BREAKING THE SURFACE 2015 – List of tutorials

TUTORIALS:

- **Remote sensing, ground truthing and precisions in seafloor habitat mapping - from small scale model to large reality,** Hrvoje Čižmek, Marine Explorers Society – 20000 Leagues NGO, Croatia
- **Cooperative Navigation and Control of the MEDUSA Autonomous Marine Vehicles: from Simulation to Field Trials,** António M. Pascoal, Instituto Superior Técnico of Lisbon - IST, University of Lisbon, Portugal
- **Advanced Input Devices for Real-Time Control of Marine Robots,** Edin Omerdić, University of Limerick, Ireland

Tutorial 1: Remote sensing, ground truthing and precisions in seafloor habitat mapping - from small scale model to large reality
Hrvoje Čižmek, Marine Explorers Society – 20000 Leagues NGO, Croatia

Traditional collection of information about the marine environment mostly using divers, is limited to a series of transect or point observations, very time-depth dependent with lower precisions as you go deeper. Remote sensing with ground truthing enables spatially continuous data collection over larger areas. One of the most questionable factor is always precisions. is tutorial will show what are the obstacles and possible solutions in solving precision problems. We will use open source GIS software Quantum GIS (QGIS) and publicly available raster and vector layers which are commonly used as basemaps in habitat mapping. Small scale, very detailed seafloor map generated by the means of remote sensing (AUV/ROV) will be used like model used for large scale but high detailed mapping. Habitat mapping of the Adriatic Sea is one of priority goals for future management policies so the methodology and precisions of that task should be at high level.

Hrvoje Čižmek is a marine biologist and an expert in ecology of Mediterranean benthic communities. His scientific research interest is in the ecology of marine caves, coralligenous and seagrass communities and also in marine seafloor habitat mapping. He has been dealing with environmental impact studies (EIS) and monitoring programmes of aquaculture facilities and nautical centres as well as mapping of marine habitats and making check-list of marine species. He is the owner and a director in the private enterprise Janolus Ltd which is dealing with EIS of all kinds regarding facilities in the Adriatic Sea, seafloor habitat mapping and professional as well as recreational diving. He is founder and manager of Marine Explorers Society – 20000 Leagues NGO where he is involved in marine biology research mostly in marine protected areas in the Adriatic Sea. His professional skills include: NAUI SCUBA instructor, licensed technical diver and speleologist, underwater photographer, sailor, Croatian mountain rescue speleodiver and GIS expert.

Tutorial 2: Cooperative Navigation and Control of the MEDUSA Autonomous Marine Vehicles: from Simulation to Field Trials

António M. Pascoal, Instituto Superior Técnico of Lisbon - IST, University of Lisbon, Portugal

This tutorial will afford practitioners a general overview of the sequence of steps involved in the implementation and at sea-testing of advanced systems for cooperative navigation and control of multiple marine robots. To this effect, the presentation will start with a brief description of the key algorithms used for networked navigation and control of a small fleet of marine vehicles, with due account for the stringent limitations imposed by the underwater acoustic channel. This will be followed by the details of systems implementation and testing using a small fleet of autonomous marine vehicles (AMVs) of the MEDUSA-class, developed at the Instituto Superior Técnico of Lisbon (IST), Portugal. The vehicles can operate in semi-submerged and fully submerged modes, are highly portable and easy to deploy, and carry a large variety of instrumentation and sensors for acoustic communications and positioning, obstacle detection, and navigation.

The tutorial will describe the mechanical and electronic systems at the core of the MEDUSA vehicles, together with the software architecture adopted for multiple vehicle mission programming and execution. To better focus the presentation, an example will be given aimed at illustrating the phases of mission programming and hardware-in-the-loop mission simulation using the UWSim underwater simulator to visualize a virtual underwater scenario. e tutorial will be complemented by a demonstration with the actual vehicles in the water.

Tutorial 3: Advanced Input Devices for Real-Time Control of Marine Robots

Edin Omerdić, University of Limerick, Ireland

This Tutorial will present recent advances in development of Human Machine Interface (HMI) for real-time control of marine robots (underwater, surface and airborne). In particular, the Tutorial will describe three types of input devices for remote control of robotic platforms, including 3D force Feedback Joystick (for control of robot motion in 3D space with active force feedback indicating thruster velocity saturation), Microphone (for remote control using voice commands) and KINECT (for control of robot motion using hand gestures).

Throughout Tutorial many important theoretical concepts will be covered by geometric interpretation and visualised via high-quality graphical illustrations, animations and movies. Live demonstrations will include use of various input devices for real-time control of ROV/SHIP simulator running at University of Limerick, Ireland. Target audience includes scientists and engineers interested in underwater robotics. Although not necessary, some basic understanding of linear algebra (matrices, vectors, etc.) and control theory concepts (open-loop systems, closed-loop systems) is highly recommended.

Dr Edin Omerdić received the B.Sc. and M.Sc. degree in Electrical Engineering from the University of Zagreb, Croatia, in 1997 and 2001, respectively. He received his PhD in Electrical Engineering from the University of Wales in 2004. Since his arrival to Mobile & Marine Robotics Research Centre, University of Limerick, Ireland in 2003, he was engaged in numerous research projects in the area of submersible robotics. His research interests include modelling & simulation of dynamic systems (marine platforms, ocean dynamics & disturbances), renewable energy, real-time simulators, virtual reality, development and design of guidance, navigation and control system for marine vessels, nonlinear control systems, implementation of soft-computing techniques in intelligent systems, underwater robotics and fault-tolerant systems. e-mail: edin.omerdic@ul.ie