

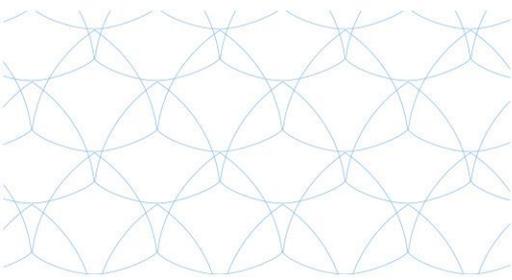
**EXCELLABUST**  
EXCELLING LABUST IN MARINE ROBOTICS

# EXPERT VISIT 2

24 - 25 May 2016

National Research Council of Italy  
– CNR

The Institute of Intelligent  
Systems for Automation - ISSIA



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## 1. VENUE

Gray Hall, University of Zagreb Faculty of Electrical Engineering (UNIZG-FER)  
Address: Unska 3, Zagreb, Croatia

## 2. PREREQUISITES FROM PARTICIPANTS

It is required to have a computer with Matlab already installed to not loose time preparing the system.

## 3. SCHEDULE

Day 1: 24 May 2016 (Tuesday)

08:30 – 09:00	<b>Meet and greet coffee</b>
09:00 – 10:15	<b>Modeling of Unmanned Marine Vehicles</b> by Massimo Caccia
10:15 – 10:30	BREAK
10:30 – 12:00	<b>Identification of Unmanned Marine Vehicles</b> by Massimo Caccia
12:00 – 14:00	LUNCH BREAK
14:00 – 14:45	<b>Filters and smoothers</b> by Massimo Caccia
14:45 – 15:00	BREAK
15:00 – 16:30	<b>Motion estimation of Unmanned Marine Vehicles</b> by Massimo Caccia

Day 2: 20 January 2016 (Wednesday)

08:30 – 09:00	<b>Meet and greet coffee</b>
09:00 – 10:20	<b>From modeling to motion estimation: an operational example</b> by Massimo Caccia
10:20 – 10:40	BREAK
10:40 – 12:00	<b>From modeling to motion estimation: an operational example (continuation)</b> by Massimo Caccia
12:00 – 14:00	LUNCH BREAK

## 4. EXPERT VISIT PLANNED OUTCOMES:

- Participants are introduced with modeling and identification of Unmanned Marine Vehicles.
- Participants are introduced with the basics of filtering and motion estimation for Unmanned Marine Vehicles.
- Participants perform an operational example of modelling, identification and motion estimation of Unmanned Marine Vehicles

## 5. LECTURE DESCRIPTION:

### 1. **Modeling of Unmanned Marine Vehicles** by Massimo Caccia

In this lecture lumped parameters practical models of Unmanned Marine Vehicles, namely ROVs and USVs, will be introduced including propeller-hull and propeller-propeller interactions.

### 2. **Identification of Unmanned Marine Vehicles** by Massimo Caccia

On-board sensor based identification techniques for Unmanned Marine Vehicles will be introduced, focusing on the design of suitable experiments.

### 3. **Filters and smoothers** by Massimo Caccia

This lecture will present basic principles of filtering and smoothing for online and offline processing of sensor data. In particular, Kalman filtering techniques will be reviewed.

### 4. **Motion estimation of Unmanned Marine Vehicles** by Massimo Caccia

This lecture will introduce design and implementation of motion estimation systems for Unmanned Marine Vehicles, pointing out how model knowledge can improve filter performance from the system control perspective.

### 5. **From modeling to motion estimation: an operational example** by Massimo Caccia

In this session participants will be introduced, through a practical example, to the modeling, sensor characterisation, design of identification experiments, identification, and design and implementation of motion estimation of Unmanned Marine Vehicles.

## 6. DESCRIPTION OF THE PARTNER INSTITUTION:



National Research Council – CNR  
The Institute of Intelligent Systems for Automation - ISSIA

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70126 Bari  
Italy

Website: [www.issia.cnr.it](http://www.issia.cnr.it)

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The Institute of Studies on Intelligent Systems for Automation (CNR- ISSIA) focuses its research on topics as robotics, automation, signal and image processing, measurement and decision support systems based on soft-computing techniques for complex applications. CNR-ISSIA has particular experience in the development of unmanned marine vehicles for observation, sampling, exploration and protection application, as well as in acoustic and imagery data fusion and analysis for environment modeling and multi-dimensional reconstruction.

CNR-ISSIA has more than twenty-five years of research experience in the field of marine robotics, supported by the development of Remotely Operated Vehicles, Unmanned Surface Vehicles and underwater manipulators such as: Roby (1990-1992); Roby2 (1992-1997), an ROV with depth rating of 200 m, currently exhibited at the National Museum of Antarctica in Genova; Romeo (1997-today), a high manoeuvrability ROV with depth rating of 500 m; Charlie (2003-today), an unmanned catamaran originally designed for sampling sea surface microlayer; ALANIS (2008-today), an unmanned RIB-like vessel designed for the monitoring of coastal areas; AMADEUS work-cell, consisting of a couple of 7 degrees of freedom electro-mechanical underwater manipulators (EC Project AMADEUS - Advanced manipulation for deep underwater sampling, 1997-'99). These robots were exploited in scientific campaigns in Antarctica, Arctic and Mediterranean, validating different operational conditions of remote control, including satellite Internet-based tele-operation. Among other topics, research activity is focused on optical and acoustic motion estimation, development of specific devices, and cooperative control of teams of vehicles. CNR-ISSIA was partner of the EC FP7 Innovative Product Concepts project MINOAS - Marine INSpection rObotic Assistant System, for the development of a vessel-inspection system based on multiple cooperative vehicles and virtual reality; EC FP7-SME CART - Cooperative Autonomous Robotic Towing system, a robotized system for the recovery of the towing line of distressed vessels. CNR is currently partner of the EC FP7-ICT MORPH - Marine robotic system of self-organizing logically linked physical nodes, a new concept for cooperative UMVs; the EC FP7 Collaborative Project CADDY - Cooperative autonomous diving buddy, for the diver operations support by means of cooperative robotic platforms. CNR is coordinator of the Italian Flagship Project RITMARE focused on research activities related to marine and maritime science and technologies. CNR is partner of the Italian project MARIS - Marine Autonomous Robotics for InterventionS, focused on cooperative underwater mobile manipulation.

## 7. BIOGRAPHIES OF LECTURERS



**Massimo Caccia**

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**Massimo Caccia** (MSc 1991) is the director of CNR-ISSIA since October 2013. He is author of 2 book chapters, and more than 100 international journal and conference papers. Principal investigator of the projects: "SEa Surface Autonomous MOdular unit" funded by the National Program of Research in Antarctica (2002-2004), "Harbour and coastal underwater anti-intrusion system" funded by IARP-FESR (2005-07), "Unmanned Multipurpose Vessel" funded by the Scientific and Technological Park of Liguria (2007-08), MINOAS, CART and MORPH projects (regarding CNR contribution), funded by EC. From 2010 he is member of the IFAC Technical Committee 7.2 Marine Systems.