

# EMRA'18

Workshop on EU-funded  
**MARINE ROBOTICS AND APPLICATIONS**



LIMERICK, Ireland

12-13th June, 2018

# PROCEEDINGS





## Organisation Committee

Edin Omerdic, University of Limerick (CRIS)

Daniel Toal, University of Limerick (CRIS)

Gerard Dooly, University of Limerick (CRIS)

Nikola Miskovic, University of Zagreb (FER)

## Acknowledgment - Sponsors

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The Networking Initiative, funded by the Marine Institute under the Marine Research Programme with the support of the Irish Government, SFI, Conference and Workshop Programme Grant, Fáilte Ireland Financial Support Programme.

[www.marinerobotics.eu](http://www.marinerobotics.eu)



Senior Research Fellow  
CRIS, University of Limerick

# WELCOME

Welcome to EMRA'18, the 5th EU Marine Robotics and Applications Workshop!

The Centre for Robotics and Intelligent Systems (CRIS), University of Limerick is hosting the 5<sup>th</sup> EU-funded Marine Robotics and Applications Workshop (EMRA'18) from 12-13<sup>th</sup> June 2018 in Limerick, Ireland. Limerick (known as The Treaty City, The City of Sieges and home of Angela's Ashes author Frank McCourt) is one of Ireland's oldest cities, famous for historical and cultural heritage, Georgian architecture, sizzling food, street art, rugby legends, and friendly people.

This EMRA edition is organised in the scope of two H2020 projects: EXCELLABUST and EUMR.

Following the success of previous EMRA workshops, the EMRA'18 will summarise ongoing EU-funded projects in marine robotics and provide a vibrant platform for sharing and discussing existing marine technological challenges and achievements. This multidisciplinary event is an excellent opportunity for networking, dissemination of the ongoing work and cross-fertilisation of ideas between marine science and enabling technologies and applications. In parallel to the EMRA'18 workshop, the SWARMS (Smart and Networking Underwater Robots in Cooperation Meshes) project consortium is organising "Conference on Novel Solutions for Underwater Vehicles in Autonomous Sea Operations" on 11<sup>th</sup> June.

I wish you all a very pleasant and fruitful workshop and stay in Limerick, and I hope you will return to your home with great experience and memories.

**Fáilte go hÉireann!**

Yours Sincerely,

A handwritten signature in blue ink that reads "Edin Omerdic".

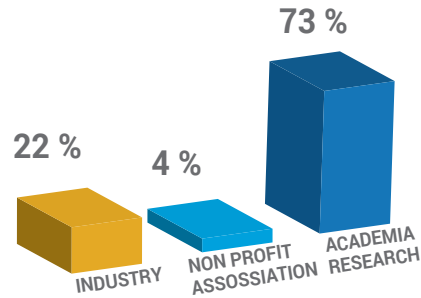
Edin Omerdic  
EMRA'18 Organising Committee Chair

# EMRA '18 FACTS & FIGURES

**90** Attendees  
from **52** institutions  
and **15** countries

\* Plus 32 live streaming followers

## Attendees profile



**1.5** DAYS

**5** SPONSORS

**27** SPEAKERS

## TOPICS

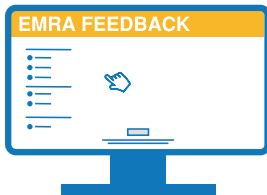


**2** KEYNOTES DEMOS

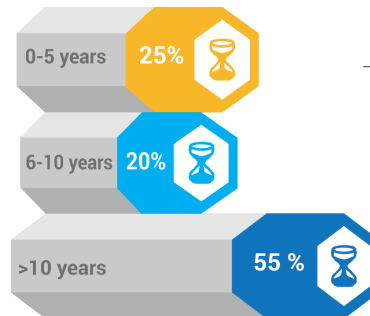
## HIGHLIGHTS FROM EVALUATION:

**72%**

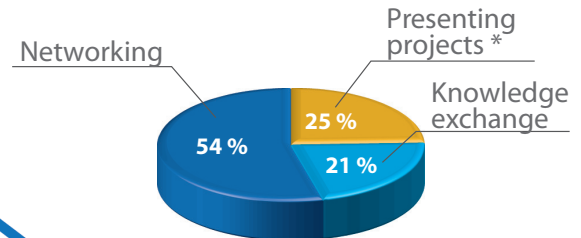
Response Rate



## Professional experience



## Motivation



\*Including keynote presentations

Satisfied with programme **8.8** ✓  
(scale from 1 to 10)

Event met expectations **9.2** ✓  
(scale from 1 to 10)



**Ideas** that could make **EMRA better** in the future  
 More details on topics in advance... **Poster sessions**...  
 More **time** for open **discussions**... **Live demos**...  
 Panel discussions on future directions of research...  
 Session of forthcoming or **open EU calls**...  
**Twitter** account/hashtag... **Corporate sponsors**...  
 More **keynote speakers**... More **industry players**...  
 Presence of **policy makers**... Themed sessions...  
 More presentations from **technology users**...  
 Extend to **other regions**. Our Ocean is global...

## “ EMRA'18 Testimonials

“An excellent event, a big thank the organising team! We felt very welcome and enjoyed our stay...”

“Excellent organisation. In many aspects better than some paid registration conferences...”

“I think some more marketing of the programme will be useful. It is a really an excellent workshop at the cutting edge of technology...”

“An excellent networking opportunities, good talks...”

“A great event. The social nights were fantastic and allowed me to make many new connections and friends...”

“Great facilities and a good choice of speakers...”

”

# Programme DAY 1 - 12<sup>th</sup> June

|       |   |                               |
|-------|---|-------------------------------|
| 08:30 | REGISTRATION AND COFFEE   |                               |
| 09:00 | WELCOME: Edin Omerdic / Edmond Magner/ Daniel Toal (University of Limerick)   |                               |
| 09:15 | KEYNOTE SPEAKER 1: Underwater Swimming Manipulators   | Kristin Y. Pettersen          |
| 10:00 | SWARMS: Smart and Networking UnderWater Robots in Cooperation Meshes  | Pedro Castillejo Parrilla     |
| 10:20 | ROBUST: Robotic Subsea Exploration Technologies   | Josep Quintana                |
| 10:40 | COFFEE BREAK  |                               |
| 11:10 | Trial and Validation of Autonomous Sensors, Vehicles and Prototypes using the SmartBay Cabled Subsea Observatory                          | John Breslin                  |
| 11:30 | MarEH4EU: Remote Software Testing & Verification over the Internet  | Thomas Vögele                 |
| 11:50 | Marine Institute ROV Operations   | David O'Sullivan              |
| 12:10 | Nido Robotics: Bringing Underwater Robots to Everyone   | Roy Petter Dyr Dahl Torgersen |
| 12:30 | UNEXMIN: Autonomous Underwater Explorer for Flooded Mines   | Mike McLoughlin               |
| 12:50 | LUNCH BREAK   |                               |
| 14:00 | RAWFIE: Road-, Air-, and Water-based Future Internet Experimentation  | Stathes Hadjiefthymiades      |
| 14:20 | iXblue: Analysis of Positioning Performance of Sparse-LBL in O&G Field Operations   | Jim Titcomb                   |
| 14:40 | HeronRobots: Towards Cheap Lightweight Bio-Inspired Autonomous Vehicle Manipulation and Grasping Underwater                               | Fabio Bonsignorio             |
| 15:00 | Force/Position Control System to Enable Compliant Manipulation from a Floating IAUV   | Patryk Cieślak                |
| 15:20 | COFFEE BREAK  |                               |
| 15:40 | Xocean: Unmanned Surface Vessels (USVs) for Ocean Data Collection   | James Ives                    |
| 16:00 | STRONGMAR: Robots at Sea  | Ana Paula Lima                |
| 16:20 | EvoLogics: Experimental Performance of an Underwater Acoustic Network of Mobile Nodes: Operational Exchange of Navigation and Sensor Data | Konstantin G. Kebkal          |
| 16:40 | Fugro: Fusing Engineering with Software to Improve the Efficiency of Offshore Operations  | Tim Rhodes                    |
| 17:00 | Nortek: New Generation DVLs for Underwater Vehicle Navigation   | Claire Cardy                  |
| 17:20 | END OF DAY 1  |                               |
| 19:30 | EMRA INFORMAL DINNER at STRAND Hotel, Limerick  |                               |

