2017

1st - 8th October

BREAKING THE SURFACE

BIOGRAD NA MORU, CROATIA

9th INTERNATIONAL INTERDISCIPLINARY FIELD WORKSHOP OF MARINE ROBOTICS AND APPLICATIONS

PROCEEDINGS

Table of contents

1. INTRODUCTION

The **Breaking the Surface** 2017 was held from 1st until 8th October in Biograd na Moru, Croatia and more than 190 people participated. The programme was divided in six program tracks: marine robotics (MAROB); marine biology and marine nature protection (MARBIO); maritime security, naval and coast guard operations (MARSEC); maritime, nautical and ship archaeology (MARCH); maritime geology (MARGEO) and Innovation Tuesday programme (INNOVA). In 7 days 38 lectures, 10 demonstrations and 5 tutorials were presented.

Dates: 1st – 8th October 2017

Location: Biograd na Moru, Croatia

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

2. REPORT ORGANIZATION

The first part of the report describes the BtS 2017 organization, including the work program. The deliverable is accompanied with appendixes with abstracts, biographies and presentations of the programme presenters:

APPENDIX I. – Abstracts and biographies

APPENDIX II. – Presentations (slides)

3. ABOUT BREAKING THE SURFACE

Breaking the Surface - BtS summer school has been organized by UNIZG FER LABUST for the last 8 years – first three years as a part of FP7-REGPOT CURE project, while in the following years with Office of Naval Research Global support. During the years, BtS served as a meeting place of experts and students of marine robotics and the marine robotics application areas such as marine biology, marine archaeology, marine 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 and hands-on working experience in the sea, doing remote sensing and sampling for various ocean sciences.

