in the European Union. The project is being coordinated by the Artificial Life Lab at the Institute of Zoology, Karl Frazens Universität, Graz, Austria. The Artificial Life Lab, under the leadership of Prof. Dr. Thomas Schmickl, specialises in research on swarm intelligence.

http://www.subcultron.eu/



2/ RESEARCH GOAL

The goal of the research of subCULTron explained by the scientist Roland Thenius from the University of Graz

https://www.youtube.com/watch?v=COddmcGgBc8

ROBOTS IN DISTRESS, BOREDOMRESEARCH (VICKY ISLEY & PAUL SMITH)

1/ FROM THE RESIDENCY : FROM SIMULATION TO ROBOTICS THROUGH BIOMIMETICS, ARTIFICIAL LIFE AND PLASTIC WASTE, AND BACK AGAIN

(Compiled from boredomresearch's report, all images © the artists)

MARCH 2016:
MATCH-MAKING PROCESS, THE ARTISTS SELECT THE SCIENCE FET OPEN CONSORTIUM

subCULTron is developing a culture of robots designed to live in challenging, human polluted, environments, where they will collect data and monitor their surroundings. We chose to work with the subCULTron future emerging technology project as we have always been fascinated with the mechanics of the natural world. Our artistic practice uses real time computing to create expressions that are informed by how natural systems behave and interact. On hearing about subCULTron's use of bio-inspired techniques, fostering new way of addressing the challenges of a world subject to intensive human activity, we were immediately captivated by, what was for us, an intoxicating mix.

MAY 2016

To begin with we knew the project would challenge our understanding of programmed behaviour as we moved out of our comfort zone of simulation and into a world that confronts the challenges of the physical environment as well as those of electrical engineering. When we arrived for our initial residency period in May 2016 at the Artificial life lab in the Karl Franzens University, Graz, Austria, we discovered a contradictory mix of similarities and differences. This combination provoked deep engagement in concepts of behaviour that bridge cultural and scientific domains.

Paul Smith and Vicky Isley with Ronald Thenius in front of the beehive at the Artificial Life Lab of the Karl Frazens University, Graz Austria

Paul Smith and Vicky Isley with the bee-inspired robots clustering at the Artificial Life Lab of the Karl Frazens University, Graz Austria

SUMMER 2016

During the summer we returned to the a-life lab where we worked with an electrical engineer building robots made from plastic waste. Although these contrast with the highly engineered robots that will ultimately inhabit the Venice lagoon, the plastic waste robots have been inspired by the simple test bots made in the lab as proofs of concept. This interaction has been rewarding on both sides. We have gained many new skills but more importantly have gained a deeper appreciation of the processes, considerations and challenges of the subCULTron project. The scientists on the other hand have enjoyed the freedom to explore ideas with a playful freedom that can often be lost within the constraints of a scientific framework.

Confronting the electronics …

Testing motion dynamics of micro-controlled plastic waste…

The shape of the digital robot in the final work *Robots In Distress* has been inspired by the plastic bottles the artists used in the lab to experiment with physical robots.

In the course of testing the motion dynamics of micro controlled plastic rubbish, the robots would start losing their synthetic tendrils to end up swimming in a plastic soup of their own remains which would get trapped in their propellers and ultimately interrupt their life cycle. Through this process we realized if we built these robots into an installation they wouldn't be able to return to their base anymore to get charged and the robots would die -suffering the same fate as much of the world's marine life.

In the time available it was important for us to follow a concept through to a point with a visual expression. This was ambitious to the point of challenging lab protocol. The established routine of analysing data sheets, testing specification and formulating and testing principles to evaluate performance of components was, in this case, a process that we needed to abridge. In doing so we encouraged a more spontaneous approach to engineering which engaged with the sometimes playful nature of artistic production and an open ended freedom common to much creative practice. This was something that lab members found inspiring and we left feeling we had made a strong and positive contribution to the language of practice by way of introducing what we came to call 'visceral engineering' where choices and directions arise from a deep feeling or sense.

2/ BIO-INSPIRED FRAGILITY AND TECHNOLOGICAL ADVANCEMENT

On April 5th 2017, as part of the Arts/Sciences lecture series organised by iMAL in Brussels, boredomeresearch presented a large body of their works.

