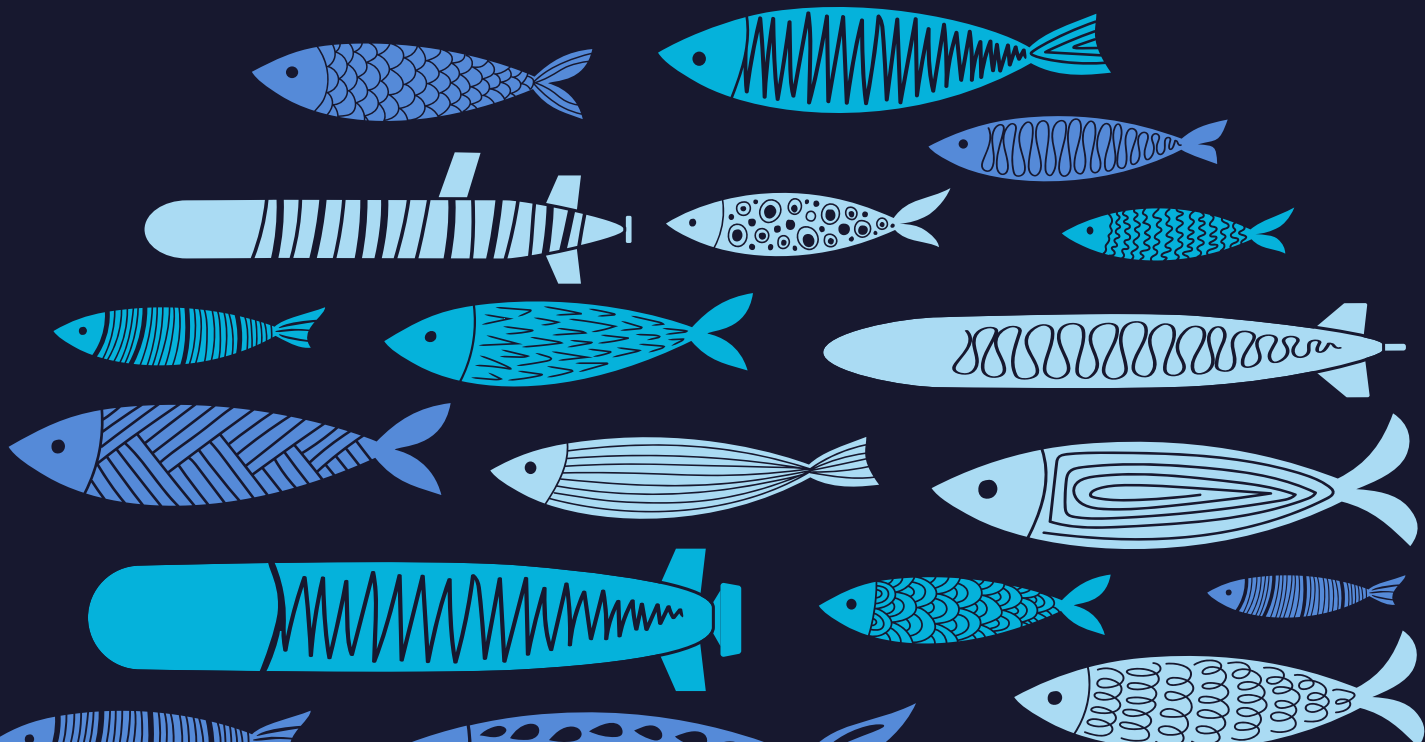
2024

29.09. – 6.10.
Biograd na Moru, Croatia

BREAKING THE SURFACE

16th INTERNATIONAL INTERDISCIPLINARY FIELD WORKSHOP OF MARITIME ROBOTICS AND APPLICATIONS



BTS MAP

1 **Hotel Adriatic**
Accomodation

2 **Lecture Room**

3 **Registration room**

4 **Coffee Break**

5 **Lavender Bar**
Social Events

6 **Demo site**

7 **Demo pool**

8 **Hotel Ilirija**
Conference restaurant and accommodation for participants

9 **Tutorial Room**

10 **Parking**

ORGANIZED BY

University of Zagreb

Faculty of Electrical Engineering and Computing

Laboratory for Underwater Systems and Technologies

Center for Underwater Systems and Technologies

University of Montenegro

Cyprus Marine and Maritime Institute

ABOUT BTS

The Breaking the Surface – BTS is an international interdisciplinary field workshop of maritime robotics and applications. Ever since 2009, it has served as a meeting place for international experts, university professors, scientists, industry representatives and students from various fields.