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

BTS2017 IN NUMBERS:
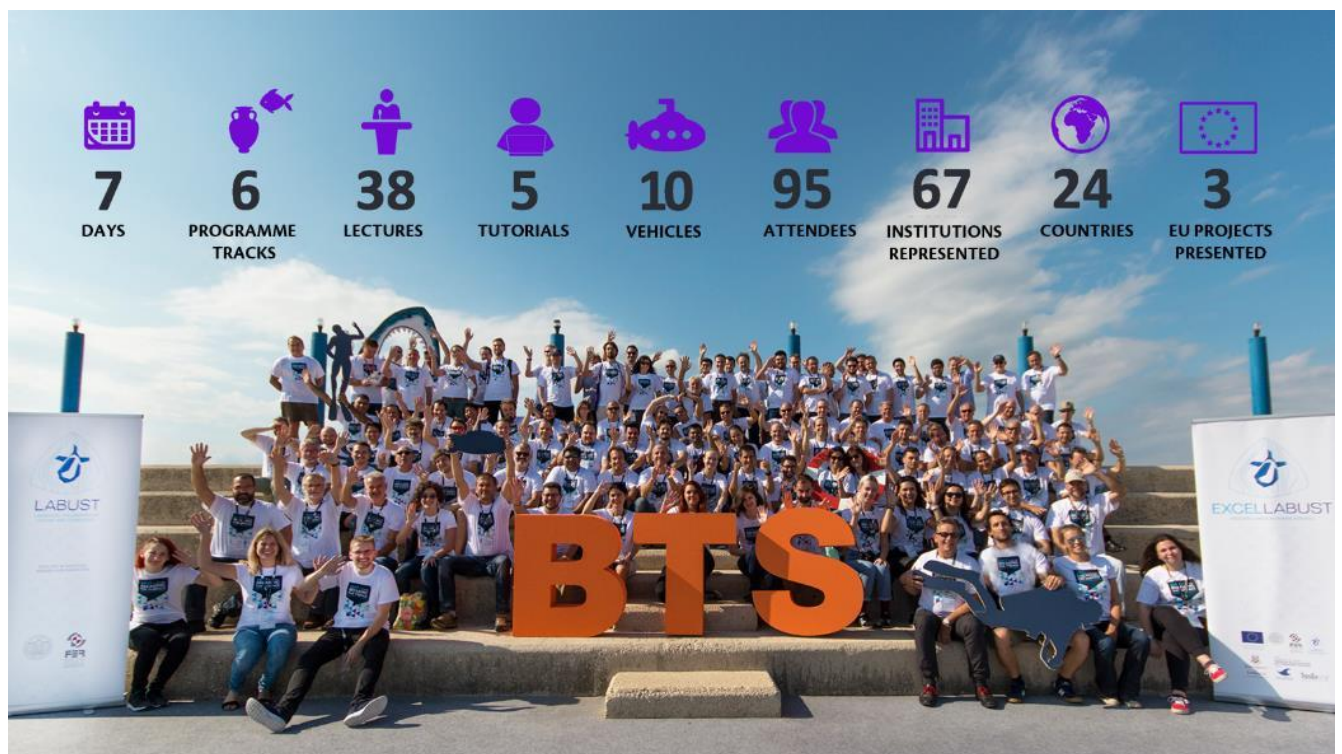
4. ORGANIZERS

Breaking the Surface summer school is organized under the European Union's Horizon 2020 project EXCELLABUST - Excelling LABUST in marine robotics (GA 691980). The main organizers are University of Zagreb Faculty of Electrical Engineering and Computing, Laboratory for Underwater Systems and Technologies and Centre for Underwater Systems and Technologies with organization support from 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 Inteligent Systems for Automation - ISSIA, National Research Council of Italy (CNR)

University of Girona (UdG)

University of Limerick (UL)

BREAKING THE SURFACE ORGANIZATION STRUCTURE:

4.1. COMMITTEES CHAIRS

Prof. Dr. Sc. Zoran Vukić
General Chair

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

Assoc. Prof. Dr. Sc. Nikola Mišković
Programme 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

mr. sc. Antonio Vasilijević,
Technical Committee Chair

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

4.2. PROGRAMME COMMITTEE

Marco Bibuli, PhD

Centre Nazionale delle Richerce - CNR Institute of intelligent systems for automation - ISSIA

Prof. Bridget Buxton, PhD

University of Rhode Island, Department of History

Massimo Caccia, MSc

Centre Nazionale delle Richerce - CNR Institute of intelligent systems for automation - ISSIA

Assoc. Prof. Marc Carreras, PhD

University of Girona Computer Vision and Robotics Research Institute - VICOROB

Damjan Miklić, PhD

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

Edin Omerdić, PhD

University of Limerick

Asst. Prof. Dr. Sc. Irena Radić-Rossi

University of Zadar, Department of Archaeology

Prof. Pere Ridao, PhD

University of Girona Computer Vision and Robotics Research Institute - VICOROB

Prof. Asgeir Sørensen, PhD

Norwegian University of Science and Technology Department of Marine Technology Centre for Autonomous Marine Operations and Systems

Prof. Daniel Toal, PhD

University of Limerick

4.3. ORGANIZING COMMITTEE

Tonko Bogovac

CUST

Marija Havaić

CUST

Barbara Klier

CUST

Ena Lucija Kovač

CUST

Petra Kovačević

CUST

Andrea Radmanić

CUST

Alan Vukić

CUST

Valentino Žinić

CUST

4.4. TECHNICAL COMMITTEE

Anja Babić, mag. ing.

UNIZG FER LABUST

Nadir Kapetanović, mag. ing.

UNIZG FER LABUST

Ivan Lončar, mag. ing.

UNIZG FER LABUST

Filip Mandić, mag. ing.

UNIZG FER LABUST

Milan Marković

UNIZG FER LABUST

Đula Nađ, dipl. ing.

UNIZG FER LABUST

M. Eng. Marin Stipanov

UNIZG FER LABUST

Kruno Zubčić

Croatian Conservation Institute

5. PROGRAMME

5.1. PROGRAMME STRUCTURE

BtS program is comprised of academic lectures, hands-on tutorials, presentation of projects and equipment and company demonstrations.