Among those, they discussed the ideas behind *Robots In Distress* and how they emerged from the confrontation of the artists's creative world with the researches conducted at the Artificial Life lab in the Karl Franzens University in Graz, Austria during their residence.
Robots in Distress is discussed towards the end of this video recording of the lecture, around 45'30".

https://www.youtube.com/watch?v=mCT0feZGmJ4&feature=youtu.be

3/ CONVERSATION WITH THE ARTISTS AND THE SCIENTIST

Inspired by Nature: Swarm of robots and artificial life works

Conversation between Vicky Isley, Paul Smith (boredomresearch), Thomas Schmickl and Annick Bureaud (podcast)

The artists, Vicky Isley and Paul Smith and Thomas Schmickl, the project leader of the scientific research project subCULTron talk about their respective approach of artificial life, both «in vitro» (artificial virtual creatures in a computer environment) and «in vivo» (robots and more precisely swarm of robots in natural environments). They present and discuss their common ground and questions in relation to the FEAT residency.

https://creativedisturbance.org/podcast/inspired-by-nature-swarm-of-robots-and-artificial-life-works-meeting-with-vicky-isley-paul-smith-boredom-research-and-thomas-schmickl-eng/

4/ *LEONARDO* ARTICLE ABOUT THE PROJECT

« Simulated Despondency for *Robots in Distress* », boredomresearch (Vicky Isley and Paul Smith), *Leonardo*, MIT Press

http://olats.org/feat/BoredomResearch-leon_a_01468.pdf

ROBOTS IN DISTRESS, BOREDOMRESEARCH (VICKY ISLEY & PAUL SMITH)

ROBOTS IN DISTRESS **OR THE REASON OF EMOTIONS IN NON-LIVING ENTITIES**

by Annick Bureaud

ROBOTS IN DISTRESS OR THE REASON OF EMOTIONS IN NON-LIVING ENTITIES

Endlessly, an underwater landscape unfolds on the screen in front of our eyes. Here and there, some metallic poles appear, remains from unknown constructions. Plastic bags and nets are litting the water floor, more and more of them. There is no life. Not a single fish, or shell or aquatic plant. Instead a noria of tiny robots, looking like alien insects that would have been hybridised with an earthian plastic bottle, are stubbornly lifting up and hopelessly falling back down. Upon rising, they emit a blinking red light contrasting with the blueish-grey color of the background environment. The whole scenery is bathed in a sepulchral sound.

Robots In Distress is an Artificial Life (or A.Life) computer-simulated world. When A.Life art emerged around the late 1980's-early1990's with artworks such as Karl Sims's *Panspermia* (1990) or Christa Sommerer & Laurent Mignonneau *Interactive Plant Growing* (1992) or *A-Volve* (1994-95), they were, somehow, celebrating life, even if virtual or unknown ones. They were colorfull and playfull.

Thirty years later *Robots In Distress* expresses a strong rupture: from exploring emergent behaviours and forms of life of the early days, its focus now is on the disappearing of life, the human impact on nature and the failure of our techno-solutions. The artificial creatures (virtual robots) are less interesting by and for themselves than in so far as they reflect upon our responsibility in the disappearance of real creatures, their despondency mirroring our own in elaborating answers.

Human beings have this capacity to develop empathy, even towards things, toward non-living entities, specially if those things have some kind of motion, and even more if this motion seems to have a goal or intention. We project very easily our own intentions not only on our fellow humans but on objects as well.

In his 1994 book *Descartes' Error: Emotion, Reason, and the Human Brain*, neurologist Antonio Damasio has shown that without emotions human beings are unable to perform correctly in the world, to have a 'rational' behaviour. Should the robots that we build have emotions then, including negative ones, to be more effective, to help us in implementing solutions? The question is left open.

What is for sure is that there is a strong feeling of melancholia in *Robots In Distress*, of having let the disaster to occur and left it to the robots to do the repairing. But, by their motion and behaviour, they too, show what we interpret as helplessness and hopelessness. And this is this very projection of our human emotions that (may) gives us the strength and the energy to react and take over, perhaps together with a swarm of strongly emotional depressed robots.

Annick Bureaud, November 2017

BOREDOMRESEARCH (VICKY ISLEY & PAUL SMITH)

boredomresearch is the name of the British artists duo composed of Vicky Isley and Paul Smith. Their work expresses a fascination with the mechanics of the natural world, exploiting computation to create visual experiences such as generative real time animations or online creations to translate scientific researches and data.

Resource : www.boredomresearch.net

CREDITS

«Robots in Distress» has been created by boredomresearch
in collaboration with subCULTron (www.subcultron.eu),
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