EXCELLABUST

EXCELLING LABUST IN MARINE ROBOTICS

Staff exchange 4

Research plan

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1. Experiment description

In the scope of Horizon 2020 FET project subCULTron, multi-layer underwater robotic system is developed. 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: artificial mussels (aMussels) which travel between the seafloor (where they act as sensor hubs) and the surface, artificial fishes (aFish) whose mission is exploration, and artificial lily pads (aPads) on the surface of the water, enabling an exchange of both information and energy. Robotic system is envisioned to consist of 120 aMussels, 25 aFishes and 5 aPads.

Localization plays a crucial role in distributed underwater monitoring, sensing and exploration. Underwater localization will be done using acoustic measurements. Since of the large scale of underwater agents in the system, they consist of inexpensive sensors, including cheap and simple acoustic modem. Capabilities of these acoustic sensors are: ranging, transferring small amount of data, and making TDOA (time difference of arrival) measurements.

Localization will be done through aPads on the surface. aPads know their absolute position using GNSS measurements, and they will be used as points of reference (beacons) for the underwater system, from which underwater agents will measure distances or TDOA measurements using acoustic modems. Possible implementations of localization algorithms consist of trilateration, or multilateration. Both algorithms require absolute positions of reference beacons, which can be sent using data transfer on acoustic modems. Former algorithm requires two-way range measurements, and the latter requires only local timestamps of the received signal. If speed of localization is considered, two-way measurements are a serious bottleneck, since the scale of measurements needed to localize the whole system increases with number of agents. That makes the latter algorithm more suitable for mentioned robotic system, because by using local timestamps of signals sent from beacons, every agent can use said measurements to localize itself.

2. Expected outcomes

1. Hardware and software integration of inexpensive acoustic modems in AUV “Sparus”.
2. Data collection necessary for multilateration.
3. Collect range data for team from University of Girona.
4. Write a report on the staff exchange.

3. Further work

1. Conduct experiments with multiple underwater robots in parallel.
2. Publish a paper presenting the experimental results.