LECTURES · LECTURES · INNOVATION TUESDAY PROGRAMME

EQUIPMENT DEMONSTRATIONS · EU PROJECT PRESENTATIONS · ROUND TABLE ON INNOVATION

COFFEE BREAKS · PROJECT MEETINGS · SOCIAL GATHERINGS

COMPANY PRESENTATIONS · KARAOKE NIGHT · GALA DINNER & HAWAII PARTY

5.1.1. LECTURES

Lectures by experts in the domains of:

| marine robotics MAROB | marine biology MARBIO | maritime archaeology MARCH | maritime security MARSEC | marine geology MARGEO | Innovations and entrepreneurships INNOVA |

List of speakers:

Marine robotics (MAROB):

- **Marc Carreras**, Computer Vision and Robotics Institute of the Universitat de Girona (ViCOROB/UdG): *Towards persistent AUVs for seabed inspection*
- **Jeremi Gancet**, Space Applications Services: *DexROV: 2017 trials results and perspectives*
- **William Kirkwood**, Monterey Bay Aquarium Research Institute: *FOCE – Long Term In Situ Ocean Acidification Instrumentation*
- **Nikola Mišković**, University of Zagreb Faculty of Electrical Engineering and Computing: *Human-robot interaction under water*
- **Eduardo Silva**, INESC TEC / ISEP: *Localization and mapping in dynamic underwater environments*
- **Kimon P. Valavanis**, University of Denver: *Navigation and Control of Unmanned Vehicles: A Fuzzy Logic Perspective*

Marine biology (MARBIO):

- **Renee E. Bishop Pierce**, Pennsylvania State University: *Subterranean Groundwater Discharge and Marine Ecosystems*
- **Draško Holcer**, Croatian Natural History Museum / Blue World Institute of Marine Research and Conservation: *Cetaceans and sea turtles of the Adriatic – the next step*
- **Craig R. Smith**, University of Hawaii at Manoa: *Extreme seafloor ecology: use of ROVs and AUVs to evaluate biodiversity and ecosystem function in the world's most remote ecosystems*

Marine archaeology (MARCH):

- **Guillermo de Anda**, Instituto Nacional de Antropología e Historia / National Geographic Society / Proyecto Gran Acuifero Maya: *The Great Maya Aquifer*
- **Andreas Kallmeyer Bloch**, The Viking Ship Museum in Roskilde: *Technology, archaeology and student challenges Finding a best practice for presenting maritime archaeology*
- **A.Harun Özdaş**, Dokuz Eylul University Institute of Marine Science and Technology: *Shipwrecks discovered along the western coast of Turkey*
- **Irena Radić Rossi**, University of Zadar:
- **Augusto Salgado**, CINAV - Centro de Investigação Naval: *Contemporary Underwater Archaeology in Portugal. New challenges, new ideas*

- **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):

- **Richard J. Nagle**, Naval Sea Systems Command/PMS-408; Navy EOD Program Support Senior Program Analyst, G2 Software Systems, Inc.: *Relevance of UMS for Below the Surface (BTS) Tasks*
- **John Potter**, NATO STO Centre for Maritime Research and Experimentation (CMRE): *Ex Machina – Integrating maritime robots into human endeavours*

Maritime geology (MARGEO):

- **Slobodan Miko**, Croatian Geological Survey: *Late Quaternary and Holocene Submerged Landscapes of the Eastern Adriatic Sea*
- **Javier Escartin**, CNRS/IPGP*: Breaking the surface of the seafloor: Studying the traces of earthquakes underwater*

Innovation Tuesday (INNOVA):