## DAY 2 - 13<sup>th</sup> June

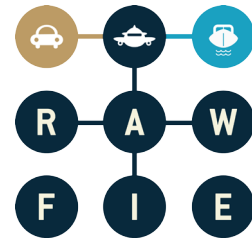
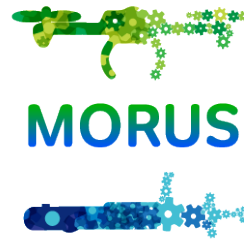
|       |  |                            |
|-------|--|----------------------------|
| 09:00 | MORNING COFFEE   |                            |
| 09:15 | KEYNOTE SPEAKER 2: Subsea Imaging and Measurement for Machine Learning (Cathx Ocean Ltd)   | Fergal Brennan             |
| 10:00 | UTOFIA: Real-Time Range-Gated 3D Camera for Subsea Applications  | Asbjørn Berge              |
| 10:20 | WiMUST: Outline, Results and Future Perspectives   | Giovanni Indiveri          |
| 10:40 | MORUS: Unmanned System for Maritime Security and Environmental Monitoring  | Stjepan Bogdan             |
| 11:00 | COFFEE BREAK   |                            |
| 11:20 | The Bluemed Initiative: Joint and Integrated Research and Innovation Strategies for Blue Jobs and Growth in The Mediterranean Area | Elena Ciappi               |
| 11:40 | EUMR: Key Marine Robotics Research Infrastructures for Starting Communities  | António Sérgio Ferreira    |
| 12:00 | SeeByte: Data Management for Long-Term Deployment  | Pedro Patron               |
| 12:20 | MaREI - Centre for Marine and Renewable Energy   | Daniel Toal                |
| 12:40 | ROVs for Use in Challenging Conditions: I-ROV & ROV ÉTÁIN  | Gerard Dooly<br>David Owen |
| 13:00 | OPEN DISCUSSION  |                            |
| 13:40 | LUNCH  |                            |
| 14:40 | END OF DAY 2   |                            |

## DEMOS, 12 - 13<sup>th</sup> June

| DEMO PRESENTATIONS                                   |                |
|--|----------------|
| Ocean Rings+   | Edin Omerdic   |
| The subCULTron project explores the Lagoon of Venice | Ronald Thenius |

# PRESENTED PROJECTS

H2020 and other EU funded schemes



**EMRA Presenters:  
Abstracts & Biographies**



## KEYNOTE SPEAKERS - Tuesday, 12<sup>th</sup> June, 09:15-10:00h

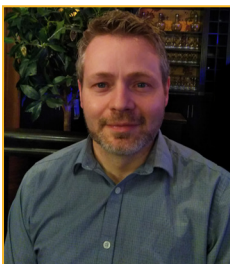


**Kristin Y. Pettersen** is a Professor in the Department of Engineering Cybernetics, NTNU where she has been a faculty member since 1996. She was Head of Department 2011-2013, Vice-Head of Department 2009-2011, and Director of the NTNU ICT Programme of Robotics 2010-2013. Kristin is Adjunct Professor at the Norwegian Defence Research Establishment (FFI). In the period 2013 – 2022 she is also Key Scientist at the CoE Centre for Autonomous Marine Operations and Systems (AMOS). She is a co-founder of the NTNU spin-off company Eelume AS, where she was CEO 2015-2016. She received the MSc and PhD degrees in Engineering Cybernetics at NTNU, Trondheim, Norway, in 1992 and 1996, respectively. She has published more than 250 papers in scientific conferences and journals, and her research interests focus on nonlinear control of mechanical systems with applications to robotics, with a special emphasis on marine robotics and snake robotics. In 2006, she and her co-authors were awarded the IEEE Transactions on Control Systems Technology Outstanding Paper Award for the paper: Global Uniform Asymptotic Stabilization of an Underactuated Surface Vessel: Experimental Results, and in 2017 for the paper: Integral Line-of-Sight Guidance and Control of Underactuated Marine Vehicles: Theory, Simulations and Experiments. She is a member of the IFAC Council and was a member of the Board of Governors of IEEE Control Systems Society 2012 - 2014. She has also held several board positions in industrial and research companies.

### Underwater Swimming Manipulators Kristin Y. Pettersen, NTNU, Norway

Snake robots are motivated by the long, slender and flexible body of biological snakes, which allows them to move in virtually any environment on land and in water. This mobility is highly desirable for autonomous robots. Since the snake robot is essentially a manipulator arm that can move by itself, it has a number of interesting applications including firefighting applications and search and rescue operations. In water, the robot is a highly flexible and dexterous manipulator arm that can swim by itself like an eel. By combining the slender, multi-articulated and thus flexible body of snakes with the efficient propulsion provided by thrusters, we obtain a new type of robot that is called an underwater swimming manipulator (USM). The USM combines several beneficial features of survey AUVs, work class ROVs and observation ROVs and AUVs into one tool. It shares the same advantageous hydrodynamic properties as the survey AUV, making it suitable for long range transportation. The flexible and slender body can access and operate in restricted areas of subsea structures, achieving excellent access capabilities compared to small observation ROVs/AUVs. The vehicle itself is a dexterous robotic arm which can operate tools and carry out intervention tasks, operating as a floating base robotic manipulator. The combined features of the USM make it an excellent choice for a subsea resident robot, which can be permanently installed on the seabed, being ready 24/7 for planned and on-demand inspection and intervention operations. This new robotic platform will reduce the use of expensive surface vessels which are needed to support such operations today, and will provide safer, greener and more cost-effective subsea operations. In this talk, Kristen will present the inspiration from biological snakes, and recent research results on modelling and control of snake robots, including both theoretical and experimental results and efforts for bringing the results from university towards industrial use.

## KEYNOTE SPEAKERS - Wednesday, 13<sup>th</sup> June, 09:15-10:00h



**Fergal Brennan** is a professional Engineer with over 20 years industry experience in the design and development of imaging systems and algorithm development. Educated to graduate and post graduate level in electronic engineering, with a particular focus on camera design and image processing, he has participated in numerous product designs thru his career and has developed several patented technology applications . At Cathx Ocean Fergal leads the research and development group and has been directly involved in the concept and design of the companies imaging platform.

### Subsea Imaging and Measurement for Machine Learning

**Fergal Brennan**, Cathx Ocean Ltd, Ireland

At present Subsea companies perform optical surveys using imaging equipment not fully optimised for Subsea imaging. These solutions impose limitations on the capability of surveys, specifically in terms of time spent and the resulting data quality. For other operators that require high resolution imagery, few suitable turn key solutions exist. For these organisations this means time and effort must be spent developing solutions to meet their needs. These systems require a large degree of online manual intervention for operation and post-processing. Currently personnel manually record events, issues or areas of interest in a survey. At Cathx, we realised there was lack of a turn-key, holistic, end to end solution to meet this problem. The available systems on the market were developed with no interdependence between cameras and light sources (or laser sources) or between the cameras and the vehicle and its other sensors. We formulated an architecture to operate successfully with emerging technologies such as AUV's and deep learning systems. From here we developed an approach to subsea imaging that delivers structured and relevant imagery while addressing the shortcomings of current systems.

Our goal was an integrated subsea imaging system ready for the rise of the autonomous subsea robot and its machine learning needs. Our design mission was to develop a system capable of integrating with the vehicle and its sensors to ensure optimum data capture. We identified that the system would need to be interconnected, upgradable and flexible and would need to use and include meta-data from sensors, such as INS, NTP/PPS timing, IMU's and others. The purpose of this being to ensure that captured imagery would be data rich and optimised for machine vision and learning algorithms.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 10:00-10:20h



**Pedro Castillejo Parrilla** is an Assistant Professor at Technical University of Madrid (UPM), Department of Telematics and Electronics (DTE). He is member of the research group Next-Generation Networks and Services (GRyS). He holds a M.Sc. and a Ph.D. both in Telecommunications (UPM). He has been involved in different European projects, like SODA, ESNA, DIYSE, LIFEWEAR, DEMANES, E-GOTHAM, I3RES and SWARMS. His areas of interest include Cyber-Physical Systems, wireless networks, network protocols and security algorithms and embedded middleware solutions. He has co-authored several conference presentations and published scientific papers in indexed journals. He has also participated as an invited lecturer in several master and doctoral courses.