BTS 2023 IN NUMBERS

23
COUNTRIES

203
ATTENDEES

16
LECTURES

9
TUTORIALS

6
DEMOS

COMMITTEES

COMMITTEES CHAIRS

Prof. Zoran Vukić, PhD
Honorary General Chair

Prof. Nikola Mišković, PhD
General Chair

Ioannis Kyriakides, PhD
General Co-Chair

Prof. Roee Diamant, PhD
Programme Chair

Ana Golec
Organizing Committee Chair

Marina Loizidou
Organizing Committee Co-Chair

Nadir Kapetanović
Technical Committee Chair

Elena Valari
Technical Committee Co-Chair

PROGRAMME COMMITTEE

Ioannis Kyriakides; Bridget Buxton; Fausto Ferreira; Igor Radusinović; Massimo Caccia; Jeff Neasham; Nuno Cruz; Bill Kirkwood; Irena Radić Rossi

ORGANIZING COMMITTEE

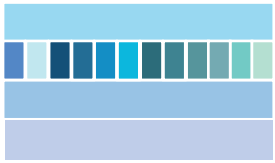
Ana Golec; Marina Loizidou; Petra Kovačević; Blanka Gott

TECHNICAL COMMITTEE

Nadir Kapetanović; Elena Valari; Đula Nađ, PhD; Igor Kvasić

LEGEND

SESSION COLOURS



Lectures

Tutorials

Demonstrations

Company programme

CATEGORIES

Marine Robotics (MAROB)

Maritime Archaeology (MARCH)

Marine Biology (MARBIO)

Marine Oceanography (MAROCEAN)

Tutorials

Company Presentation

Demonstrations

LOCATIONS

Lecture Room – Hotel Adriatic
All lectures and presentations

Demo pool and open waters nearby
Equipment demonstrations

Tutorial room – Hotel Ilirija
Tutorials

Lavender bar – Hotel Adriatic
Social events

	SUNDAY, 29.09.	MONDAY, 30.09.	TUESDAY, 1.10.
09:00 - 09:15		Opening session	The Effect of Anthropogenic Change and Protection on Fish Movement Patterns *Jonathan Belmaker*
09:15 - 09:30		Doing More With Less – Effective Use of Limited Acoustic Bandwidth *Mandar Chitre*	
09:30 - 09:45			
09:45 - 10:00			Technical Advances to Study Effects of Underwater Noise Exposure on Hearing and Behaviour of Marine Mammals *Maria Morell*
10:00 - 10:15		Expanding Ocean Observing Systems in Time, Space and the Parameter Dimensions for Societal Benefit *Daniel Hayes*	
10:15 - 10:30			
10:30 - 10:45			COFFEE BREAK
10:45 - 11:00		COFFEE BREAK	
11:00 - 11:15			Funding the Gap in Ocean Technology *Erika Montague*
11:15 - 11:30		Technology and the Underwater Archaeology of the Southern Levant *Gil Gambash*	
11:30 - 11:45			
11:45 - 12:00			Heterogeneous Multi-agent Systems for Monitoring and Preservation of Marine Environment *Ivana Palunko*
12:00 - 12:15		Enhancing Marine Turtle Conservation through Advanced Technologies: Current Innovations and Future Needs *Yaniv Levy*	
12:15 - 12:30			
12:30 - 12:45			LUNCH
12:45 - 13:45		LUNCH	
13:45 - 14:00			Tutorial 5 Intro: Identifying Wrecks of the Deep *Stephanie Blankshein, Felix Pedrotti*
14:00 - 14:15		Tutorial 1 Intro: Uncovering the Communication of Sperm Whales *Guy Gubnitsky*	
14:15 - 14:30			
14:30 - 14:45			Tutorial 7 Intro: The SeaClear Project: A Use-case for Robotic Marine Litter Collection and Recycling Aspects *Stefan Sosnowski, Shahab Heshmati-Alamdari, Iva Pozniak*
14:45 - 15:00		Company Presentation: dive-IT d.o.o. *Željko Pavlaković*	
15:00 - 15:15			BREAK
15:15 - 15:30		Underwater Localization Challenge Introduction	Underwater Localization Challenge: Tutorial 5 hands-on; Tutorial 7 hands-on
15:30 - 15:45			
15:45 - 16:00			
16:00 - 16:15		BREAK	
16:15 - 16:30		Tutorial 1 hands-on; Underwater Localization Challenge	
16:30 - 16:45	REGISTRATION		
16:45 - 17:30			
17:30 - 17:45			DEMOS
17:45 - 18:30		DEMOS	
18:30 - 18:45	WELCOME DRINK		
18:45 - 19:00			
19:30 - 20:30	DINNER	DINNER	DINNER
20:30 - 21:00		IEEE OES PARTY	INTERNATIONAL NIGHT
From 21:00			

