

2018 30.09.-07.10.
**BREAKING
THE SURFACE**
BIOGRAD NA MORU, CROATIA
10th INTERNATIONAL INTERDISCIPLINARY FIELD WORKSHOP
OF MARINE ROBOTICS AND APPLICATIONS

Workshop Proceedings



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1. INTRODUCTION



The 10th summer school “Breaking the Surface” 2018 (<http://bts.fer.hr/>) was held from 30th September to 7th October in Biograd na Moru, Croatia and more than 200 people participated. The program was divided into six program tracks: maritime robotics (MAROB); marine biology and marine nature protection (MARBIO); maritime security, naval and coast guard operations (MARSEC); maritime, nautical and ship archaeology (MARCH); marine geology (MARGEO); as well as the Innovation Tuesday program (INNOVA). In 7 days, 29 lectures, 8 demonstrations and 4 tutorials were held.

Dates: 30th September to 7th October 2018

Location: Biograd na Moru, Croatia

Website: <http://bts.fer.hr/>

2. ABOUT BREAKING THE SURFACE

The Breaking the Surface - BTS summer school has been organized by UNIZG-FER LABUST for the past 10 years. During the years, BTS served as a meeting place of experts and students of maritime robotics and maritime robotics application areas such as marine biology, maritime archaeology, maritime security, oceanography, marine geology and oceanology. This is the world’s first successful, multi-year field training program that combines academic topics in marine robotics and robotics application areas with hands-on working experience in the sea, doing remote sensing and sampling for various ocean sciences.

The Breaking the Surface summer school was organized in an attempt to strengthen the links between maritime robotics research and end-users, as well as to provide attendees with a one-week intense summer school consisting of plenary talks, hands-on trainings and demonstrations of maritime technologies, given by EXCELLABUST project partners and worldwide experts.

The program is organized in the form of plenary talks, hands-on tutorials and demonstrations of maritime technologies, e.g. maritime robotics (MAROB); marine biology and marine nature protection (MARBIO); maritime security, naval and coast guard operations (MARSEC); maritime, nautical and ship archaeology (MARCH), marine geology (MARGEO), and the Innovation Tuesday program (INNOVA).



3. ORGANIZERS

The Breaking the Surface 2018 summer school was organized under the European Union's Horizon 2020 project EXCELLABUST - Excelling LABUST in marine robotics (GA 691980). The main organizers are the University of Zagreb Faculty of Electrical Engineering and Computing (UNIZG-FER), the Laboratory for Underwater Systems and Technologies (LABUST) and the Centre for Underwater Systems and Technologies (CUST) with organizational support from the Institute of Studies on Intelligent Systems for Automation - ISSIA, National Research Council of Italy (CNR), University of Girona (UdG), and University of Limerick (UL).



ORGANIZERS



University of Zagreb



Faculty of Electrical
Engineering and Computing



Laboratory for Underwater
Systems and Technologies



Centre for Underwater
Systems and Technologies

IN PARTNERSHIP WITH



Institute of Studies on Intelligent
Systems for Automation - ISSIA,
National Research Council of Italy
(CNR)



University of Girona (UdG)



University of Limerick (UL)

BREAKING THE SURFACE ORGANIZATION STRUCTURE:

3.1. COMMITTEE CHAIRS



Prof. Zoran Vukić, PhD
General Chair

*University of Zagreb
Faculty of Electrical
Engineering and Computing,
Laboratory for Underwater
Systems and Technologies*



**Assoc. Prof. Nikola
Mišković, PhD**
Program Committee Chair
**EXCELLABUST project
Coordinator**

*University of Zagreb
Faculty of Electrical
Engineering and Computing,
Laboratory for Underwater
Systems and Technologies*



Ivana Mikolić, mag. ing.
Organizing
Committee Chair

*University of Zagreb
Faculty of Electrical
Engineering and Computing,
Laboratory for Underwater
Systems and Technologies*