### SWARMS: Smart and Networking UnderWATER Robots in Cooperation Meshes

**Pedro Castillejo**, Polytechnic University of Madrid, Spain

The primary goal of the SWARMS project is to expand the use of underwater and surface vehicles (AUVs, ROVs, USVs) to facilitate the conception, planning and execution of maritime and offshore operations and missions. This will reduce the operational costs, increase the safety of tasks and of involved individuals, and expand the offshore sector. SWARMS project aims to make AUVs, ROVs and USVs further accessible and useful, making autonomous maritime and offshore operations a viable option for new and existent industries:

- Enabling AUVs/ROVs to work in a cooperative mesh thus opening up new applications and ensuring re-usability by promoting heterogeneous standard vehicles that can combine their capabilities, in detriment of further costly specialised vehicles.

- Increasing the autonomy of AUVs/USVs and improving the usability of ROVs for the execution of simple and complex tasks, contributing to mission operations' sophistication.

The general approach is to design and develop an integrated platform for a new generation of autonomous maritime and underwater operations, as a set of software/hardware components, adopted and incorporated into the current generation of maritime and underwater vehicles in order to improve autonomy, robustness, cost-effectiveness, and reliability of offshore operations, namely through vehicles cooperation. SWARMS' achievements will be demonstrated in three field testing sites and occasions, taking into account different scenarios and use cases: Corrosion prevention in offshore installations, Monitoring of chemical pollution, Detection, inspection and tracking of plumes, Berm building, Seabed Mapping.



**Josep Quintana** received his Ph.D. degree in technology information in 2012 from the University of Girona, Spain. Dr. Quintana has participated in the MIDAS project of the VII Framework Programme, and several national projects. His research activity is mainly focused on underwater robotics in topics such as large-scale seafloor mosaicing, and 3D reconstruction, and also on image analysis for medical imaging comprehending skin cancer detection, melanoma detection and psoriasis assessment.

### ROBUST: Robotic Subsea Exploration Technologies

**Josep Quintana**, Coronis Computing S.L., Spain

There is a need to develop an autonomous, reliable, cost effective technology to map vast terrains, in terms of mineral and raw material contents which will aid in reducing the cost of mineral exploration, currently performed by ROVs and dedicated SSVs and crew. Furthermore, there is a need to identify, in an efficient and non-intrusive manner (minimum impact to the environment), the richest mineral sites. This technology will aid the seabed mining industry, reduce the cost of exploration and especially the detailed identification of the raw materials contained in a mining sites and enable targeted mining only of the richest resources existing.

The ROBUST proposal aims to tackle the aforementioned issue by developing sea bed in situ material identification through the fusion of two technologies, namely laser-based in-situ element-analysing capability merged with underwater AUV (Autonomous Underwater Vehicle) technologies for sea bed 3D mapping. This will enable resource identification done by robotic control enabled by the synergy between AUV hovering and manipulator capabilities. The underwater robotic laser process is the Laser Induced Breakdown Spectroscopy (LIBS), used for identification of materials on the sea bed. The AUV Robotic vehicle will dive, identify the resources that are targeted for LIBS scanning through 3D real time mapping of the terrain (hydro-acoustically, laser scanners, photogrammetry) and position the LIBS in the required locations of mineral deposits on the ocean floor to autonomously perform qualitative and quantitative analyses.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 11:10-11:30h



**John Breslin** is the General Manager of Smart Bay Ireland. He is responsible for the promotion and management of projects at the SmartBay Marine and Renewable Energy Test Site in Galway Bay. John has over 20 years' experience in marine survey, vessel operations & commercial management. Previously John worked as the Commercial manager for Europe at P&O Maritime and was responsible for developing and implementing the European regions growth strategy within the offshore wind and government shipping sectors. While employed at the Marine Institute he was responsible for the Management of Irelands Research Vessels and Deepwater ROV. John was a Co-owner and Director at Seabed Surveys International a specialist hydroacoustic survey company. He holds a Postgraduate Diploma in Management from the Irish Management Institute, a M.Sc (Research) from UCD, a B.Sc. in Marine and Fisheries Biology from the University of Aberdeen and has other qualifications in Applied Chemistry, Laboratory Practices and Aquaculture. John's hobbies include open water swimming, running and cycling and he is passionate about realising Ireland's potential for harnessing power from seas. Currently, he is a council member of Galway Chamber.

### Trial and Validation of Autonomous Sensors, Vehicles and Prototypes using the SmartBay Cabled Subsea Observatory **John Breslin, SmartBay, Ireland**

The subsea cabled observatory represents a significant addition to the SmartBay Marine and Renewable Energy test site. SmartBay comprises a suite of commercially available technology platforms including a network of buoys, sensor hardware and communication systems against which new technologies can be validated. The SmartBay Test Site is being used by technology developers and the research community to validate performance and assess the survivability, operability and reliability of a range of autonomous sensors, vehicles and prototypes.

Projects undertaken at the test site move concepts and prototype technologies from the lab into the sea for more effective trial and validation within a real-marine world environment. The presentation will highlight a range of projects to demonstrate how cabled observatories and dedicated marine test sites can be used to assist in the commercialisation of new products for the offshore oil and gas, environmental monitoring and marine renewable energy sectors. Autonomous platforms have been instrumental in our understanding of oceanic processes through their ability to sense and report physical state variables in a far more cost-effective way than traditional vessel-based observations, with much larger ability to cover temporal and spatial scales otherwise impossible to observe. This presentation addresses the question of whether this observational capacity could be extended to non-physical parameters on autonomous AUV and ASV platforms. The outcome of a European Union funded project, MARIABOX, will be used to illustrate both the possibilities and the current limitations of sensors and platforms in autonomous bio-chemical sampling in the ocean.



## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 11:30-11:50h



**Thomas Vögele** is a Senior Scientist and Head of International Business Development at the Robotics Innovation Center (RIC) in Bremen, Germany. The RIC is operated by the German Research Center for Artificial Intelligence DFKI GmbH. It is specialized in the development of robotics solutions for various application areas, including offshore inspection and maintenance, maritime technologies, and oceanographic exploration.

Dr. Vögele holds a PhD in Computer Science and Artificial Intelligence from Bremen University, and an MS in Geology from Free University Berlin.

At the RIC, he is responsible for the development and management of R&D projects related to methods and technologies to improve the capabilities of ROVs, AUVs, and other robotic systems for maritime applications. He coordinated several EU-funded projects in this domain, including the recently finished "ROBO-CADEMY" Marie Curie ITN, the Interreg project "Smart-Bot/RoboShip", and the FP7 STREP "MINOAS". He was responsible for the acquisition of "MarEH4EU"

### MarEH4EU: Remote Software Testing & Verification over the Internet

**Thomas Vögele**, DFKI Robotics Innovation Centre, Germany

In 2015, the DFKI Robotics Innovation Center inaugurated the Maritime Exploration Hall (MarEH) in Bremen, Germany. This large (23m x19m x8m) sea-water filled indoor basin is used to test maritime robotics systems under realistic, yet controlled conditions. With its size and infrastructure, the MarEH is unique in Germany, and it is safe to say that there are not many equivalent facilities in Europe and worldwide.

The MarEH is mainly used by DFKI researchers, but is also open to external users from academia and industry. However, until now use of the MarEH by researchers from other European member states is limited due to the significant logistical efforts required to ship material and personnel to and from Bremen.

Through the EU funded MarEH4EU project, DFKI could establish a technical infrastructure that enables external researchers to test software in the MarEH without the need to be present on-site. DFKI provides the necessary technical infrastructure and support for the remote experiments, which includes a fast internet connection, a tracking system, robotic systems, and support personnel. Currently, the infrastructure is limited to experiments with surface water systems. MarEH4EU is one of the facilities funded through the RAWFIE (Road-, Air- and Water- based Future Internet Experimentation) project as part of the FIRE (Future Internet Research and Experimentation) initiative.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 11:50-12:10h



**David O'Sullivan** obtained an MSc. in Marine Biology from UCC and subsequently joined the Marine Institute as part of the Fisheries Ecosystem Advisory Service team. He now works with INFOMAR, Ireland's national seabed mapping program to develop value-added collaborations by day and as a hydrographic surveyor by night. He has worked at sea on a variety of vessels including with the Canadian Coastguard when he participated in a hydrographic survey across the Atlantic from Canada to Iceland to Norway suffering various levels of seasickness. Much of his current work attempts to link physical seabed characteristics with their biological associations, namely their abundance and distribution of species. Last year David was Chief Scientist on a three week ROV survey that explored and mapped the deep, unknown regions of Ireland's continental shelf with a view to monitoring protected habitat and will be the subject of his talk today.