- **Alex Alspach**, Toyota Research Institute: *Soft Sensing and Simulation*
- **Marin Bek**, UNIZG FER / H2O Robotics: *Breaking the corporate*
- **Fabio Bruno**, University of Calabria: *From research to business: some experiences at the University of Calabria*
- **Thomas Curtin**, Applied Physics Laboratory, University of Washington: The Scaling of Innovation Tools
- Cesare Fantuzzi, University of Modena and Reggio Emilia: *Bridging the gap between academic research and commercially viable technology*
- **Vladimir de Franceschi**, Founder Institute, Inc.: *Startup How To*
- **Gerardo Morales-Hierro**, Triple Helix Venture Capital: *Financing of Early Stage Technology Startups*
- **Vlatka Petrović**, University of Zagreb: *Paths to market – getting university innovation into the right hands*
- **Tom Runge**, German Research Center for Artificial Intelligence DFKI, Robotics Innovation Center: *Rich & Famous with Underwater Robotics? Attempt of an objective assessment*
- **Martina Schraudner**, Fraunhofer Center for Responsible Research and Innovation: *Uncovering the impact of the institutional environment on transfer activities*

5.1.2. TUTORIALS

- **H2020 EXCELLABUST project: Omnidirectional Vision for Underwater Robots** by Nuno Gracias, Ricard Campos, Computer Vision and Robotics Institute of the Universitat de Girona (ViCOROB/UdG)
- **H2020 EXCELLABUST project: Parallel Computing with CUDA made (almost) simple** by Matija Rossi, Univeristy of Limerick
- **H2020 EXCELLABUST project: POP ART (POrtable Pelagic Autonomous Robotic Technology) concept & field demonstration** by Massimo Caccia, Marco Bibuli, Gabriele Bruzzone, Angelo Odetti, Consiglio Nazionale delle Ricerche – Istituto di Studi sui Sistemi Intelligenti per l'Automazione

- **H2020 DexROV project: Teleoperation of a simulated ROV and arm** by Gianluca Antonelli, ISME / University of Cassino
- **Underwater Camera Calibration with the Pinax model** by Andreas Birk, Tomasz Łuczyński, Jacobs University Bremen, Robotics Group

5.1.3. DEMONSTRATIONS

- **H2020 DexROV project: Experiencing and mitigating latency in remote ROV operations** by Jeremi Gancet, Space Applications Services
- **H2020 DexROV project: Dexterous manipulation** by Alessio Turetta, Graal Tech
- **H2020 subCULTron project - first swarm tests** by Tamara Petrović, Barbara Arbanas, Anja Babić, Ivan Lončar, Milan Marković, Goran Vasiljević, University of Zagreb Faculty of Electrical Engineering and Computing

5.1.4. COMPANY PROGRAMME

- **BluEye Robotics** by Martin Ludvigsen, Sindre Hansen
- **Blueprint subsea** by Robin Sharphouse, Kevin Webster
- **EvoLogics** by Konstantin Kebkal, Oleksiy Kebkal
- **NORBIT** Subsea by Thomas Rygh