Antonio Vasilijević, PhD
Technical Committee Chair

*University of Zagreb
Faculty of Electrical
Engineering and Computing,
Laboratory for Underwater
Systems and Technologies*



3.2. PROGRAM COMMITTEE



Marco Bibuli, PhD

National Research Council of Italy (CNR), Institute of intelligent systems for automation - ISSIA



Prof. Bridget Buxton, PhD

University of Rhode Island, Department of History



Massimo Caccia, MSc

National Research Council of Italy (CNR), Institute of intelligent systems for automation - ISSIA



Assoc. Prof. Marc Carreras, PhD

University of Girona Computer Vision and Robotics Research Institute - VICOROB



Asst. Prof. Dr. Sc. Irena Radić-Rossi

University of Zadar, Department of Archaeology



Edin Omerdić, PhD

University of Limerick



Prof. Pere Ridao, PhD

University of Girona Computer Vision and Robotics Research Institute - VICOROB



Prof. Asgeir Sørensen, PhD

Norwegian University of Science and Technology



Prof. Daniel Toal, PhD

University of Limerick



3.3. ORGANIZING COMMITTEE



Petra Kovačević



Tonko Bogovac



Anamarija Miličević



Ivan Trubić



Ivan Dominić



Mladen Petr



Valentino Žinić



3.4. TECHNICAL COMMITTEE



Anja Babić, mag. ing.

*University of Zagreb
Faculty of Electrical
Engineering and Computing,
Laboratory for Underwater
Systems and Technologies*



Nadir Kapetanović, mag. ing.

*University of Zagreb
Faculty of Electrical
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Ivan Lončar, mag. ing.

*University of Zagreb
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M. Eng. Marin Stipanov

*University of Zagreb
Faculty of Electrical
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Laboratory for Underwater
Systems and Technologies*



Kruno Zubčić

*Croatian Conservation
Institute*



4. PROGRAM

4.1. PROGRAM STRUCTURE

The BTS program is comprised of academic lectures, hands-on tutorials, project presentations and equipment and company demonstrations.



29 **LECTURES**

- 9 MAROB
- 2 MARBIO
- 2 MARCH
- 2 MARSEC
- 3 MARGEO
- 11 INNOVA



4 **TUTORIALS**

- groups of 20 students
- 2-3 students per computer



4 COMPANY **PRESENTATIONS**

- BluEye Robotics
- Blueprint Subsea
 - EvoLogics
- Sonardyne International Ltd



4 **DEMOS**



4 EU PROJECTS

4.1.1. LECTURES

Lectures were given by experts in the domains of:



Maritime
robotics
MAROB



Marine biology
MARBIO



Maritime
archaeology
MARCH



Maritime
security
MARSEC



Marine geology
MARGEO



Innovation day
INNOVA



List of speakers:

Maritime robotics (MAROB):

- Aviad Avni, University of Haifa, Israel: [Advanced maneuvering and vision algorithms for surveys with the SPARUS II AUV](#)
- Milica Stojanović, Northeastern University, USA: [Underwater acoustic communications: Fundamentals and new results](#)
- Torsten Jeinsch, University of Rostock, Germany: [Key technologies towards the vision of complex autonomous underwater operations: From project SMIS to MUM](#)
- William Kirkwood, Monterey Bay Aquarium Research Institute, USA: [Shearwater: The future of hybrid autonomous marine vehicles](#)
- Alexander Philips, National Oceanography Centre, UK: [Oceanids: Development of next generation marine autonomous systems for ocean science](#)
- Tim Mundon, University of Washington, USA: [Micro-scale wave energy generation for autonomous sensors and robotics](#)
- Walter Caharija, SINTEF Ocean AS, Norway: [Autonomy and remote control technology in sea aquaculture activities](#)
- Xianbo Xiang, Huazhong University of Science and Technology, China: [Cloud-based Management and Control of Autonomous Marine Vehicles: Concept and Demonstration](#)
- Iain A. Anderson, University of Auckland: [A fast fish-like human-powered racing submarine](#)