### Marine Institute ROV Operations David O'Sullivan, Marine Institute, Ireland

Offshore reef habitats are protected under the Habitats Directive but not enough information exists to make informed conservation management decisions in Ireland. In response, a deep-sea explorative survey, called SeaRover, took place in July 2017 aboard the ILV Granuaile equipped with the Marine Institute's remotely operated vehicle (ROV) Holland 1 and a multidisciplinary team of scientists to observe seabed features and biological associations along the northwest continental shelf. The Holland 1 employs high-definition (HD) camera, various composite video feeds and a robotic arm to facilitate sample collection.

The primary scientific objective was to map the distribution and abundance of geogenic and biogenic reef habitat along the northwest shelf edge of Ireland's continental slope with HD video. The data acquired will improve our understanding of these sensitive ecosystems in Irish waters and their underlying geomorphology and it broadens our understanding of the ecological requirements for these environments in support of sustainable management of Ireland's marine resources.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 12:10-12:30h



**Roy Petter Dyrdaahl Torgersen** is a founder & CEO of Nido Robotics in Spain. A Master Mariner by trade, and a passionate scuba diver, he became involved in underwater robotics almost by accident, eventually founding Nido Robotics, where a rapidly growing team develop telerobotics and teleoperation solutions for one of our planet's most hostile environments: the Ocean. At Nido Robotics, we work tirelessly to help our customers become more efficient in data collection underwater while lowering risk to personnel and installations. We do this by offering equipment with the best price-to-performance ratio currently on the market, and through training and services.

### Nido Robotics: Bringing Underwater Robots to Everyone

**Roy Petter Dyrdaahl Torgersen**, Nido Robotics, Spain

At Nido Robotics, we believe that no humans should not be exposed to dangerous work environments and that it should be everyone's right to engage in activities that feel fulfilling while creating value for others in society or our planet. This means that tasks that are repetitive or dangerous have to be eliminated or automated through the use of robots. Our Oceans are one of these environments.

Underwater robotics is not something new - the first remotely operated vehicles were commissioned in the sixties. However, this technology has traditionally been extremely expensive, only accessible to heavy industries like oil and gas, the military, research facilities with large budgets and a few extremely rich individuals.

Luckily, the convergence of technological developments in sensors and hardware, new manufacturing methods and Open Source philosophy has made it possible to build underwater robots and sensors to prices that are not only affordable enough for every company and research group to have their own but even to mobilize private citizens to get involved in data collection and exploring our planet.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 12:30-12:50h



**Mike McLoughlin** is chartered Mining Engineer, fellow of IOM3, trained as a shiftboss at Nchanga Open Pit, and mine captain at Ndola Lime company, employed as an engineer, a manager in UK Open Cast Coal sites and as a consultant. Mike has used his site experience to develop unique mining software and solutions which he develops and markets through his company Rockmate Limited. He is presently part of the RCI \ 4DCoders.com team developing post processing software for UNEXMIN.

### UNEXMIN: Autonomous Underwater Explorer for Flooded Mines

**Mike McLoughlin**, 4DCoders, United Kingdom

This EU Horizon2020 project is developing a novel robotic system for the autonomous exploration and mapping of Europe's flooded mines. The Robotic Explorer (UX-1) will use non-contact methods for autonomous 3D mine mapping for gathering valuable geological and mineralogical information with a view to reopening former uneconomic mines.

The Multi-robot Platform will represent a new technology line that is made possible by recent developments in autonomy research allowing the development of a unique new class of mine explorer service robots, capable of operating without a tether. Such robots do not exist nowadays; UX-1 will be the first of its kind. Research challenges are related to miniaturisation and adaptation of deep sea robotic technology to this new application environment and to the interpretation of geoscientific data. Completed initial stages included component validation and simulations to understand the behaviour of technology components and instruments to the application environment followed by the construction of the first Prototype. Post processing and data analysis tools are being developed in parallel, and pre-operational trials are launched in real life conditions. In the final stage of the project extensive pilots will take place during which UX-1 will be iteratively improved after each increasingly demanding trial session.

The final, most ambitious demonstration will take place in the UK with the resurveying of the entire Ecton mine (UK) that nobody has seen for over 150 years. This final pilot will demonstrate the Platform's scalability from small missions to the largest by increasing the number of deployed autonomous drones, and supporting multi-robot cooperation in confined 3D spaces with real-time sensor and data fusion for reliable navigation and communications.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 14:00-14:20h



**Stathes Hadjiefthymiades** is an Associate Professor in the Department of Informatics and Telecommunications, University of Athens (UoA), Athens, Greece. His research interests are in the areas of distributed-, mobile- and pervasive computing. He leads the activities of the Pervasive Computing Research Group (p-comp) established in UoA in 2003. He is also directing the Network Technologies, Services and Applications (NeTSA) Laboratory of UoA and the Graduate Programme on Graduate Programme on Management and Economics of Telecommunication Networks. He is the Project Coordinator for the H2020 FIRE+ project RAWFIE.

### RAWFIE: Road-, Air-, and Water-based Future Internet Experimentation Stathes Hadjiefthymiades, University of Athens, Greece

In this presentation, we provide an overview of the H2020 FIRE+ project RAWFIE placing emphasis on the resources made available by the project and the experimentation opportunities that they provide.

RAWFIE stands for Road-, Air- and Water-based Future Internet Experimentation and aims to interconnect numerous devices (UxV, x=Air, Ground, Surface) in the form of testbeds where Mobile IoT experiments can be performed. RAWFIE offers a suite of tools that allow experimenters to remotely specify their needs, manage the underlying architecture, launch experiments and collect / analyze data.



## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 14:20-14:40h



**Jim Titcomb** is currently the Offshore Technical lead for iXblues activity in the energy market. After studying at Fleetwood nautical college, Jim spent the first half of his career working in the high resolution seismic industry working mainly in the North Sea and South East Asia. In the late 1990s Jim took a shore position with Racal Survey Ltd where he lead the assessment of AUV technology, selecting the sensor suite for Racal's Bluefin 21s and participating in design reviews throughout the development of those first Bluefin vehicles. In 2008 he joined iXsea as it was then, leading the introduction of PHINS inertial navigation technology in to the oil and gas market. In more recent years, Jim has been advising the iXblue team developing their new acoustic positioning system CANOPUS.

### iXblue: Analysis of Positioning Performance of Sparse-LBL in O&G Field Operations

**Jim Titcomb**, iXblue, United Kingdom

Market conditions over recent years have led to a drive for cost savings in the oil and gas sector. Additionally, there is a developing focus on the development of Hybrid or fully autonomous vehicles for Oil and gas operations. These vehicles must operate securely extremely closely to subsea infrastructure, making accuracy and security of positioning essential.

The combination of INS and underwater acoustic technologies allows the expected secure and accurate positioning to be reached. The technique enables a number of additional positioning modes, beyond the traditional LBL and sparse LBL which are discussed. Benefits such as unlimited multiuser, synchronous reply LBL, very infrequent interrogation of a significantly reduced number of transponders, full monitoring of vehicles attitude, automated calibration and flexible arrays are described and discussed.