WEDNESDAY, 2.10.	THURSDAY, 3.10.	FRIDAY, 4.10.	SATURDAY, 5.10.
Let's Shrink It: Hydrobatic Underwater Robots for Confined Spaces *Daniel Duecker*	**Introduction to MBZIRC Tutorials**	**Challenge Presentations**	FIELD TRIP
Scalable Marine Robotics for a New Era of Ocean Exploration *Giancarlo Troni*	**MBZIRC Tutorial 1: Autonomous Drones in GNSS-denied Operation for Search and Object Manipulation at Sea by UNIZG-FER** *Marko Car, Matko Orsag, Marijana Peti, Robert Milijaš, Jakob Domislović, Antun Ivanović, Barbara Arbanas Ferreira*	COFFEE BREAK	
COFFEE BREAK	**MBZIRC Tutorial 2: Operation of Heterogeneous UAV-USV System in a GNSS-denied Maritime Environment** *Shaoming He*	**Enhancing Cetacean Research through Whale-watching Tourism in the Mid-atlantic** *Laura González García*	
Simulation-based Smart Testing of Autonomous Systems for Digital Assurance *Stephanie Kemna*	COFFEE BREAK	**MONUSEN Centre: Achievements in Underwater Sensor Networks and Marine Robotics** *Slavica Tomović, Igor Radusinovic*	
Company Presentation *Xylem*	**MBZIRC Tutorial 1 hands-on** / **MBZIRC Tutorial 2 hands-on**	**Company Presentation** *Fameline Energy (HMS)*	
Company Presentation *Deep Trekker Inc.*		LUNCH	
LUNCH	LUNCH	**Tutorial 6 Intro: The Maritime Computer Vision Initiative (MaCVi): Use-Cases and Hands-On** *Janez Perš, Benjamin Kiefer*	
Tutorial 4 Intro: Underwater Photogrammetry Systems: Optical Design, Calibration and Metrical Performance *Fabio Menna*	**MBZIRC Tutorial 3: Autonomous Catamaran in GNSS-denied Operation for Search and Intervention at Sea by UNIZG-FER** *Juraj Obradović, Matko Batoš, Fausto Ferreira, Barbara Arbanas Ferreira, Natko Kraševac, Luka Mandić*	**Tutorial 3 Intro: Integration of Interdisciplinary Data for Landscape Mapping of Submerged Ancient Cities: the uBlueTec approach** *Jordy Moies, Jafar Anbar, Kalliopi Baika*	
Tutorial 2 Intro: Underwater Optical 3d Imaging *Tomislav Petković*	**MBZIRC Tutorial 4: GNSS-denied Over-water Navigation for UAVs and USV by Nomagic Warsaw Mimotaurs** *Karol Pieniący*	BREAK	
BREAK	BREAK	**Tutorial 6 hands-on** / **Tutorial 3 hands-on**	
Underwater Localization Challenge: **Tutorial 4 hands-on** / **Tutorial 2 hands-on**	**MBZIRC Tutorial 3 hands-on** / **MBZIRC Tutorial 4 hands-on**		
DEMOS	**DEMOS**	**DEMOS**	
DINNER	DINNER	CLOSING CEREMONY AND GALA DINNER	
	PUB QUIZ	BTS KARAOKE NIGHT	

