Recent Advances in Marine Robotics

Tuesday, May 21, 2019

Venue: **Seminar Room - Building 4 – LIRMM, 161 rue Ada 34095, Montpellier**

SCHEDULE

8:30-8:50	**Arrival & welcome at LIRMM**	
8:50-9:00	**Opening** (Organizer: Ahmed CHEMORI, LIRMM – CNRS)	
9:00 – 9:30	Antonio M. PASCOAL, IST-University of Lisbon, Portugal **Title:** Exploring the Frontier of Marine Robotics: Cooperative Navigation and Control of Networked Systems.	
9:30 – 10:00	Daniel SIMON, INRIA - LIRMM, France **Title:** LPV modeling and varying sampling control applied to AUVs.	
10:00 – 10:15	**Coffee break**	
10:15 – 10:45	Luc JAULIN, Lab-STICC, ENSTA-Bretagne, France **Title:** Explore and return problem in a minimalist environment.	
10:45 – 11:15	Lionel LAPIERRE, LIRMM – Univ. of Montpellier, France **Title:** Using robots for karstic exploration.	
11:15 – 11:45	Vincent CREUZE, LIRMM – Univ. of Montpellier, France **Title:** Robotic tools and methods for underwater archaeology and marine biology.	
11:45 – 12:15	Ahmed CHEMORI, LIRMM – CNRS, France **Title:** Control of Fin-Actuated Biomimetic Underwater Robots for Inspection Applications.	

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ABSTRACTS

SPEAKER	Title & abstract of the Talk
Antonio PASCOAL	**Exploring the Frontier of Marine Robotics: Cooperative Navigation and Control of Networked Systems** **Abstract:** This talk addresses the general topic of *cooperative motion navigation and control* of marine vehicles, both from a theoretical and a practical perspective. The presentation builds upon practical developments and experiments. Examples of scientific missions with ASCs and AUVs, acting alone or in cooperation, set the stage for the main contents of the presentation. Especial emphasis is placed on the problem of operating groups of vehicles for *scientific ocean studies, habitat mapping in complex 3D scenarios, geotechnical surveying, and sustained presence at sea in hazardous environments*. From a theoretical standpoint, a number of challenging problems are addressed in the area of *cooperative motion control and navigation of groups of autonomous vehicles.* The connections with advanced methods for navigation, including geophysical-based navigation, are also briefly discussed. The results obtained are illustrated with videos from actual field tests with multiple marine robots exchanging information over acoustic networks.
Daniel SIMON	**LPV modeling and varying sampling control applied to AUVs** **Abstract:** Varying sampling can be used to accommodate limited computation or sensory resources of embedded systems, such as underwater vehicles. The sampling rate can be modelled as an additional uncertain variable of a Linear Parameter Varying system for which a robust control loop can be designed. The method is applied to the altitude control of an AUV.
Luc JAULIN	**Explore and return problem in a minimalist environment** **Abstract:** We consider an underwater robot that has to explore a huge unknown environment and be able to come back home. We assume that no localization system exists, the robot is not allowed to surface to collect the GPS, and the environment is minimalist (i.e., with few landmarks). We want to show that in this context, it can be possible to perform a safe exploration without being lost. For this purpose we will copy the marine turtles which are able to travel long cycles in the ocean and come back to their birth beach or imitate the Polynesians that were able to travel across islands far from each other. To guarantee that all along the mission, the robot will never be lost, we combine interval analysis, constraint-based methods and graph theory.
Lionel LAPIERRE	**Using robots for karstic exploration** **Abstract:** Groundwater resources qualification and quantification is an urgent issue, nowadays and for the next generations. Moreover, the confined chaotic structure of the karstic environment presents exciting robotic challenges in terms of navigation, guidance, control and mission control. The presentation focuses on the recent results on this topic and the remaining open issues.
Vincent CREUZE	**Robotic tools and methods for underwater archaeology and marine biology** **Abstract:** This talk will describe the context of deep-water archaeological intervention and present the tools and methods we have developed for the shared control of very small multipurpose underwater vehicles. We will focus on underwater grasping devices (robotic hands, claws, and suction devices), robust control, coordination of robots, haptic feedback and vision based methods for underwater localization and 3D modelling.
Ahmed CHEMORI	**Control of Fin-Actuated Biomimetic Underwater Robots for Inspection Applications** **Abstract:** To fulfill needs of shipwreck inspection for archeological applications, U-CAT has been developed at the Centre for Biorobotics (TUT, in Estonia) with 5 design requirements: (i) The main interest is the video footage from the interior of the shipwreck to identify objects of interest, (ii) The robot has to penetrate in confined spaces, so it must be small and maneuverable, (iii) The vehicle must be capable of silent motion in order to not disturb the bottom sediments that would make visual observations impossible, (iv) The vehicle has to be untethered (autonomous) as the cable would significantly constrain vehicle's motion inside the wreck, (v) The cost of the vehicle has to be affordable for archaeologists with a limited budget. This talk deals with motion control of Biomimetic autonomous underwater vehicles, with a special focus on the case study of U-CAT turtle-like biomimetic underwater robot.