

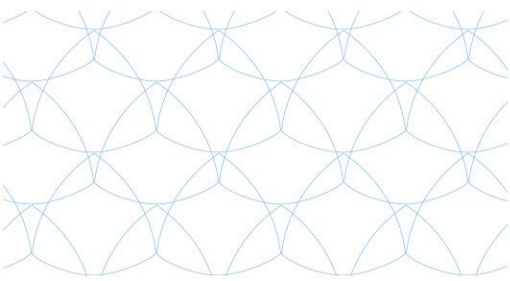
**EXCELLABUST**  
EXCELLING LABUST IN MARINE ROBOTICS

# INVITED TALK

12<sup>th</sup> April 2017

## High-resolution Sea-floor Optical Mapping using Unmanned Underwater Vehicles

Assoc. Prof. Rafael Garcia  
University of Girona



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



## 1. INVITED TALK DETAILS

**Date:** April 12<sup>th</sup>, 2017  
**Time:** 15:00 – 16:00  
**Location:** Gray Hall, University of Zagreb Faculty of Electrical Engineering (UNIZG-FER)  
Unska 3, Zagreb, Croatia

**Title:** High-resolution Sea-floor Optical Mapping using Unmanned Underwater Vehicles  
**Name:** Prof. Rafael Garcia  
**Affiliation:** Computer Vision and Robotics Research Institute, University of Girona  
Edifici CIRIS, Parc Científic i Tecnològic UdG  
C/ Pic de Peguera 13 (La Creueta)  
17003 Girona, Spain

## 2. ABSTRACT

Robotics has greatly advanced in the last few years as a tool for environmental monitoring and seafloor characterization. Seafloor imagery is routinely acquired during near-bottom mapping surveys conducted by Unmanned Underwater Vehicles (UUVs). Deep-sea hydrothermal fields or shallow-water coral reef communities are, for instance, two scenarios that have long been the target of such studies. Imagery is useful to characterize the nature and distribution of geological features and biological communities, extract ecological indicators, and to provide a permanent visual record of the seafloor condition. However, imaging studies often yield large numbers of images (several tens of thousands, especially in deep-sea cruises) that are frequently underutilized largely because of the difficulties inherent in processing and visualizing large data sets. Moreover, light suffers from a rapid and nonlinear attenuation underwater that affects the acquired images, which forces AUVs to navigate close to the seafloor, thus increasing the risk of the survey mission.

In this talk we will present ongoing work at the University of Girona towards development and application of vision-based seafloor survey methodologies, including large area 2D mosaicing (>1sqkm), monocular-based 3D mosaicing, and omnidirectional mapping. The developed tools set a first step towards detecting and documenting the temporal variations associated with the active processes operating at these sites.

### 3. BIOGRAPHIES OF LECTURERS



**Dr. Rafael Garcia**

Website: <http://eia.udg.edu/~rafa>

Email: [rafael.garcia@udg.edu](mailto:rafael.garcia@udg.edu)

**RAFAEL GARCIA** graduated in computer engineering in June 1994 at the Autònoma University of Barcelona (UAB), received the DEA (MSc) in Computer Science in July 1996 and the Ph.D. degree in computer engineering in 2001, both at the University of Girona (UdG), Spain. His research activity mainly focuses on robotics in topics such as robot navigation and mapping, sensor fusion, 3D reconstruction, semantic representation of video imagery and large-scale mosaicing. Dr. Garcia was the director of the Computer Vision and Robotics Group (VICOROB) of the University of Girona from March 2009 to June 2015. Currently, he is the director of the Underwater Vision Lab, which belongs to VICOROB. Dr. Garcia has been visiting researcher at the Universität der Bundeswehr (Germany), University College Cork (Ireland), IRISA-INRIA (France), and the University of Miami (USA). He is involved in several national and transnational projects in the field of robotics and computer vision and has participated in the creation of two spin-off companies.

### 4. DESCRIPTION OF THE PARTNER INSTITUTION:

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

**Computer Vision and Robotics Research Institute,  
University of Girona**

Address: Edifici PIV, Campus Montilivi  
Universitat de Girona  
17071 Girona  
Spain

Website: <http://vicorob.udg.edu>

The University of Girona is a public institution devoted to excellence in teaching and research and to participating in the progress and development of society through the creation, transmission, diffusion and criticism of knowledge related to sciences, technology, humanities, social sciences and arts. The Computer Vision and Robotics Research Institute (VICOROB) at the University of Girona is devoted to the research related to the areas of computer vision, image processing and robotics. VICOROB is composed of 75 members (22 PhDs) and in the period 2007–2012 has participated in 21 European and Spanish Research Projects (4,5M€) and 23 Industry Contracts (1M€), has supervised 55 PhD/MSc theses and published 97 articles in journals, 47 book chapters and 180 conference attendances.



**GIRONA UNDERWATER  
VISION AND ROBOTICS**

**Girona Underwater Vision and Robotics Lab**

Address: Edifici CIRS, Parc Científic i Tecnològic UdG  
C\ Pic de Peguera 13 (La Creueta)  
17003 Girona

Spain

Website: <http://cirs.udg.edu>

Contact: Assoc. Prof. Dr. Marc Carreras

<http://eia.udg.es/~marcc>

[marc.carreras@udg.edu](mailto:marc.carreras@udg.edu)

[Girona Underwater Vision and Robotics](#) research lab, as part of the Institute, has a strong experience in the design and development of hovering AUV prototypes with high-resolution image mapping capabilities. 5 AUV prototypes have been designed during the last 10 years, all of them having a different conceptual design. Being [GIRONA 500 AUV](#) and [SPARUS II AUV](#) the currently operative platforms. During the last years the team has worked on the development of advanced image processing techniques for the 2D and 3D mapping of the seafloor, as well as with the fusion of these techniques with navigation data coming from state of the art navigation sensors (DVL, gyros, USBL) together with global optimization techniques to face large-scale maps. Map based navigation and SLAM of underwater robots using both acoustics and/or video images is currently one of the main topics of research. VICOROB has also a long experience in intelligent control architectures and has contributed in mission control systems, behaviour-based architectures, robot learning and path planning for AUVs. Finally, the group has expertise in mechatronics and software integration. Recently, 4 Sparus II AUVs have been developed to be delivered to external research institutions, three of them participating in the EU-funded euRathlon underwater competition. UdG has consistently shown in the past that it can afford young and senior researchers the proper intellectual setting for training in the interdisciplinary field of cooperative autonomous robotics. After 20 years doing research, the team has become a benchmark in Europe for the design and construction of autonomous underwater vehicles, and the development of cutting edge software for the processing of visual and acoustic data. The team is also a member of [TECNIO](#) network of Excellence in technology transfer in Catalonia region. We are located in [Scientific and Technological Park](#) of the UdG.