SOCIAL EVENTS

29.9.
Sunday, 16:30 – 18:00
Hotel Adriatic
REGISTRATION

29.9.
Sunday, 18:00 – 19:30
Lavender Bar
WELCOME DRINKS

30.9.
Monday, from 20:30
Demo Pool
IEEE OES PARTY

1.10.
Tuesday, from 20:30
Lavender bar
INTERNATIONAL NIGHT

3.10.
Thursday, from 20:30
Lavender bar
PUB QUIZ

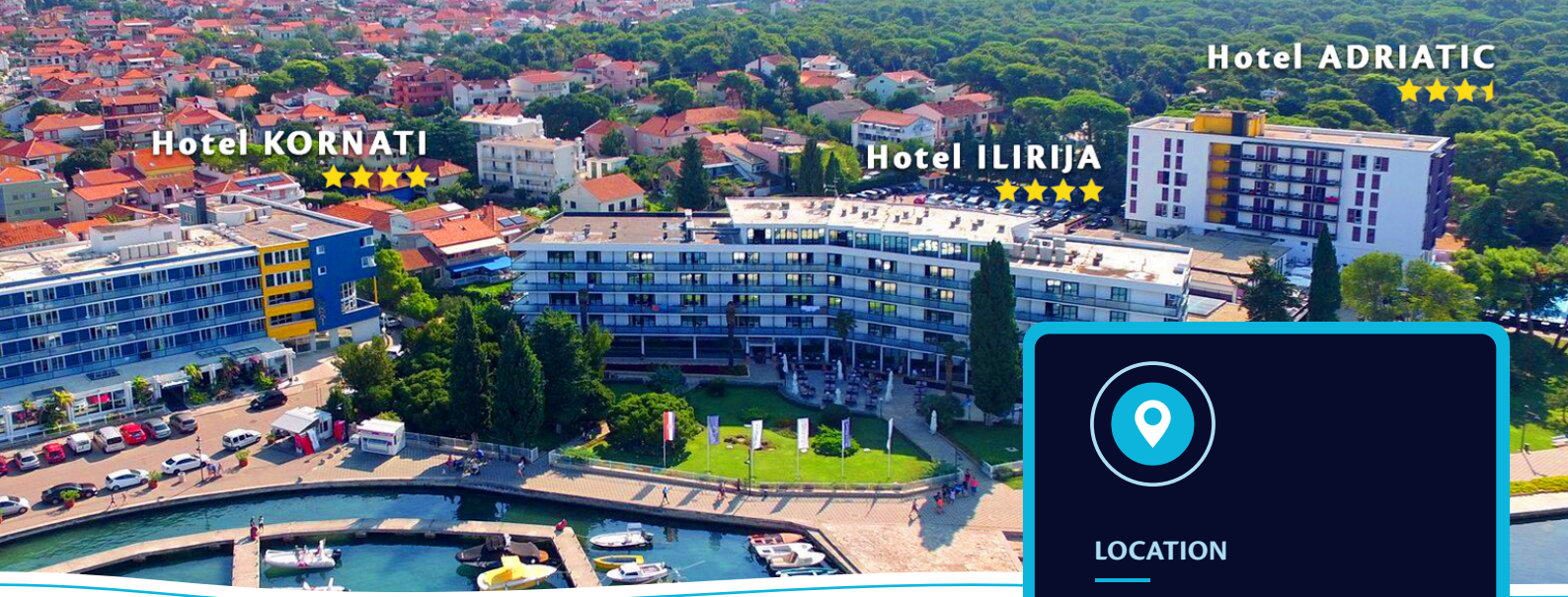
4.10.
Friday, 19:30 – 21:00
Hotel Adriatic
CLOSING CEREMONY AND GALA DINNER

4.10.
Friday, from 21:00
Lavender bar
BTS KARAOKE NIGHT

5.10.
Saturday, 09:00 – 16:00
FIELD TRIP

RESTAURANT HOURS

07:30 – 09:00 **BREAKFAST**
12:30 – 13:45 **LUNCH**
19:30 – 20:30 **DINNER**



LOCATION

Ilirija Resort
Tina Ujevića 7
23200 Biograd na Moru
Croatia

VENUE

BTS 2024 is taking place in Ilirija Resort hotels in Biograd na Moru, Croatia. The resort consists of three hotels that are within one minute of walk from each other.

REGISTRATION

The registration package includes :

- accreditation
- access to all technical programs (lectures, tutorials, demos, workshops)
- access to our social program: coffee breaks, social events, gala dinner on Friday evening, field trip on Saturday

A corporate registration includes:

- 2 accreditations
- access to all technical programs (lectures, tutorials, demos, workshops)
- access to our social program: coffee breaks, social events, gala dinner on Friday evening, field trip on Saturday
- a 30 min time-slot for the presentation of the product gamut
- logistical / infrastructural local support and organization collaboration for an expo / hands-on demonstration activity at the prescribed site

TYPE	EARLY BIRD BY 31ST JULY	REGULAR BY 15TH SEPTEMBER
Student	160 €	190 €
Standard	330 €	380 €
Corporate	2000 €	2500 €

Lectures

Doing More With Less – Effective Use Of Limited Acoustic Bandwidth

Mandar Chitre, ARL, National University of Singapore, Singapore

Communication and navigation on and above the surface of the ocean is mostly accomplished using electromagnetic waves. Once below the surface, electromagnetic waves do not get us very far, and often we have to either be disconnected and fully autonomous, use tethered systems to aid high-speed communication, or rely on acoustics for sensing, communication and navigation. Critical undersea operations require human-in-the-loop, and the cost and complexity of tethering sensors and robots can often be prohibitive. While sound propagates well underwater, acoustic systems are severely constrained by limited available acoustic bandwidth. While acoustic systems have become more performance and reliable as compared to what they used to be, physics sets a limit on how much data can be pushed through the acoustic channel.