Marine biology (MARBIO):

- Ivona Cetinić, NASA Goddard Space Flight Center/USRA, USA: [Chasing ocean carbon – from sky to sea and below](#)
- Andrea Gori, Institut de Ciències del Mar - Consejo Superiores de Investigaciones Científicas, Spain: [Submarine technology for the study and conservation of deep coral gardens and cold-water coral reef](#)

Maritime archaeology (MARCH):

- Bridget Buxton, University of Rhode Island, USA: [“We’re \(not\) going to need a bigger boat”: the tech that will replace traditional research vessels in deep sea and coastal environments](#)
- Kotaro Yamafune, Texas A&M University, USA: A brief history of ancient ships
- Irena Radić Rossi, University of Zadar, Croatia: [How to protect an outstanding shipwreck site?](#)
- Kotaro Yamafune, A.P.P.A.R.A.T.U.S. LLC & Matko Čvrljak, Roskilde Viking Ship Museum: *A Methodology for Accurate and Quick Photogrammetric Recording of Underwater Cultural Heritage*

Maritime security (MARSEC):

- Philip Macilivray, US Coast Guard Pacific Area, USA: [Cyber-security solutions for unmanned systems, and their use in conjunction with new technologies to advance port security and maritime domain awareness](#)
- Niv David, Tel Aviv University, Israel: [Cyber security for marine technologies](#)

Marine geology (MARGEO):

- Hironobu Kan, Kyushu University, Japan: [New survey visualization: Merging photogrammetric 3D model with a multibeam bathymetry](#)
- Marko Bakašun, GEOmar d.o.o., Croatia: [ROV inspection](#)
- Manuel Bensi, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS: [Exploring the ocean and the seabed: oceanographic case studies where marine robotics can be applied](#)



Innovation Tuesday (INNOVA):

- Yvan Petillot, Heriot-Watt University, UK: [The ORCA Hub: Offshore robotics for certification of assets](#)
- Scott Reed, SeeByte, UK: [The evolution of smart software within maritime robotics](#)
- Daniel M. Lofaro, George Mason University, USA: [Robots in politics and business](#)
- Paul Oh, University of Nevada Las Vegas, USA: [Consumer Robotics in the Age of Acceleration](#)
- Miriam Rueda, Asociación Emerge, Spain: Protoatlantic – [Protoatlantic – a European accelerator program of the marine sector](#)
- Marc Carreras, IQUA Robotics, Spain: [IQUA Robotics: past, present and future](#)
- Iain Vincent, Planet Ocean Limited / ecoSUB Robotics Limited, UK: [Democratising the AUV: ecoSUB Robotics – from concept to commercial reality](#)
- Enrique Gonzalez Sancho, Nido Robotics, Spain: [Entrepreneurship in marine robotics](#)
- Marin Bek, H2O Robotics, Croatia: [Experiences in building an international business](#)
- James Ives, XOCEAN, Ireland: [Unmanned ocean data collection](#)
- António Sérgio Ferreira, Laboratório de Sistemas e Tecnologia Subaquática (UPorto), Portugal: [EUMarineRobots: The “Oprah” of Marine Robotics](#)

4.1.2. TUTORIALS

- Mandar Chitre, Chinmay Pendharkar, Prasad Anjani, Manu Ignatius, Subnero, Singapore: [Hands-on with software-defined modems & underwater networks](#)
- Barbara Arbanas; Anja Babić; Ivan Lončar; Milan Marković; Filip Mandić; Goran Vasiljević, University of Zagreb Faculty of Electrical Engineering and Computing, Croatia: [subCULTron – underwater measurements using aMussel](#)
- Nuno Gracias; László Neumann, Computer Vision and Robotics Institute of the Universitat de Girona/ ViCOROB, Portugal: [Underwater Optical Image Enhancement Techniques](#)
- Narcís Palomeras, University of Girona, (Spain) and Natàlia Hurtós, IQUA Robotics, (Spain): [Sparus II](#)

