Tutorial Title: **Control Allocation & Fault-Tolerant Control Systems**

Continuing Education Units and Professional Development Hours

Instructor(s): **Dr. Edin Omerdic ~ University of Limerick - Ireland**

Overview:

Typically, open-frame underwater vehicles have p>=4 actuators (thrusters) for the motion in the horizontal plane and the control allocation problem in this case is very complex and hard to visualise, because the normalised constrained control subset is p-dimensional unit cube.

The course will include:

- To introduce and define general control design problem based on control allocation.
- To formulate problem for class of underwater vehicles with p=4 actuators (thrusters).
- To give a clear picture and a geometric interpretation of the problem using low-dimension example.
- To present existing methods for its solution and to introduce a hybrid approach, based on the integration of a pseudoinverse and the fixed-point iteration method, which is able to allocate the entire attainable command set and finds the solution optimal in l2 sense, i.e. which minimises the control energy cost function.
- To discuss fault tolerance and implementation issues.
- To demonstrate unique visualisation of control space.
- To present results from sea trials - real-world application of proposed algorithm.
- To perform live demonstration (through Internet) of proposed control allocation algorithm for the real-time remote control of Internet-enabled ROV Control System (UL-based hardware-in-the-loop real-time ROV & SHIP simulator).
- To perform live demonstration of remote presence concept: Long endurance robotic systems for routine inspection of offshore subsea oil & gas installations and marine renewable energy devices from remote control centre through Internet in real time. In other words, we will demonstrate real-time control of UL-based mini ROVs from Newfoundland.

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.

Biography:

Dr Edin Omerdic received his 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.