In this talk, I discuss practical strategies to make the most of the available bandwidth. These span a wide range of techniques from effective coordination for access to the acoustic medium across multiple systems to state-of-art physics-guided machine learning techniques that can leverage priors for maximizing data rates and minimizing the amount of data that needs to be transferred to achieve missions. While tetherless underwater systems traditionally log sensor data locally for offline processing, I wish to show you that it is often possible to communicate key information (including sensor data, images, videos, etc) in real-time over an underwater acoustic wireless link if one uses the available bandwidth smartly.

30.9.2024
09:15 – 10:00
MAROB
Mandar Chitre

Mandar Chitre *is currently the Head of the Acoustic Research Laboratory (ARL) at the Tropical Marine Science Institute (TMSI) in Singapore. He is also an Associate Professor at the Department of Electrical & Computer Engineering (ECE) of the National University of Singapore (NUS). Mandar's research interests include underwater acoustic communications & networking, ocean acoustics, signal processing & machine learning, and collaborative underwater robotics. He was awarded the Distinguished Technical Achievement Award by the IEEE Oceanic Engineering Society in 2020 for his work on underwater communications & networking. He served as the Editor-in-Chief for the IEEE Journal of Oceanic Engineering from 2018 to 2023.*

Expanding Ocean Observing Systems In Time, Space And The Parameter Dimensions For Societal Benefit

Daniel Hayes, Cyprus Marine and Maritime Institute, Cyprus

Ocean Observing Systems (OOSes) consist of many types of technology for measuring ocean parameters, generally divided between the "sensor" and the "platform" that supports it with some combination of power, communications and physical mounting in addition to geographic and vertical positioning or transport. Traditional methods involve ships, moorings, and buoys. Autonomous systems such as surface drifters, profiling floats, underwater and surface vehicles, bottom landers, and coastal radars have drastically improved the ability of oceanographers to observe the ocean by increasing the coverage in space and time while reducing costs. New sensing devices have increased the number and quality of the observable parameters, while reducing power and computing requirements. In this talk, a review of the latest developments in autonomous observing will be presented, with a focus on societal applications. Particular examples will be presented, such as underwater gliders, which are known for measuring fundamental physical ocean parameters such as pressure, temperature, conductivity, dissolved oxygen, and a range of optical fluorescence and backscatter signals. The more recently integrated sensors like echosounders, vision profilers, dissolved gases, and passive acoustics have been demonstrated take advantage of the long endurance and accessibility to remote or difficult environments. Integration is costly and time consuming because of the need for non-recurring engineering and development arising from a lack of interoperability among platforms and sensors. In this talk, we will also address an open source approach we have developed to ease this process for ourselves, and for others. The concept is called "SIRMA" ™ (Smart Interoperable Real-time Marine Assembly).

30.9.2024
10:00 – 10:45
MAROCEAN
Daniel Hayes

Daniel Hayes *has participated or led several national projects on ocean observations and modelling and was the coordinator of a national infrastructure project to set up and operate the first ocean glider facility to study the seas of Cyprus. He has led work packages in EU glider projects GROOM, BRIDGES, and GROOM II. He specializes in the analysis of data collected byships, buoys and autonomous vehicles to investigate small and mesoscale physical exchange processes. He has been working on the development of the real time observing and forecasting system for Cyprus, including collection and analysis of data and development of numerical circulation models including the assimilation of in situ glider data. Under his direction, CSCS has become a dealer and service provider for underwater glidersand related services.*

Technology And The Underwater Archaeology Of The Southern Levant

Gil Gambash, University of Haifa, Israel

The recent decade has seen the rapid development of new technological solutions in the service of underwater archaeology, which scholars working on the coastline of the Southern Levant have been quick to adopt and develop, in an endeavour to take the research of local coastal societies in antiquity to the next level. This talk presents archaeological research projects currently underway along the Carmel coast of Israel, from Atlit, through Dor, to Caesarea, highlighting the new technologies employed and developed by them, and demonstrating their impact on historical research and our knowledge of past coastal societies in the ancient Southern Levant, from Prehistory to Late Antiquity.

