

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,

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.

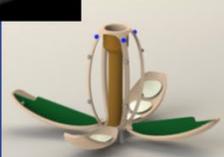
Between those two layers, *artificial fish* move/monitor/explore the environment and exchange info with the mussels and lily pads. Artificial mussels are novel class of underwater agents.

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.




Bioinspiration

How the subCULTron learns from nature

© 2011 and 2012 Vicky Isley & Paul Smith
http://www.subcultron.org/wordpress/

One of the main players in subCULTron is the aMussel. Its design is inspired by real-world mussels. The main parts of the robot inspired by nature are the shell, protecting the robot against physical shocks. Further the ability to dig into the ground is inspired by nature. For the robots this feature is important to prevent them from being drifted away by water currents, while observing the environment.

The aFish is inspired by real-world fish. The pointy body shape allows to move fast through the water, the big lateral plan allows low diameter curves without drifting. The flat body allows fast sinking and rising movements. Further the algorithms, that control the aFish (and the other robots) will be inspired from behaviour of animals, e.g., fish in fish schools.





© 2011 and 2012 Vicky Isley & Paul Smith
http://www.subcultron.org/wordpress/




The surface station of subCULTron was inspired by the lily pad, allowing it to float and move on the surface with minimal exposition to wind and water current, but with the ability to move omnidirectional. Just like in nature, the big surface is used for energy harvesting, but in this case not for photosynthesis, but by solar panels.

This project is supported by: EU H2020 FET-Proactive project 'subCULTron', no. 640967;

“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.

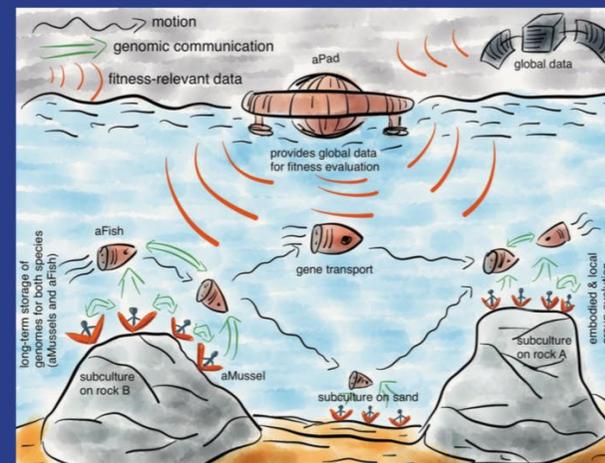
<http://www.subcultron.eu/>



Robots, Biology and Culture

Interaction of Robots in subCULTron

The different groups of robots in subCULTron (aFish, aMussel, aPad) have to operate in different areas of the lagoon of Venice, or even outside the lagoon. Due to the fact, that different areas can be very different regarding the environmental situation (e.g., water turbidity, current, temperature, physical features of the seafloor) different behavioural programs of the different groups and subgroups of robots are needed. One main focus of subCULTron is to develop control algorithms, that allow groups of robots to adapt to a given location, and communicate to other robots, how they have adapted.



In subCULTron we approach the challenge of subgroup adaptation from two sides: On the one hand we will use algorithms inspired from biological systems, that deal with the exchange of genetic information between populations of the same species, but living in different habitats. The “genes” we will use will be settings for the given controllers. We will use drifting aMussels, as well as aFish as vector for virtual gene transport. On the second hand we will use algorithms that are inspired from processes in human society. These algorithms focus on the ability of the members of a group to exchange information and “discuss” about possible solutions for a given problem (e.g., the temporal unusability a sensor system due to actual physical conditions of the environment). By combining this bioinspired algorithms with algorithms inspired by human society we will generate a novel type of robotic entity, consisting of different types of robots, operating in and adapting to a complex and dynamic environment.

This project is supported by: EU H2020 FET-Proactive project ‘subCULTron’, no. 640967;

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>

CREDITS

«Robots in Distress» has been created by boredomresearch
in collaboration with subCULTron (www.subcultron.eu),
Artificial Life Lab, Karl Franzens University Graz (<http://zool33.uni-graz.at/artlife/>)

«Robots in Distress» has been created as part of the FEAT/Future Emerging Art and Technology project, featart.eu

FEAT is an initiative of eutema GmbH (AT), Stichting Waag Society (NL), and youris.com (BE).

FEAT has been funded by the EU backed programme FET (Future and Emerging Technologies) Open.

It has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement
No 686527 (H2020-FETOPEN-2015-CSA).

