EXCELLABUST

EXCELLING LABUST IN MARINE ROBOTICS

Staff exchange 1
Research plan

Feb – Mar 2016

Filip Mandić @University of Girona

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691980.

UNIVERSITY OF ZAGREB FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING

LABUST LABORATORY FOR UNDERWATER SYSTEMS AND TECHNOLOGIES

Consiglio Nazionale delle Ricerche

UNIVERSITY of LIMERICK OLLSCOIL LUIMNIGH

Universitat de Girona Institut de Recerca en Visió per Computador i Robòtica

GIRONA UNDERWATER VISION AND ROBOTICS

1. Experiment description

In order to estimate its position using single range measurements, the vehicle has to travel sufficiently informative trajectories. This can disable the vehicle from doing other useful activities which require trajectories that are not informative enough. In order to avoid that, an approach with two vehicles, where one of them is a beacon, can be used. In that case, a mobile beacon, which knows its position accurately (from GPS), is responsible for travelling trajectories which will provide informative range measurements for the underwater vehicle navigation filter. Such approaches are very common in literature.

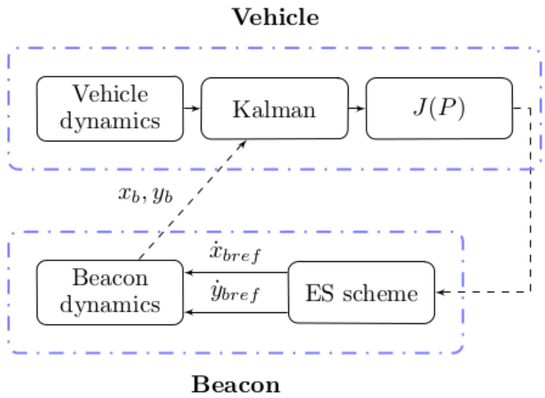

Figure 1

Figure 1 depicts the main idea behind the new algorithm which also enables better vehicle position estimation by using single beacon measurements. Mobile beacon sends its position (xb, yb) to the vehicles Kalman filter used for navigation. Information generated in the navigation filter is then used to calculate cost function value J which gives a measure of observability. Current cost value is then sent to mobile beacon which tries to minimize it online by using extremum seeking scheme which steers the mobile beacon towards the minimum of cost function. The beacon again sends its position to the vehicle, thus closing the control loop. Range measurement used for determining vehicle's position is acquired during the communication cycle. Since better observability is achieved when beacon vehicle is sufficiently close to underwater vehicle in horizontal plane, algorithm has a positive side effect that it also enables beacon vehicle to track underwater vehicle.

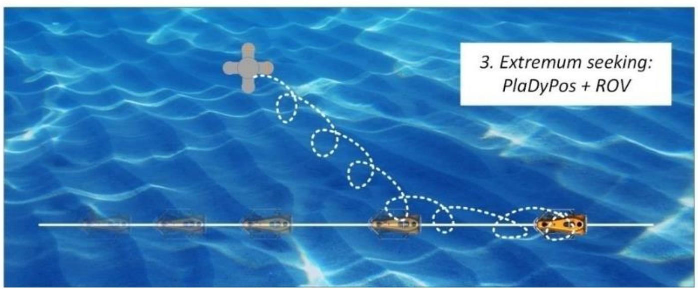

Figure 2

Figure 3 depicts test scenario where there is a part where beacon vehicle approaches underwater vehicle while vehicle is static, and a second part of test where underwater vehicle is following straight line trajectory. Simulation results and more detailed explanation of the algorithm can be found here: http://www.sciencedirect.com/science/article/pii/S2405896315021564.

2. Further work

Proposed algorithm was already tested in real-life conditions, not only in simulations, but with some modifications e.g. all processing was done on beacon vehicle because there was no acoustic data exchange, only range was acoustically measured. Since these were preliminary tests, conducted in order to show feasibility of proposed approach, there are further steps to be done. With that in mind, here are some of the possible experiments:

1. Implement and test complete scheme with communication cycle included as depicted in Fig. 1. and compare efficiency of the approach by comparing localization accuracy achieved by proposed approach, with the case of static beacon, beacon executing circular trajectory, dead reckoning etc. Some improvements can also be introduced:
    i. Take into account saturation of the actuators (maximal speed) and inspect possible solutions
2. Inspect possibility of deploying algorithm on under-actuated vehicle, since algorithm as it is now, is intended for fully-actuated vehicles.

3. Expected outcomes

1. Experimentally collect data to support simulation findings
2. Publish conference paper presenting collected data