EXCELLABUST
EXCELLING LABUST IN MARINE ROBOTICS

Staff exchange 3
Research plan

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GIRONA UNDERWATER VISION AND ROBOTICS

1. Experiment description

The proposed subject of study and application is the multi-layer underwater robot society developed as part of the Horizon 2020 FET project subCULTron. The aim of this project is achieving long-term autonomy in a learning, self-regulating, self-sustaining underwater society and culture of robots. The heterogeneous robotic system consists of three separate agent types, of which two are significant here: artificial mussels (aMussels) which travel between the seafloor (where they act as sensor hubs) and the surface, and artificial lily pads (aPads) on the surface of the water, enabling an exchange of both information and energy, while also providing mechanical docking stations for aMussels to attach to in order to recharge their batteries (Fig 1). The aPad is an overactuated surface platform equipped with four thrusters.

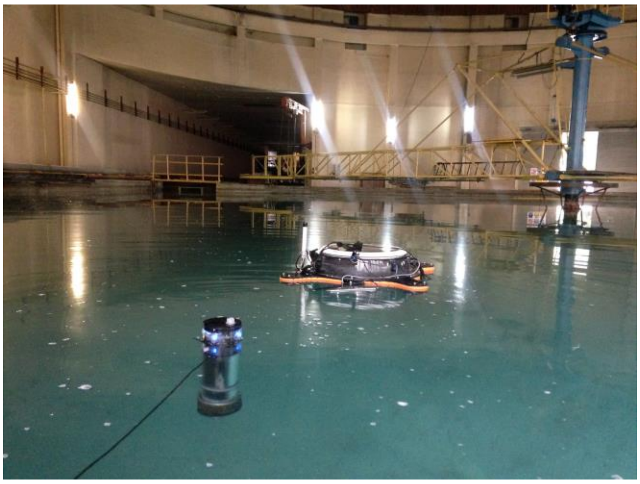

Fig 1. aPad surface platform moving to collect and dock aMussel robot.

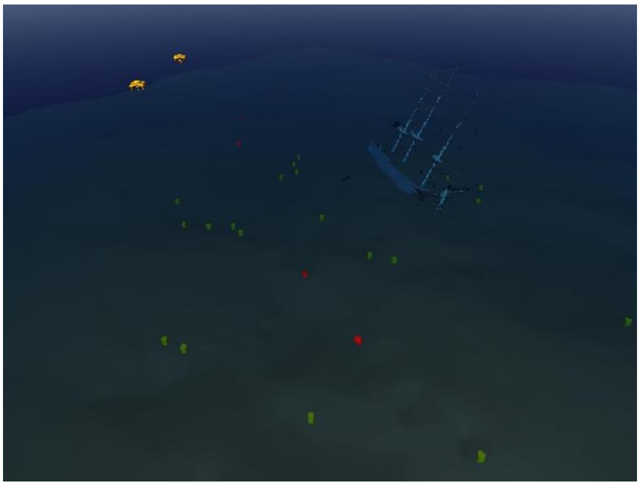

Fig 2. Example simulated marine environment scene with multiple robotic agents

The aim of long-term autonomy means a certain level of fault tolerance has to be present in the system. The envisioned scenario combines aspects of fault tolerant control and fault detection with cooperative control and mission planning in order to achieve pseudo-assembly of robots into a single structure that compensates for an individual robot's loss of functionality while planning and scheduling energy exchange tasks, i.e. a malfunctioning thruster (or several). Due to the envisioned ratio of agents in the robotic swarm being 5 charging-capable aPads to 120 charge-requesting aMussels, even a faulty aPad is a very valuable and important asset. A robot with fault can self-diagnose, self-detect, and report results to neighbours ("distress calls"), at which point cooperative fault compensation can start. Thrust allocation as part of an overview of differences between faulty and working platforms in a control context, post-assembly movement control, and load optimisation are all issues that need to be addressed in further work.

2. Expected outcomes

1. Familiarise with partners from related areas of research.
2. Additional development of the simulator.
3. Determine best methods of modelling and optimisation for chosen behaviour problem; implement, test, and benchmark in simulator.
4. Write a report on the staff exchange.

3. Further work

1. Conduct experiments with the real system of marine surface platforms in Brodarski Institute in Zagreb.

2. Publish a paper presenting the collected simulation and experimental results.