30.9.2024
11:15 – 12:00
MARCH
Gil Gambash

Gil Gambash *is a professor of Mediterranean History and Archaeology. Focusing on the coastal Southern Levant in antiquity, he currently studies environmental and economic topics in the history and archaeology of harbour sites between Gaza and Akko. He is the former Chair of the Department of Maritime Civilizations and former Director of the Recanati Institute for Maritime Studies at the University of Haifa. He is the co-founder and former Director of the Haifa Center for Mediterranean History. In recent years, he was Leverhulme visiting professor at the School of Advanced Study in London, and fellow and group leader at the Israel Institute for Advanced Studies in Jerusalem.*

Enhancing Marine Turtle Conservation Through Advanced Technologies: Current Innovations And Future Needs

Yaniv Levy, Israel National Nature and Parks Authority/University of Haifa, Israel

30.9.2024
12:00 – 12:45
MARBIO
Yaniv Levy

Dr. Yaniv Levy *established the National Sea Turtle Rescue Center in Israel in 1999 and has managed it since. Under his leadership, the center has joined the global effort to save endangered sea turtles. He mentors and supervises staff in medical diagnostics, treatment, rehabilitation, emergency responses, and patient monitoring. Dr. Levy also recruits and trains staff and volunteers, conducts surgeries, and performs research. Live-stranded marine mammals are occasionally treated at the rescue center under his supervision. Since 2004, Dr. Levy has served as the Coordinator and Supervisor of the Marine Turtle Conservation Project in Israel under the Nature and Parks Authority. He oversees all conservation efforts to improve marine turtle populations in Israel, including coastal surveys, nest relocations to hatcheries, and data and sample collection from stranded turtles. He trains rangers and volunteers and has established the Turtle Rescue Center and a breeding group for green sea turtles. His work also involves scientific research and promoting public awareness through lectures, educational programs, and media.*

Dr. Levy is a member of the Marine Turtle Specialist Group (MTSG) under the IUCN, ensuring compliance with regulations on turtle husbandry and managing budgets. Recently, he secured governmental funding and donations to build a state-of-the-art sea turtle hospital and establish the world's first productive green sea turtle breeding group for conservation. His dedication has significantly contributed to the conservation and rehabilitation of marine turtles in Israel, and he believes in public education and "hands-on" involvement, with over 700 volunteers participating in various projects to protect and preserve marine turtles.

The Effect Of Anthropogenic Change And Protection On Fish Movement Patterns

Jonathan Belmaker, School of Zoology, Faculty of Life Sciences & The Steinhart Museum of Natural History, Tel Aviv University, Israel

The Eastern Mediterranean Sea suffers from multiple stressors, including an unprecedented increase in the number of non-indigenous species, one of the fastest rates of warming water temperatures, and fishing. I will present a summary of recent studies, mostly conducted using acoustic telemetry, aiming at understanding how these immense changes are impacting fish behavior, and discuss the role of marine protected areas in buffering these changes. We show here, using several different examples, how behavioral changes may impact MPA function and the interaction with surrounding fished areas. First, we examine whether fish home ranges differ between MPA and surrounding areas. Home range size will define the probability of remaining safe within that MPA or crossing its boundaries and being exposed to mortality. We find evidence that home range size is reduced close to MPA borders. Second, we find that while MPAs contain the same biomass of invasive species as fished areas, invasive impact is reduced inside MPA. We attribute this to behavioral changes associated with the presence of large predatory grouper within MPA which induce fear in the invasive prey which reduces feeding rates. Finally, we examine how fish behaviors change in response to warming waters and extreme weather events. The results will dictate the size and shape of MPAs needed to secure fish populations under changing climates. Taken together, the results have strong implications for understanding how anthropogenic change modifies fish behaviors and impacts MPA function.

01.10.2024
09:00 – 09:45
MARBIO
Jonathan Belmaker

Jonathan Belmaker *represents a research group based at Tel Aviv University, Israel. Earth's biodiversity is both remarkable and fragile. His research team seeks to understand the processes generating this diversity, and how human stressors, including invasive species, warming waters, and overfishing, impact the ecological processes underpinning it. They use a multi-directional approach that brings together experimental manipulations, large scale observations and computer modeling to examine these questions. In particular, they are using acoustic telemetry to follow movement patterns and examine how fish behaviors responds to change and protection.*

Technical Advances To Study Effects Of Underwater Noise Exposure On Hearing And Behaviour Of Marine Mammals

Maria Morell, Institute for Terrestrial and Aquatic Wildlife Research (ITAW),
University of Veterinary Medicine Hannover, Germany

There is an increasing concern on how anthropogenic underwater noise affects marine mammals. Marine mammals, and especially cetaceans (whales and dolphins) rely on sound for all the daily activities (finding prey, communication, navigation, etc). Changes in behaviour, masking of their acoustic signals or hearing impairment due to noise exposure might have severe consequences. Since marine mammals spend the majority of the time underwater, it is challenging to study the effects of noise on them. Acoustic tags are used in our team to measure behavioural responses to noise exposure. Auditory brainstem responses can be measured to living marine mammals exposed to noise to determine the effects of acoustic deterrent devices on hearing. In addition, post-mortem examinations of the ears can also reveal potential effects of noise exposure (as well as from other causes) on hearing. Technical advances on living and death animals allow us to quantify effects of noise exposure on marine mammals.