An analysis of results from real field operations during several projects and various configurations are presented.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 14:40-15:00h



**Fabio Bonsignorio** is a Visiting Professor at the Bi-robotics Institute of the Scuola Superiore Sant'Anna in Pisa. He was a Professor at the University of Carlos III, Madrid until 2014, where he was awarded the Santander Chair of Excellence in Robotics in 2009. Fabio is the Founder and CEO of Heron Robots (advanced robotic solutions), as well as a Founding Director of euRobotics aisbl, the private part of SPARC, the euRobotics PPP. He is currently a member of the Research Board of Directors of SPARC. He worked in the R&D departments of several major Italian and American companies, mainly in the applications of intelligent systems and technology transfer with coordination/management responsibilities for more than 20 years. His preferred research topics are in advanced robotics: cognition, control, modelling, software architectures, robot swarms, intelligent agents, epistemological issues in robotics, performance evaluation and foundational issues like 'morphological computation'. Fabio has pioneered and introduced the topic of Reproducible Research and Benchmarking in Robotics and AI. He is a co-editor of an upcoming book in Springer COSMOS book series, an Associate Editor of the IEEE Robotics and Automation Magazine, and an Entrepreneurship Co-Chair of IROS 2018, and has been in the Program Committee of various conferences. He is co-chair of IEEE RAS TC-Pebras, he has been the corresponding and more active editor of the Special Issue on Replicable and Measurable Robotics Research on IEEE Robotics and Automation Magazine, general co-chair of the IEEE RAS 2015 Summer School on Replicable and Measurable Robotics Research.

### Towards Cheap Lightweight Bio-Inspired Autonomous Vehicle Manipulation and Grasping Underwater

**Fabio Bonsignorio**, HeronRobots/CNR, Italy

HeronRobots and CNR-ISSIA work together on a potentially disruptive deeply bio inspired mobile manipulation and grasping technology especially suited for underwater applications. To this purpose they constituted the Joint Lab Heron@CNR (<http://www.issia.cnr.it/wp/heroncnr/>).

As a first goal, we are developing a new tendon-based manipulation system – loosely connected to an underwater(semi) autonomous vehicle- which does not require significant mechanical accuracies in the joints and in the limbs. The system will exploit morphological computation and the Lie Group underlying structure of the arm motion. The main issues with Deep (reinforcement) Learning, and in general Machine Learning, methods when applied to robotics is their data inefficiency. The learning system operates in a huge abstract state space which consider way too many physically impossible configurations and does not consider the underlying group transformation structure of the possible motions. Our system will overcome (or at least mitigate) those limitations. To our knowledge this is the first time that a compliant robotic system is governed by a DRL system inherently exploiting morphological computation and body dynamics.

This will allow implementing autonomous underwater vehicle manipulation with unprecedented dexterity at low cost. We will present our scientific and technological methodology, earlier results and prototype, the open issues and opportunities, and our plans for the future.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 15:00-15:20h



**Patryk Cieślak** received his PhD in 2016 from the Department of Robotics and Mechatronics, AGH University of Science and Technology in Kraków, Poland. He was involved in several projects concentrating around control system design in mobile robotics and manipulator systems. He is also a co-author of a commercial rehabilitation robot called Prodrobot. Recently, his research interests focus around autonomous underwater mobile manipulation. He is a Marie Curie postdoc in the Underwater Vision and Robotics Lab (CIRS) by the University of Girona, Spain.

### Force/Position Control System to Enable Compliant Manipulation from a Floating IAUV

**Patryk Cieślak**, University of Girona, Spain

The aim of this project is the design and implementation of a control system for an intervention autonomous underwater vehicle (I-AUV), composed of an AUV equipped with a multi-degree-of-freedom (multi-DOF) manipulator, to enable it to perform fully autonomous compliant underwater manipulation.

The control system is based on a combination of a task-priority kinematic control approach with admittance force control concepts. The robot's manipulator is equipped with a force/torque sensor to enable force control in various interaction tasks. These tasks include autonomous floating pipe inspection, hull cleaning and bolt screwing/unscrewing. All of the tasks will be tested during implementation, in an advanced underwater robotics simulator, including dynamics of the manipulator and the AUV, hydrodynamics based on actual geometry, sensor simulation, collision and measurement of the interaction forces. Then the tasks will be experimentally performed in the CIRS test tank using Girona500 I-AUV equipped with a 4-DOF electric manipulator and in the Herriot-Watt OSL tank using an X-Y plotter with a 7-DOF arm.



**James Ives** is the founder and CEO of Xoccean, he is a Chartered Engineer and Fellow of Engineers Ireland. James was previously the CEO of tidal energy business OpenHydro, a senior manager at Accenture and an engineer at Ricardo Consulting Engineers.

### Xoccean: Unmanned Surface Vessels (USVs) for Ocean Data Collection

**James Ives**, Xoccean, Ireland

It's often quoted that we know more about the surface of Mars than we do about our oceans seabed. That's because it is estimated that 95% of the world's oceans are yet to be mapped. The reason is that it can be difficult and expensive to collect this data due to factors such as weather, budgets and vessel availability. On top of this, the size of the ocean economy is set to double by 2030 to \$3.0t. Ocean data is a key enabler of this growth.

Xoccean has developed an unmanned surface vessel (USV) specifically for performing tasks such as hydrographic survey, fish stock survey and data harvesting. The USV is 4.5m long x 2.2m wide, has over three weeks endurance and operates over the horizon via a satellite link.

The benefits of using the USV for ocean data collection are that it is safe with no crew required to go offshore, can tolerate extreme weather conditions, has minimal environmental impact and collects data at 1/3rd cost of conventional means.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 16:00-16:20h



**Ana Paula Lima** is a marine biologist with work experience in Biomedical Engineering. After finishing the PhD in Animal Science her research interest shifted towards innovative medical therapies that will enable the body to repair, replace, restore and regenerate damaged or diseased cells, tissues and organs. During five years, she worked on the development of artificial intelligent matrices inspired on the tissues of echinoderms and on immunomodulatory biomaterials for cardiovascular devices. Since she joined INESC TEC, she returned to her origins as a marine biologist by managing projects in the field of marine robotics.

### **STRONGMAR: Robots at Sea** **Ana Paula Lima, INESC TEC, Portugal**

INESC TEC is strongly committed to become a centre of excellence in maritime technology and, in particular, deep sea technology. The STRONGMAR project aims at creating solid and productive links in the global field of marine science and technology between INESC TEC and established leading research European institutions, capable of enhancing the scientific and technological capacity of INESC TEC and linked institutions, helping raising its staff's research profile and its recognition as a European maritime research centre of excellence.

The STRONGMAR project seeks complementarity to the TEC4SEA research infrastructure: on the one hand, TEC4SEA promotes the establishment of a unique infrastructure of research and technological development, and on the other, the STRONGMAR project intends to develop the scientific expertise of the research team of INESC TEC. These objectives will be fulfilled through a set of measures: summer schools, winter schools, short-term scientific meetings, long-term staff visits, networking meetings, workshops, conferences, technology transfer workshops with stakeholders, and other dissemination activities.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 16:20-16:40h



**Konstantin Kebkal** received his engineering degree from the Technical University Sevastopol (Ukraine) in 1995 and his PhD in Electronic Engineering from the Technical University Berlin (Germany) in 2000. Extensive experience in underwater acoustics, signal processing, applied mathematics and electrical engineering. His studies of the physics of dolphin communication laid the groundwork for EvoLogics' Sweep Spread Carrier (S2C) technology for underwater data transmissions: based on results of these studies he has developed a patented ultra-broadband communication system providing high reliability needed for applications in the oceanographic and offshore applications. In 2000 he co-founded R&D company EvoLogics GmbH aimed at developing flexible and reliable solutions for the maritime industry, especially underwater communication, navigation and positioning systems and networks for increasing the flexibility of operations whilst reducing risks and costs. More than 100 scientific publications, 2 international patents.

### Experimental Performance of an Underwater Acoustic Network of Mobile Nodes: Operational Exchange of Navigation and Sensor Data

**Konstantin G. Kebkal**, EvoLogics GmbH, Germany

Underwater sensor networks, deployed in the water column or on the bottom, distributed over vast areas, require coordinated operation in many applications and, therefore, prompt data exchange among themselves. Organization of real-time access to data collected underwater requires sensors to be fitted out with digital communication means. In particular, the AUVs operating in a group require intensive exchange of navigation data when engaged in cooperative manoeuvring or performing coordinated measurements, or agreeing on modifying the current mission with an operator on the surface support vessel. The technology enables data transfer in networks of arbitrary topology, the number of intermediate nodes between source and receiver may be fixed or variable, data delivery route can be static or dynamic. Particular implementation of the digital underwater acoustic network is represented in form of a program framework (EviNS- Evologics intelligent Networking Software) - a stack of network protocols, each of which is designed to solve the problem of hydro-acoustic data delivery under certain conditions of underwater acoustic environment. The program framework is implemented as open source code, enabling any adaptation of the framework to operate on different hardware platforms, in particular, the operation on the hardware platform (i.e. "on board") of the underwater acoustic modems built upon the S2C technology. With this framework the underwater acoustic modem represents commercial or experimental platform allowing to combine the existing network protocols, as well as to integrate additional custom protocols (stack of customized protocols developed by end users).



## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 16:40-17:00h



**Tim Rhodes** joined Fugro in 2006 and has managed the development of control systems for the ROV fleet and other subsea remote systems for the Fugro internal market since then. All the electronics hardware and software has been designed 'in house' which makes Fugro able to supply innovative and custom engineering solutions to its clients. Tim is based in Aberdeen, Scotland but travels to Singapore on a regular basis to work with the team in the factory there.

### Fusing Engineering with Software to Improve the Efficiency of Offshore Operations

**Tim Rhodes**, Fugro, United Kingdom

Performing a Deepwater rendezvous to perform equipment transfers is an operation fraught with hazards when controlled remotely. Similarly, placement of seismic nodes on the sea floor in a precise layout also calls for novel control and tooling solutions.

In this talk I will explain the innovative mechanisms by which new Ocean Bottom Seismic Node technology has been deployed for maximum efficiency and safety. This approach offers the subsea industry a step change in seismic survey capabilities and enables surveys of complex topologies and large areas to be undertaken at considerably reduced cost.

## PRESENTATIONS - Tuesday, 12<sup>th</sup> June, 17:00-17:20h



**Claire Cardy** studied Oceanography at the National Oceanography Centre, Southampton. After graduating, she worked for several years for Fugro and BMT in metocean data analysis. During this period, Claire worked primarily on global offshore oil and gas projects, ranging from feasibility studies through to front end engineering design. Following this, Claire joined ABPmer to focus on numerical modelling of currents and waves for the UK marine renewables sector.

Since joining Nortek in 2016, Claire has been involved in subsea navigation, particularly focusing on DVL development, and is responsible for managing sales and technical support within the UK.

### New Generation DVLs for Underwater Vehicle Navigation

**Claire Cardy**, Nortek, United Kingdom

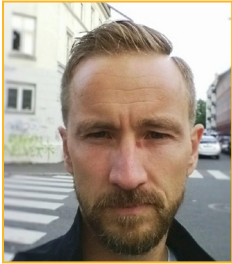
The error sources associated with Doppler velocity log (DVL) based navigation are relatively extensive and have been well documented.

In order to improve the accuracy of DVL based navigation, Nortek has developed a new generation Doppler velocity log (DVL) which makes use of several improvements in acoustic technology. This includes a new bottom detection principle which contributes to increasing the range significantly compared to standard DVLs, and the introduction of a more robust data quality control assessment, referred to as a Figure of Merit (FOM).

Our new generation DVL also has an improved time synchronisation with inertial navigation systems (INS), which additionally improves the accuracy of the navigation package as a whole.

Using the Kongsberg Maritime HUGIN autonomous underwater vehicle (AUV) as a testbed, we present the sea trial results undertaken with our new generation DVL. This trial demonstrates exceptional performance in terms of long term accuracy, making the Nortek DVL a viable alternative for high end state of the art underwater navigation, and ideally suited for the entire range of marine autonomy applications.

## PRESENTATIONS - Wednesday, 13<sup>th</sup> June, 10:00-10:20h



**Asbjørn Berge** is a senior scientist at the Smart Sensor Systems group at SINTEF Digital. SINTEF is a private, non-profit research institute, and the largest independent research organization in Scandinavia. With over 10 years of contract research experience, Asbjørn currently leads several projects investigating topics ranging from intelligent video conferencing cameras to low-cost mobile phone based 3D scanning for the construction industry. He has participated in several projects concerned with robotics, covering the range from object detection and gripping to path-planning for mobile robotics and autonomous drone navigation. He has a PhD in image analysis from the University of Oslo, and a MSc in Applied Mathematics from the Norwegian University of Technology and Science. Asbjørn has 15+ peer reviewed publications, and a patent for high speed synchronization of video and external signals. Asbjørn worked from 2008-2013 as adjoint associate professor at University of Oslo, teaching graduate level courses in image analysis. His research interests cover vision for autonomy, pattern recognition and video and temporal data analysis, as well as analytics at the edge.

### UTOFIA: Real-Time Range-Gated 3D Camera for Subsea Applications

**Asbjørn Berge**, SINTEF Digital, Norway

We present a range gated camera system designed for underwater robotics and real-time (10Hz) 3D estimation. The system uses a fast-shutter CMOS sensor (1280x1024) customized to facilitate gating with 1.67ns (18 cm in water) delay steps relative to the triggering of a solid-state actively Q-switched 532nm laser. A depth estimation algorithm has been carefully designed to handle the effects of light scattering in water; i.e. forward and backward scattering.

The raw range gated signal is carefully filtered to reduce noise while preserving the signal even in the presence of unwanted backscatter. The resulting signal is proportional to the number of photons that is reflected during a small time-unit (range) and objects will show up as peaks in the filtered signal. We show depth estimation results when scanning a range of 8m (typically 1m-9m) at 10Hz. The results are dependent on the water quality. We are capable of estimating depth at distances of over 4.5m at-tenuation lengths when imaging high albedo targets at low attenuation lengths, and we achieve a depth resolution ( $\sigma$ ) ranging from 1cm-9cm depending on signal level.

We present and discuss use cases related to use of visual 3D for subsea applications.

## PRESENTATIONS - Wednesday, 13<sup>th</sup> June, 10:20-10:40h



**Giovanni Indiveri** is Associate Professor, since 2011, in Systems and Control Engineering at the School of Engineering of the University of Salento in Lecce, Italy. He holds a Laurea degree in Physics since 1995 and a Dottorato di Ricerca (Ph.D.) in Electronic Engineering and Computer Science since 1998 (both from the University of Genova, Italy). From 1999 to 2001 he was a post-doc Researcher at the Fraunhofer (formerly GMD) Institute for Intelligent Autonomous Systems FhG - AiS of Sankt Augustin, Germany. From December 2001 to January 2011 he was Ricercatore (Assistant Professor) at the University of Salento. He is currently member of the IFAC Technical Committees 7.2 Marine Systems and 7.5 Intelligent Autonomous Vehicles of which he was Chair in the triennium 2009 - 2011. He is the Scientific Responsible of the University of Salento Research Unit of the Interuniversity Centre of Integrated Systems for the Marine Environment (ISME) since 2007. His research interests are in the area of autonomous robotics and, in particular, of navigation, guidance and motion control for marine and underactuated robots. Specific research topics include modeling and identification of marine robots, pose regulation, trajectory tracking and path following for underactuated kinematic robot models, marine robot navigation, outlier robust parameter identification and state estimation. He has published over 100 papers in international journals and conferences proceedings on these subjects. He is the Coordinator of the H2020 - LEIT ICT 23 Call 1 Project WiMUST: Widely scalable Mobile Underwater Sonar Technology from 1st February 2015 to 31 January 2018, <http://www.wimust.eu>.

### WiMUST: Outline, Results and Future Perspectives

**Giovanni Indiveri**, University of Salento (ISME), Italy

The WiMUST (Widely scalable Mobile Underwater Sonar Technology) project aims at expanding and improving the functionalities of current cooperative marine robotic systems, effectively enabling distributed acoustic array technologies for geophysical surveying with a view to exploration and geotechnical applications. Recent developments have shown that there is vast potential for groups of marine robots acting in cooperation to drastically improve the methods available for ocean exploration and exploitation. Traditionally, seismic reflection surveying is performed by vessel towed streamers of hydrophones acquiring reflected acoustic signals generated by acoustic sources (either towed or onboard a vessel). In this context, geotechnical surveying for civil and commercial applications (e.g., underwater construction, infrastructure monitoring, mapping for natural hazard assessment, environmental mapping, etc.) aims at seafloor and sub-bottom characterization using towed streamers of fixed length that are extremely cumbersome to operate. The vision underlying the WiMUST project is that of developing advanced cooperative and networked control / navigation systems to enable a large number (tens) of marine robots (both on the surface and submerged) to interact by sharing information as a coordinated team (not only in pairs).