4.1.2. DEMONSTRATIONS

- Thomas Glotzbach; Sabir Ouchen; Joaquim Pinol Bel, Torpex Scooter, Germany: [Underwater scooter Torpex with newly developed hollow shaft motor](#)
- Iain Vincent; Jeremy Sitbon, Ecosub Robotics, UK: [Smart network localisation](#)
- Marko Bakašun; Matej Ćurić; Ivor Meštrović, Geomar, Croatia: [ROV inspection](#)
- Enrique Gonzalez Sancho, Nido Robotics, Spain: [Enrique Gonzalez Sancho](#)

4.1.3. COMPANY PROGRAM

- Martin Ludvigsen, Norway: [BLUEYE ROBOTICS](#)
- Tom Bennetts, Colin Sutherland, UK: [SONARDYNE INTERNATIONAL LTD](#)
- Konstantin Kebkal, Oleksiy Kebkal, Germany: [EVOLOGICS](#)
- Robin Sharphouse, Kevin Webster, UK: [BLUEPRINT SUBSEA](#)

4.1.4. WORKSHOPS

- Narcís Palomeras, University of Girona, Spain and Natàlia Hurtós, IQUA Robotics, Spain: [Workshop: defining a ROS package to standardize underwater messages](#)



4.2. SCHEDULE

	SUNDAY 30.09.	MONDAY 01.10.	TUESDAY 02.10.	WEDNESDAY 03.10.	THURSDAY 04.10.	FRIDAY 05.10.	SATURDAY 06.10.
09:00		Opening session Zoran Vukobratović, Marina Stokich	The ORCA Hub: Offshore robotics for certification of assets Yves Perleux	Motion assessment of an unmanned planing craft in seaway Miroslav Gropar	Underwater acoustic communications. Fundamentals and new results Milica Stojanović	Key technologies towards the vision of complex autonomous underwater operations. From project SMIS to MUM Tamas Jelench and Martin Karsenti	FIELD TRIP
09:45		Cyber security for marine technologies Nir David	The evolution of smart software within maritime robotics Scott Reed	New survey visualization, merging photogrammetric 3D model with a multibeam bathymetry Félicie Kan	How to protect an outstanding shipwreck site? Irena Radic-Rond	Chasing ocean carbon – from sky to sea and below Ivana Crnić	
10:30		COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	
10:45		"We're (not) going to need a bigger boat": the tech that will replace traditional coastal research vessels Bridget Ruxton	Robots in politics and business Daniel M. Lofaro	Cyber-security solutions for unmanned systems, and their use in conjunction with new technologies to advance port security and maritime domain awareness Philip McGillivray	Micro-scale wave energy generation for autonomous sensors and robotics Tim Munden	Autonomy and remote control technology in sea aquaculture activities Walter Cahanja	