01.10.2024
09:45 – 10:30
MARBIO
Maria Morell

Dr. Maria Morell *is a research associate at the Institute for Terrestrial and Aquatic Wildlife Research (University of Veterinary Medicine Hannover, Germany). Her main research interests are framed in the fields of hearing and effects of anthropogenic noise on marine mammals. More specifically, her expertise focuses on inner ear ultrastructure with the objective to understand high-frequency hearing adaptations in toothed whales and to detect cases hearing loss in marine mammals. She started working on the auditory system of cetaceans (group formed by whales, dolphins and porpoises) during her Master and PhD at the Technical University of Catalonia (UPC-Barcelona tech, Spain). Then, she moved to the University of British Columbia (Canada) for a first post-doc and to the Institute for Neurosciences of Montpellier (INSERM, France) for a second post-doc, to further extend her knowledge on inner ear anatomy and pathology in cetaceans. Her research has implications in the fields of comparative anatomy, conservation of endangered species, as well as underwater noise management.*

Funding the Gap in Ocean Technology

Erika Montague, Schmidt Marine Technology Partners, USA

Schmidt Marine Technology Partners is a program of the Schmidt Family Foundation. We focus our work on 1) Funding the development of ocean technologies that solve complex ocean health issues, and in most cases strong commercialization potential, 2) Providing broader business support through a network of consultants and mentors, 3) Helping those working in the marine technology field get better connected to each other and with outside resources, and 4) Acting as a source of vetted information about emerging trendsand companies. We created this "venture philanthropy" model to fill an often fatal gap in support available for the development of ocean technologies, which typically require something beyond traditional grants in order to achieve full potential and availability. Our goal is to tailor our assistance to the needs of individual groups, and to provide long-term support for groups whose efforts show the most promise. Beyond funding we tailor our assistance to the needs of individual groups to help them move their ideas across the dreaded "Valley of Death" toward economic sustainability.

01.10.2024
11:00 – 11:45
MAROCEAN
Erika Montague

Erika Montague *is the chief technologist at Schmidt Marine. She is an oceanographer, explorer, and evangelist of technology for a healthier ocean, with a Ph.D. in oceanography from Johns Hopkins University. Her past research has involved work with submersibles and unmanned vehicles with a focus on the development of novel, non destructive methods for studying extreme and remote marine environments. Erika has led cruises to study bioluminescent life forms and test underwater technologies for use at the surface and down to the deepest parts of the ocean. She aims to bridge the gap between diverse stakeholders to create sustainable solutions that leverage the technology driven culture of today to empower the next generation.*

Heterogeneous Multi-Agent Systems For Monitoring And Preservation Of Marine Environment

Ivana Palunko, University of Dubrovnik, Laboratory for Intelligent Autonomous Systems (LARIAT), Croatia

Oceans are negatively affected by human activities that harm marine life, undermine coastal communities and impact human health, with marine pollution being one of the most significant issues facing oceans worldwide. Marine litter is a human-created waste, persistent, manufactured or processed solid material that has been discharged into the marine and coastal environment, brought indirectly to the sea with rivers, sewage, storm water or winds; or accidentally lost, including material lost at sea in bad weather. Today's oceans contain 26-66 million tons of waste, with approximately 94% located on the seafloor. So far, collection efforts have focused mostly on surface waste, with only a few local efforts to gather underwater waste, always using human divers. This problem could be addressed by building a stable and reliable system capable of tackling a highly disputed social, economic and environmental issue, namely ocean pollution. This talk will focus on how bringing together state-of-the-art technologies from the fields of machine learning, sensing, manipulation, aerial and marine technologies can be used for monitoring and preservation of marine environment.

01.10.2024
11:45 – 12:30
MAROB
Ivana Palunko

Ivana Palunko, PhD *is an associate professor at the Department of Electrical Engineering and Computing, University of Dubrovnik. She earned her Ph.D. in 2012 in Controls Systems from University of New Mexico, USA under supervision of prof. Rafael Fierro. From 2012 until 2014, she was a postdoctoral researcher in the Research Centre for Advanced Cooperative Systems (ACROSS) at the Department of Control and Computer Engineering, University of Zagreb, Faculty of Electrical Engineering and Computing (UNIZG-FER). In 2013/2014, she was a visiting researcher at Information-oriented Control, TU Muenchen, Germany under supervision of prof. Sandra Hirche. In 2014 she joined the University of Dubrovnik as an assistant professor. In 2019, she founded the Laboratory for Intelligent Autonomous Systems (LARIAT) at the University of Dubrovnik, and currently she is the head of LARIAT. She authored and co-authored more than 35 scientific peer-reviewed papers. Also, she coordinated and participated in more than 20 projects funded by EU FP7, H2020, HORIZON Europe, ESF, Interreg, US NSF, NATO SfP, EOARD, HRZZ, etc. Her main research interests are in optimal adaptive control, machine learning andartificial intelligence with applications in robotics and multi-agentsystems.*