5.2. SCHEDULE

Time	MONDAY 02.10.	TUESDAY 03.10.	WEDNESDAY 04.10.	THURSDAY 05.10.	FRIDAY 06.10.
09:00 – 09:45	OPENING SESSION — Mislav Grgić, Zoran Vukić, Nikola Mišković	Startup How To — Vladimir de Franceschi	Localization and mapping in dynamic underwater environments — Eduardo Silva	FOCE – Long Term In Situ Ocean Acidification Instrumentation — William Kirkwood	Ex Machina – Integrating maritime robots into human endeavours — John Potter
09:45 – 10:30	Human-robot interaction under water — Nikola Mišković	The Scaling of Innovation Tools — Thomas Curtin	Technology, archaeology and student challenges: Finding a best practice for presenting maritime archaeology — Andreas Kallmeyer Bloch	Extreme seafloor ecology: use of ROVs and AUVs to evaluate biodiversity and ecosystem function in the world's most remote ecosystems — Craig R. Smith	Subterranean Groundwater Discharge and Marine Ecosystems — Renee E. Bishop Pierce
10:30 – 10:45	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK	COFFEE BREAK
10:45 – 11:30	Shipwrecks discovered along the western coast of Turkey — A.Harun Özdaş	Rich & Famous with Underwater Robotics? Attempt of an objective assessment — Tom Runge	Relevance of UMS for Below the Surface (BTS) Tasks — Richard J. Nagle	Late Quaternary and Holocene Submerged Landscapes of the Eastern Adriatic Sea — Slobodan Miko	Navigation and Control of Unmanned Vehicles: A Fuzzy Logic Perspective — Kimon P. Valavanis
11:30 – 12:15	DexROV: 2017 trials results and perspectives — Jeremi Gancet	Paths to market – getting university innovation into the right hands — Vlatka Petrović	Cetaceans and sea turtles of the Adriatic – the next step — Draško Holcer	Contemporary Underwater Archaeology in Portugal. New challenges, new ideas — Augusto Salgado	Breaking the surface of the seafloor: Studying the traces of earthquakes underwater — Javier Escartin
12:15 – 13:00	A Methodology for Accurate and Quick Photogrammetric Recording of Underwater Cultural Heritage — Kotaro Yamafune	Financing of Early Stage Technology Startups — Gerardo Morales-Hierro	The Great Maya Aquifer — Guillermo de Anda	Towards persistent AUVs for seabed inspection — Marc Carreras	COMPANY PRESENTATION — Evologics
13:00 – 14:30	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
14:30 – 15:00	COMPANY PRESENTATION — BluEye Robotics	Breaking the corporate — Marin Bek	T2 intro: Parallel Computing with CUDA made (almost) simple — University of Limerick	COMPANY PRESENTATION — Norbit	COMPANY PRESENTATION — Blueprint subsea
15:00 – 15:30	T1 intro: Omnidirectional Vision for Underwater Robots — University of Girona	Soft Sensing and Simulation — Alex Alspach	T3 intro: Underwater Camera Calibration with the Pinax model — JACOBS Bremen	T4 intro: Teleoperation of a simulated ROV and arm — ISME	T5 intro: POP ART (POrtable Pelagic Autonomous Robotic Technology) concept & field demonstration — CNR
15:30 – 16:00 / 16:00 – 16:30	DEMO subCULTron Group 1 / T1 hands-on Group 2 / DEMO Blueye Group 3	Bridging the gap between academic research and commercially viable technology — Cesare Fantuzzi / From research to business: some experiences at the University of Calabria — Fabio Bruno	T2 hands-on Group 1 / T3 hands-on Group 2 / DEMO DexROV 1 Group 3	T4 hands-on Group 1 / DEMO Norbit Group 2 / DEMO DexROV 2 Group 3	DEMO BluePrint Group 1 / T5 hands-on Group 2 / DEMO Evologics Group 3
16:30 – 16:45		COFFEE BREAK			
16:45 – 17:30	DEMO subCULTron Group 2 / T1 hands-on Group 3 / DEMO Blueye Group 1	Uncovering the impact of the institutional environment on transfer activities — Martina Schraudner	T2 hands-on Group 2 / T3 hands-on Group 3 / DEMO DexROV 1 Group 1	T4 hands-on Group 2 / DEMO Norbit Group 3 / DEMO DexROV 2 Group 1	DEMO BluePrint Group 2 / T5 hands-on Group 3 / DEMO Evologics Group 1
17:30 – 18:00 / 18:00 – 18:30	DEMO subCULTron Group 3 / T1 hands-on Group 1 / DEMO Blueye Group 2	ROUND TABLE — UWR Technologies: The Road Ahead - On Creativity, Innovation and Enterpreneurship — moderated by Kemal Dalić	T2 hands-on Group 3 / T3 hands-on Group 1 / DEMO DexROV 1 Group 2	T4 hands-on Group 3 / DEMO Norbit Group 1 / DEMO DexROV 2 Group 2	DEMO BluePrint Group 3 / T5 hands-on Group 1 / DEMO Evologics Group 2

SESSION COLORS: Lectures; Innovation tuesday; Social events; Company programme; Tutorial; Demonstration