11:30		Shearwater: The future of hybrid autonomous marine vehicles William Kirbywood	Consumer robotics in the age of acceleration Paul Oh	Submarine technology for the study and conservation of deep coral gardens and cold-water coral reefs Andrea Gost	Exploring the ocean and the seabed: oceanographic case studies where marine robotics can be applied Manuel Baral	A fast fish-like human-powered racing submarine Iain A. Anderson	
12:15		The role of technical devices in the frame of underwater archaeological researches Sébastien Tine	Proteatlantic – A European accelerator program of the marine sector Miriam Rando	Oceanix: Development of next generation marine autonomous systems for ocean science Alexander Phillips	Cloud-based management and control of autonomous marine vehicles. Concept and demonstration Xiaoqiang Jiang	ROV Inspection Marko Bakula, Miroslav Čuntić and Ivo Matković	
13:00		LUNCH	LUNCH	LUNCH	LUNCH	LUNCH	
14:30		COMPANY PRESENTATION Blueye Robotics		COMPANY PRESENTATION BluePrint Systems	COMPANY PRESENTATION Sonardyne	COMPANY PRESENTATION Evelogics	
15:00		T1 Intro: Underwater optical image enhancement techniques University of Girona		T2 Intro: Sparus II IKUA Robotics, University of Girona	T3 Intro: Hands-on with software defined modems & underwater networks Subsea, National University of Singapore	T4 Intro: subCULTrom UNIC FSR	
15:30		DEMO 1 Nido Robotics Group 1	DEMO 2 Blueye Group 3	DEMO 3 BluePrint Group 1	DEMO 4 acsUB Group 3	DEMO 5 Torque Group 3	DEMO 6 Sonardyne Group 3
16:30		DEMO 1 Nido Robotics Group 2	DEMO 2 Blueye Group 1	DEMO 3 BluePrint Group 2	DEMO 4 acsUB Group 1	DEMO 5 Torque Group 2	DEMO 6 Sonardyne Group 1
17:30		DEMO 1 Nido Robotics Group 3	DEMO 2 Blueye Group 2	DEMO 3 BluePrint Group 3	DEMO 4 acsUB Group 2	DEMO 5 Torque Group 1	DEMO 6 Sonardyne Group 2
18:00		DEMO 1 Nido Robotics Group 1	DEMO 2 Blueye Group 3	DEMO 3 BluePrint Group 1	DEMO 4 acsUB Group 3	DEMO 5 Torque Group 3	DEMO 6 Sonardyne Group 3
18:30		DEMO 1 Nido Robotics Group 2	DEMO 2 Blueye Group 1	DEMO 3 BluePrint Group 2	DEMO 4 acsUB Group 1	DEMO 5 Torque Group 2	DEMO 6 Sonardyne Group 1
19:30		DEMO 1 Nido Robotics Group 3	DEMO 2 Blueye Group 2	DEMO 3 BluePrint Group 3	DEMO 4 acsUB Group 2	DEMO 5 Torque Group 1	DEMO 6 Sonardyne Group 2
20:30		DEMO 1 Nido Robotics Group 1	DEMO 2 Blueye Group 3	DEMO 3 BluePrint Group 1	DEMO 4 acsUB Group 3	DEMO 5 Torque Group 3	DEMO 6 Sonardyne Group 3
From 21:00		NOIRWEGIAN PARTY	EXCELLABUST PARTY		OTS KARAOKE PARTY	GALA DINNER	GREAT GASTRO PARTY