The project brings together a group of research institutions, geophysical surveying companies and SMEs with a proven track record in autonomous adaptive and robust systems, communications, networked cooperative control and navigation, and marine robot design and fabrication. The project has recently ended by successfully demonstrating the possibility of performing geotechnical surveys with a team of autonomous robots. Results will be presented and discussed.

## PRESENTATIONS - Wednesday, 13<sup>th</sup> June, 10:40-11:00h



**Stjepan Bogdan** is Full Professor at the Laboratory for Robotics and Intelligent Control Systems (LARICS), Department on Control and Computer Engineering, Faculty of Electrical Engineering and Computing, University of Zagreb, where he teaches several courses in robotics and automation. His research interests include autonomous systems, aerial robotics, multi-agent systems, intelligent control systems, bio-inspired systems and discrete event systems. He spent one year as Fulbright researcher at the Automation and Robotics Research Institute, Arlington, USA, in Prof. Frank Lewis' lab. He is a co-author of 4 books and has published more than 160 conference and journal papers. He was the Principal Investigator and a researcher on 24 national and international scientific projects. Currently he is involved in 2 EU FP7 projects (ASSISI and EuRoC), 3 EU H2020 project (subCULTron, ACROSS, RoboCom++) and coordinates 1 NATO-SpS international project (MORUS). He served as an Associate Editor of IEEE Trans. on Automation Science and Engineering. He is an Associate Editor of Journal of Intelligent and Robotic Systems; International Review of Mechanical Engineering (IREME); Transactions of the Institute of Measurement & Control; Journal of Control Theory and Applications. He served as a Program Committee member of major control and robotics conferences. He is a member of KoREMA and IEEE senior member. He is appointed as a member of IEEE Technical Committee on Intelligent Control, representative of Croatia at European Union Control Association and was a vice-chair of Croatian Robotics Society.

### MORUS : Unmanned System for Maritime Security and Environmental Monitoring

**Stjepan Bogdan**, University of Zagreb, Croatia

The main goal of MORUS project is a design and development of a fully operational complex robotic system prototype comprised of an Unmanned Aerial Vehicle (UAV) and Unmanned Underwater Vehicle (UUV) capable of autonomous and cooperative mission executions related to environmental, border and port security.

In this talk we will present novel heavy-payload UAV design and control structure based on moving mass concept with mid-range adaptive algorithm.

## PRESENTATIONS - Wednesday, 13<sup>th</sup> June, 11:20-11:40h



**Elena Ciappi** received a B.S. in Mechanical Engineering in 1996 and a Ph.D. in Theoretical and Applied Mechanics in 1999 from the university of Rome "La Sapienza". In 1999 she joined INSEAN as researcher, in 2010 she became senior researcher at the same Institute, lately become the Institute for Marine Engineering of the National Research Council of Italy (CNR-INM).

She has been doing research activity in the field of experimental and theoretical modeling of Fluid-Structure Interaction problems in naval engineering, with application to hydro-elasticity, hydro/aerodynamic noise sources characterization and control, and to interior noise problems for both marine and aeronautical applications. She has been principal investigator / coordinator of several research projects and testing activities founded by the European Community, the European Defense Agency (EDA), the Italian Navy, the US Navy, as well as by maritime and aeronautical industries. She is member of the project management team and national coordinator of the technology platform of the BLUEMED-CSA.

She has experience in serving international research committees. For the International Towing Tank Conference (ITTC) she has been Chairman of the Specialist Committee on Hydrodynamic Noise and member (for two terms) of the Specialist Committee on Vortex Induced Vibrations.

### The Bluemed Initiative: Joint and Integrated Research and Innovation Strategies for Blue Jobs and Growth in The Mediterranean Area

**Elena Ciappi, CNR, Italy**

The BLUEMED Initiative was launched in 2014 in the framework of the European Commission Blue Growth Strategy, to promote a joint effort among Mediterranean Countries with the ambition to implement integrated research and innovation actions for blue jobs and growth in the Mediterranean area.

The initiative starts from the awareness that the Mediterranean Sea is a basin with unique bio-geo-physical characteristics and socio-economic features: it significantly contributes to the EU economy, has a unique cultural heritage and natural patrimony and a number of different resources that are not yet fully exploited. At the same time, natural and anthropogenic pressures as well as the need for a governance of common space and resources add complexity to the management of such a delicate geopolitical area.

This presentation provides understandings on the steps that brought to the development of the BLUEMED Initiative and the progresses made from its launch, the publication of the BLUEMED Strategic Research and Innovation Agenda (SRIA) and the funding of the BLUEMED Coordination and Support Action (CSA). Key activities carried out at political level and the tools used for engaging all relevant stakeholders, namely scientists, policy makers, private companies, and civil society, at national and international level are presented. Moreover, SRIA objectives and CSA structure are discussed as well as preliminary outcomes and on-going activities within the BLUEMED CSA devoted to the updating of the SRIA, the prioritization of the actions, the analysis of the framework conditions and the involvement of the non-EU Mediterranean Countries.



## PRESENTATIONS - Wednesday, 13<sup>th</sup> June, 11:40-12:00h



**António Sérgio Ferreira** is a senior Research Engineer at LSTS-FEUP, where he is responsible for onboard autonomy, planning and coordination of multiple vehicles. António Sérgio Ferreira holds an M.Sc. in Informatics engineering from FEUP, Porto, Portugal, and his areas of expertise include robotics, multi-agent systems, and software engineering. He has participated in offshore maritime operations and survey missions under several national and European projects. He has published extensively in reference journals and conference proceedings in the fields of maritime robotics. He has also been in charge of operational deployments in the Pacific and Atlantic oceans and in the Mediterranean and Adriatic seas.

### **EUMR: Key Marine Robotics Research Infrastructures for Starting Communities** **António Sérgio Ferreira, UPORTO (LSTS-FEUP), Portugal**

The Marine Robotics Research Infrastructure Network - EUMarineRobots is EU Horizon2020 research and innovation action project that will provide transnational access to the prestigious European marine robotics infrastructures to researchers from both academia and industry, establishing a well-developed world-class network.

The available research and development infrastructures include a full range of aerial, surface and subsurface marine robotic assets.

## PRESENTATIONS - Wednesday, 13<sup>th</sup> June, 12:00-12:20h



**Pedro Patron** is the Engineering Manager at SeeByte managing SeeByte's full Autonomy portfolio. He is responsible for the delivery of SeeByte's research, projects and products in this area. Pedro joined SeeByte in January 2011, to lead the development of SeeByte's Neptune product, which delivers adaptive planning for optimizing the execution of autonomy behaviours during collaborative multi-vehicle operations. He obtained his PhD from Heriot-Watt University (UK) in 2010 for his research in adaptive mission planning for unmanned systems. He holds an Engineering Degree with first-class honours from Universidad de Oviedo (Spain), and was granted with an EU Erasmus fellowship through which he completed a Diplome d'Etudes Approfondies (DEA) in Computer Vision, Image processing and Robotics from the INPG (France) in 2003.

### SeeByte: Data Management for Long-Term Deployment

**Pedro Patron**, SeeByte, United Kingdom

Recent advances on autonomy are now enabling underwater platforms to be deployed unattended for long periods of time. These platforms are carrying a great variety of sensors. Internal sensors are used for monitoring the health and status of the system, while external sensors are used for mapping and understanding their surrounding environment. All of these sensors are collecting high volumes of diverse data. Communication links underwater remain limited, sporadic, and poor quality. Furthermore, the storage and endurance resources of those platforms are limited. Additionally, these underwater assets are expected to be versatile to cope with different types operations, and highly modular payload configurations. All of this poses challenges of scalability, and calibration and requirements for on-line data management, making the data gathering and transmission tasks dynamic and difficult to model. There is a need to reduce the data acquisition and transmission expense of underwater assets through the use of optimization algorithms for sampling and exfiltration of data.

This presentation reviews the evolution of data manipulation in unmanned maritime platforms from classic data management approaches to more recent novel techniques that can provide rapid data ingestion and processing followed by an accurate and fast extraction.

## PRESENTATIONS - Wednesday, 13<sup>th</sup> June, 12:20-12:40h



**Daniel Toal** is the founder and director of Centre for Robotics & Intelligent Systems (CRIS), an Associate Professor at the University of Limerick, and a chartered engineer in Electrical and Systems Engineering. He obtained his PhD degree in Marine Robotics from the University of Limerick, after working in industry both in Ireland and abroad. Dan is collaborating with research and industry partners across Ireland, Europe and North America, on numerous projects falling under his research interests: field robotics for challenging environments (land-based, marine, airborne / ROVs, AUVs, UAVs), marine technology, ocean environment and renewable energy sectors. He has been awarded the Denny Medal - best journal paper award 2007/2008 - Journal of Marine Engineering Technology.