LECTURE CATEGORIES: MAROB; MARBIO; MARCH; MARSEC; MARGEO; INNOVA; COMPANY PRESENTATION

LOCATIONS:
- LECTURES HALL @ HOTEL ADRIATIC (PURPLE) — Programme: ALL lectures and presentations
- DEMO POOL & OPEN WATERS NEARBY — Programme: equipment demonstrations
- TUTORIAL ROOM @ HOTEL ADRIATIC (PURPLE) — Programme: tutorials, mission plannings, data analyses
- LAVENDER BAR @ HOTEL ADRIATIC (PURPLE) — Programme: Welcome Drink
- BELVEDER BAR — Social events: BTS Karaoke, Excellabust Party

REGISTRATIONS
Sunday, 1.10.
16:30 – 18:00

WELCOME DRINKS
Sunday, 1.10.
18:00 – 19:30

NORWEGIAN PARTY
Monday, 2.10.
20:30 – 0:00

EXCELLABUST PARTY
Tuesday, 3.10.
21:00 – 0:00

KARAOKE NIGHT
Thursday, 5.10.
21:00 – 0:00

CLOSNING CEREMONY GALA DINNER
Friday, 6.10.
19:30 – 21:00

HAWAII POOL PARTY
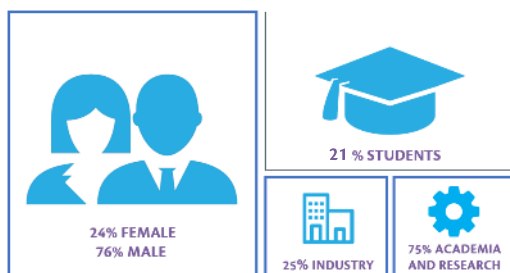Friday, 6.10.
21:00 – 0:00

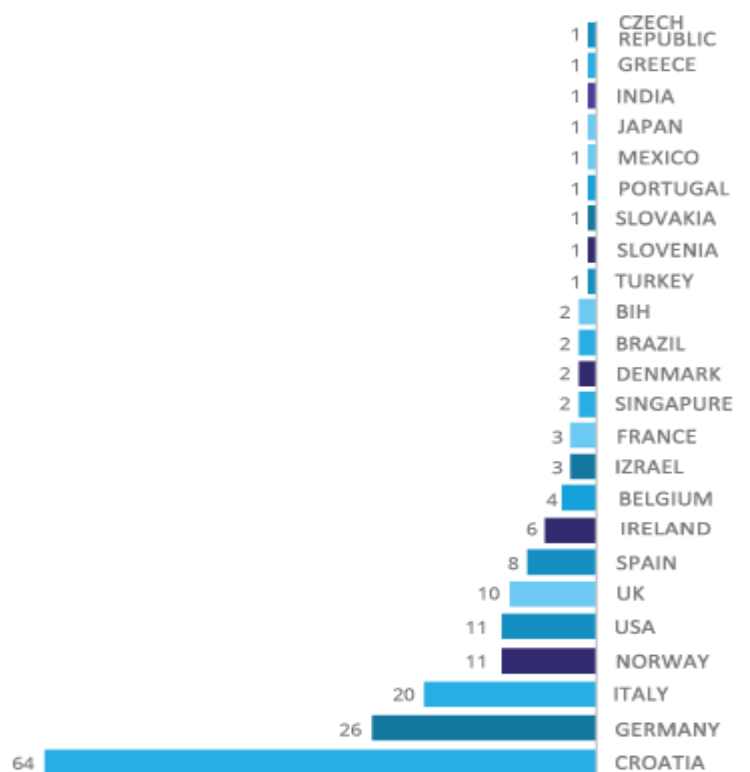## FIELD TRIP
Saturday, 7.10.
8:00 – 16:00