SESSION COLORS

	Lecture
	Innovation Tuesday
	Social events
	Company programme
	Tutorial
	Demonstration

LECTURE CATEGORIES

	MAROB	MARSEC	COMPANY PRESENTATION
	MARBO	MARGIO	
	MARCI	INNOVA	

LOCATIONS

	LECTURE ROOM 1 & 2 (NOT LABARATIC) Depend on the number of participants	TUTORIAL ROOM 1 & 2 (NOT LABARATIC) Depend on the number of participants	RECEPTION Social events OTS, Innovation Tuesday
	DINING ROOM & OPEN WATER MUSEUM Depend on the number of participants	LAVOIR ROOM 1 & 2 (NOT LABARATIC) Depend on the number of participants	

SOCIAL EVENTS



Registrations
Sunday, 30.9.
16:30 - 18:30



Welcome drink
Sunday, 30.9.
18:00 - 19:30



Norwegian party
Monday, 1.10.
From 21:00



**EXCELLABUST
party**
Tuesday, 2.10.
18:00 - 19:30



BTS karaoke night
Thursday, 4.10.
From 21:00



Gala dinner
Friday, 5.10.
19:30 - 21:00



Great Gatsby party
Friday, 5.10.
From 21:00



Field trip
Saturday, 6.10.
9:00 - 16:00

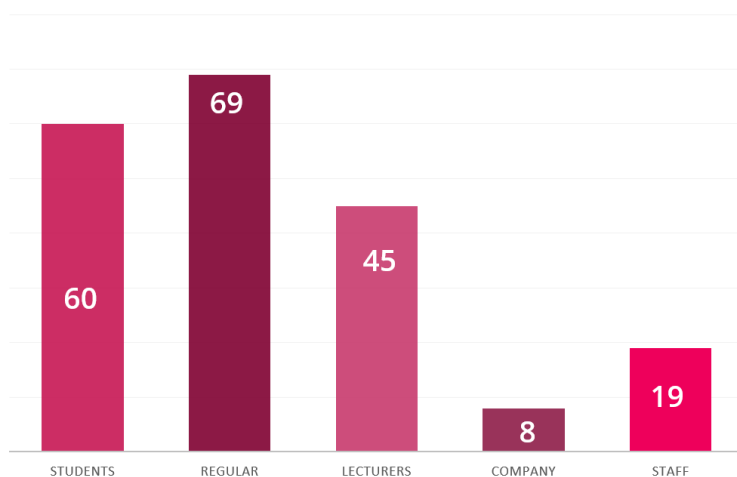
5. BTS PARTICIPANTS

In 2018, more than 200 participants from academia and industry from various fields joined Breaking the Surface.

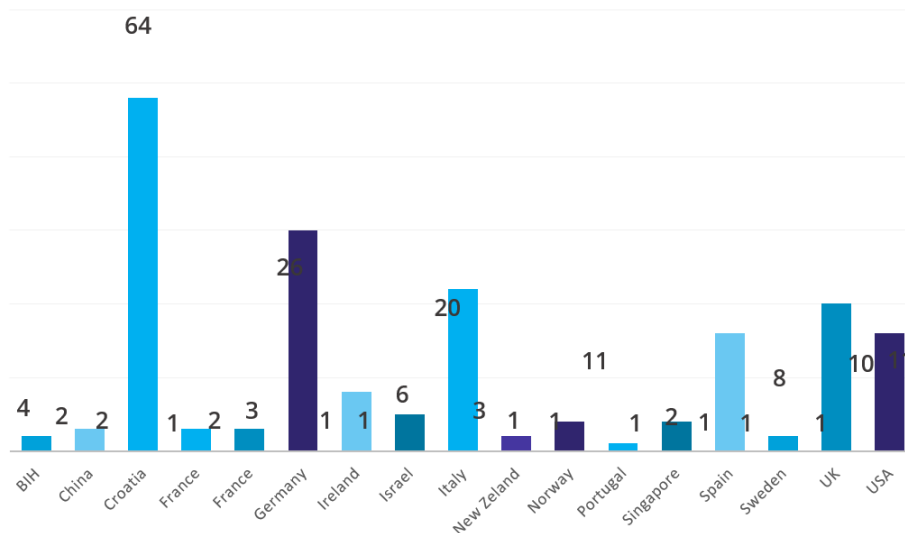


PARTICIPANT PROFILE

201 PARTICIPANTS



17 COUNTRIES



6. PROGRAM ABSTRACTS, BIOGRAPHIES AND PRESENTATIONS

Lectures' abstracts and lecturers' biographies are available in **APPENDIX I. – Abstracts and biographies.**
Slides from presentations are available in **APPENDIX II. – Presentations (slides).**

7. SUPPORTERS

FINANCED BY



EXCELLABUST



Financed in the scope of project EXCELLABUST - Excelling LABUST in marine robotics (GA 691980) which has received funding from the European Union's Horizon 2020 research and innovation program.

SUPPORTED BY



Embassy of the United States Zagreb
– Croatia



Norwegian Embassy

Royal Norwegian Embassy in Zagreb



Foundation of the Croatian Academy
of Sciences and Arts – HAZU



MINISTRY OF SCIENCE
AND EDUCATION
OF THE REPUBLIC OF CROATIA

Ministry of Science and Education
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Nekić cosmetics

Perković
VOĆNE RAKIJE I LIKERI

Rakije Perković



Medvedgrad brewery



8. APPENDIX I – ABSTRACTS AND BIOGRAPHIES

Abstracts and biographies are available [here](#).

9. APPENDIX II – PRESENTATIONS

Presentations are available [here](#).