### MaREI - Centre for Marine and Renewable Energy

**Daniel Toal**, University of Limerick (CRIS), Ireland

MaREI is the marine and renewable energy research, development and innovation centre, supported by Science Foundation Ireland. It combines the expertise of a wide range of research groups and industry partners, with the shared mission of solving the main scientific, technical and socio-economic challenges across the marine and renewable energy sectors.

MaREI's 'Field Robotics' capabilities focus on the development of ICT and robotics systems to:

- (i) support the planning, construction and maintenance phases of marine and renewable energy installations,
- (ii) facilitate increased automation of facility inspection and intervention activities,
- (iii) fundamentally reduce the costs of exploiting these high-energy (MRE-rich) regions.

Challenges the team are addressing include the need for automatic and semi-automatic stabilisation & navigation with minimal pilot input, ensuring device control redundancy, and the need for intuitive pilot-focused information and control systems.

High energy environments prohibit the use of divers to maintain energy infrastructure. Developing underwater robots and remotely operated vehicles enables us to exploit these high-energy, hostile environments safely, reliably, and cost effectively. To observe and maintain a high energy site, the underwater vehicle must: be capable of working in strong wind and current environment, have a good vision system to recognise the parts of installed infrastructure in need of attention, and the intervention tools to fix potential issues

## PRESENTATIONS - Wednesday, 13<sup>th</sup> June, 12:40-13:00h



**Gerard Dooly** has worked extensively in the optical fibre sensors and marine robotics research centres at the University of Limerick since the completion of his PhD in 2008. Some of his recent research topics include environmental monitoring, subsea event triggered sensing platforms, miniature daughter-ROV's, anti-mine countermeasure ops and remote vehicles for incident response. His research interests include optical fibre sensors, differential optical absorption spectroscopy, advanced control systems, underwater robotic engineering and advanced sonar operations and processing. Gerard also has a keen interest in underwater shipwreck discovery, survey and identification and has participated in many deep-water diving expeditions worldwide.

**David Owen** is Engineering Manager and Lead Electronic Engineer at Forum Energy Technologies, Sub-Atlantic, Aberdeen UK since September 2013. Previously he was employed as Engineering Manager at C-Tecnics Ltd (2009 - 2012), Senior Electronic and Software Engineer at Sub-Atlantic Ltd (2002 - 2009) and Electronic Design Engineer at Kongsberg Maritime (1999 - 2003).

### ROVs for Use in Challenging Conditions: I-ROV & ROV ÉTÁIN

**Gerard Dooly**, University of Limerick (CRIS), Ireland  
**David Owen**, FORUM Technologies, United Kingdom

The Centre for Robotics & Intelligent Systems (CRIS), operating at the University of Limerick, is the only research centre focused on the application and development of marine robotics within the island of Ireland. The centre is actively involved in developing a diverse range of novel technologies in national funded, European funded and industry collaborative projects.

This joint presentation with David Owen from Forum Technologies is a short overview of ongoing research activities and available infrastructure within the centre, including work-class ROV Étaín (manufactured by FORUM Technologies, UK) and inspection-class I-ROV.

## DEMO Presentation - Tuesday, 12<sup>th</sup> June and Wednesday, 13<sup>th</sup> June



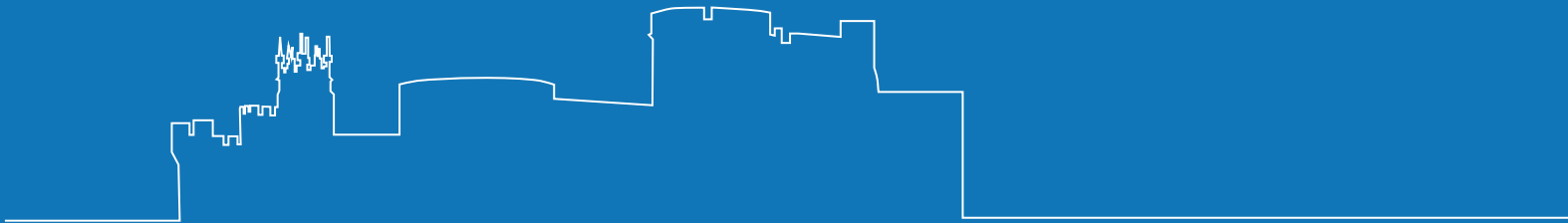
**Ronald Thenius** currently researcher in the subCULTron project. Since 2004 he works in the Artificial Life Lab of the University of Graz. After his Ph.D. (Biology) he has been participating in the EU-funded projects I-SWARM, Symbion, REPLICATOR and CoCoRo. His main fields of research are swarm robotics, bioinspired robotics and bio mimicry in robot control, with a special focus on Simemould, honeybees and vertebrate neuronal systems as archetypes. The “long distance goal” of his research is the development of a general model of organisation in swarms of biological lifeforms, to allow to generate control strategies for swarms of autonomous artificial entities

### SubCULTron project explores the Lagoon of Venice

**Ronald Thenius**, University of Limerick (CRIS), Ireland

subCULTron aims for achieving long-term autonomy in a learning, self-regulating, self-sustaining underwater society/culture of robots in a high-impact application area: Venice, Italy.

Our heterogeneous system consists of 3 different agent types: On the sea-ground, artificial mussels are the collective long-term memory of the system, allowing information to stay beyond the runtime of other agents, thus allowing to continue learning from previously learned states. These mussels monitor the natural habitat, including biological agents like algae, bacterial incrustation and fish. On the water surface, artificial lily pads interface with the human society, delivering energy and information influx from ship traffic or satellite data. Between those two layers, artificial fish move/monitor/explore the environment and exchange info with the mussels and lily pads. Artificial mussels are novel class of underwater agents. We aim to push forward the edge of knowledge with novel sensors (electric sense/electro-communication), novel bio-inspired algorithms (underwater hives) and novel energy harvesting in underwater scenarios.





## IN MEMORIAM

During last five years, the marine robotics community lost three extraordinary people: Prof. Antonio Tiano, Prof. Geoff Roberts and Liam Miller. Antonio and Geoff had brought highly prolific contributions to the field. They made a number of significant achievements, particularly in the field of marine system identification and multivariable marine control systems design, respectively. Both were highly active members of the International Federation of Automatic Control's Technical Committee on Marine Systems. They have been actively involved in setting up the leading marine robotics conferences, supervision of PhD students and networking activities.

Liam Miller was a member of CRIS team, marine lover, expert diver, extraordinary sailor, and successful PhD candidate, whose knowledge of sea conditions and sailing experience was invaluable for CRIS teamwork and field trials.

We will remember them as passionate teachers and researchers, marine robotics enthusiasts and, above all, great men.

Fair wind friends, we are missing you. Wish you were here!



**Prof. Antonio Tiano**  
(1943 – 2013)

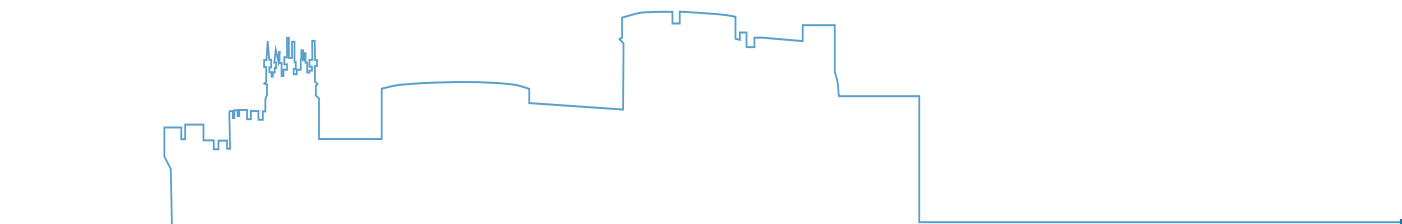


**Prof. Geoffrey Roberts**  
(1949 – 2015)



**Liam Miller**  
(1959 – 2014)

# NOTES



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