6. BTS PARTICIPANTS

In 2017, 192 participants from academia and industry from various fields joined Breaking the Surface.
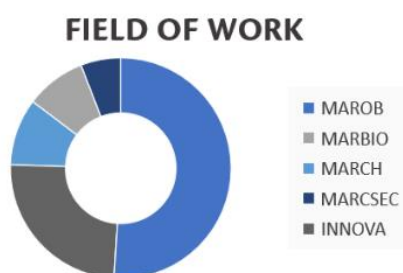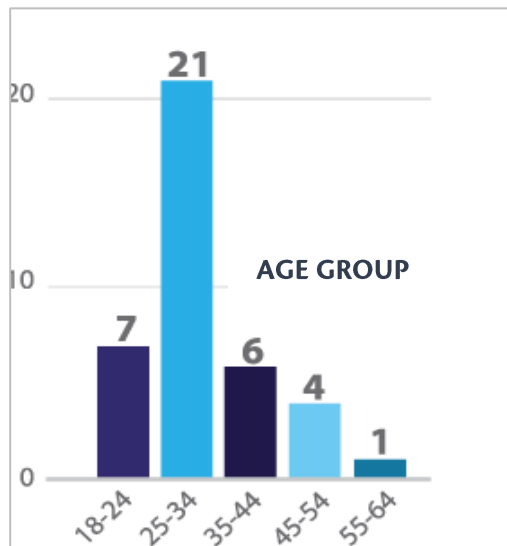

PARTICIPANTS PROFILE

24% FEMALE
76% MALE

21 % STUDENTS

25% INDUSTRY

75% ACADEMIA AND RESEARCH

24 COUNTRIES

Count	Country
1	CZECH REPUBLIC
1	GREECE
1	INDIA
1	JAPAN
1	MEXICO
1	PORTUGAL
1	SLOVAKIA
1	SLOVENIA
1	TURKEY
2	BIH
2	BRAZIL
2	DENMARK
2	SINGAPURE
3	FRANCE
3	IZRAEL
4	BELGIUM
6	IRELAND
8	SPAIN
10	UK
11	USA
11	NORWAY
20	ITALY
26	GERMANY
64	CROATIA

AGE GROUP

Values: 18-24: 7, 25-34: 21, 35-44: 6, 45-54: 4, 55-64: 1

FIELD OF WORK

- MAROB
- MARBIO
- MARCH
- MARCSEC
- INNOVA

192 PARTICIPANTS

COMPANY 9
STAFF 17
REGULAR 86
STUDENT 42
LECTURERS 38

4,88
OVERALL GRADE BY PARTICIPANTS

92%
WOULD COME BACK NEXT YEAR (REST MAYBE)

93%
PEOPLE HEARD ABOUT BTS THROUGH PERSONAL RECOMMENDATION

TESTIMONIALS

REASONS TO ATTEND:

- Knowledge and Collaborations
- Great opportunity to come in touch with many expertees in the field of marine sciences
- Because it is a great combination of lectures, workshops and demonstrations from maritime fields. And for me, big plus was innovation day!
- Because it provided a great opportunity to inform students and engineers about the technology needs for studying and monitoring the deep sea, i.e., the largest and most pristine ecosystems in the biosphere
- Because it's awesome!
- Friend told me it's the best conference ever
- BtS each year brings together the most important research groups and companies from the field of marine robotics existing in the world today. BtS gives me the opportunity to get to know them, listen to their work in person and all that in a friendly and relaxed atmosphere. Further, due to great facilities available, BtS allows for on-site testing and demonstrations of equipment.

7. PROGRAMME 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).*

8. SUPPORTERS

FINANCED BY

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 programme.

SUPPORTED BY

Embassy of the United States Zagreb – Croatia

Royal Norwegian Embassy in Zagreb

Foundation of the Croatian Academy of Sciences and Arts – HAZU

Kri\ževačka Pivovara

Rakije Perković

9. APPENDIX I – ABSTRACTS AND BIOGRAPHIES

Abstracts and biographies are available here.

10. APPENDIX II – PRESENTATIONS

Presentations are available here.