Let's Shrink It: Hydrobatic Underwater Robots For Confined Spaces

Daniel Duecker, Technical University of Munich - Munich Institute of Robotics and Machine Intelligence (MIRMI), Germany

Confined aquatic environments range from rivers and marinas to constrained industry basins such as nuclear storage ponds. These scenarios pose challenging yet promising tasks to be performed by underwater robotic systems including manipulation and sampling as well as exploration and monitoring of spatial environmental fields, e.g. performed by robot teams. The cluttered and confined nature of these scenarios demands for a new class of underwater robotic platforms that is small-scale, low-cost, and possesses agile – hydrobatic – maneuvering capabilities, a list of features that calls for taking inspiration from an aerial sibling: drones.

Despite the recent progress, guidance, navigation, and control are widely unsolved for agile micro underwater robots. This talk aims to provide an overview of the recent progress and open challenges in this field. We will focus on three bottleneck topics within micro underwater robotic research: suitable low-cost robot designs, self-localization methods for confined underwater environments, and algorithms for field exploration.

02.10.2024
09:00 – 09:45
MAROB
Daniel Duecker

Daniel Duecker *is Senior Scientist and Groupleader of the"Environmental Robotics" Group at the Munich Institute of Robotics and Machine Intelligence (MIRMI) at TU Munich. He received his B.S. and M.S. degree in mechanical engineering and an MBA degree in technology management from TU Hamburg in 2012, 2015, and 2016, respectively. During his studies, he spent two semesters at the University of California, Berkeley, where besides course work, he conducted research at the Berkeley Center for Control and Identification. His PhD research (graduation in 2022) at TU Hamburg focused on micro underwater robots for environmental monitoring including methods for localization and control. His dissertation was awarded with the PhD-award by Erwin-und Gisela Sick Stiftung. Furthermore, he received the distinct teaching award by Deutsches Maritimes Zentrum (DMZ) in 2022.*

Scalable Marine Robotics For A New Era Of Ocean Exploration

Giancarlo Troni, Monterey Bay Aquarium Research Institute (MBARI), USA

The ocean is vital to all living beings but still needs to be explored, leaving many questions unanswered. Fortunately, underwater robotics has greatly improved ocean exploration by accurately mapping the seafloor in high resolution and tracking animals in midwater. However, these platforms are often too expensive to build and operate, limiting ocean exploration and discovery. To address this issue, we need to lower the barriers to entry, particularly for scientific research requiring high-resolution measurements on a large scale. In this talk, I will share some of the collaborative research work that our team, the CoMPAS lab at MBARI, has been involved in addressing precision navigation and machine perception. These are just a few examples of how marine robotics research can help close the ocean exploration gap.

02.10.2024
09:45 – 10:30
MAROB
Giancarlo Troni

Giancarlo Troni *is a Principal Engineer at the Monterey Bay Aquarium Research Institute (MBARI), with a focus on the control and estimation of underwater robotics systems. He has a Ph.D. from Johns Hopkins University and has previously served as a Postdoctoral Research Fellow at both the University of Michigan and MBARI, where he worked extensively on underwater robotics. Currently, Giancarlo is dedicated to developing better tools and methods for small, low-cost autonomous machines that can scale ocean exploration. Despite the fact that current technology has enabled us to reach even the deepest parts of the ocean, much of it remains unexplored. The challenge lies in creating cheaper, smaller, and power-efficient systems that can autonomously explore the ocean, thereby reducing the cost for scientists to acquire quality field data.*

Simulation-Based Smart Testing Of Autonomous Systems For Digital Assurance

Stephanie Kemna, DNV AS, Norway

The development and use of autonomous boats and ships is steadily progressing; autonomous boats are already commercially available, and there are many ongoing research projects on autonomous ferries and ships. While most of these systems do not yet operate fully autonomously, even decision support systems are changing the mode of operations compared to traditional shipping practices. To ensure that these (semi-)autonomous systems can safely be introduced to the real world, we need to assure the systems. Assurance refers to obtaining justified confidence that a product (or process) conforms to existing safety, environmental, societal, or regulatory requirements. For example, the IMO is actively developing the regulatory framework for Maritime Autonomous Surface Ships (MASS), for autonomous ships we want to ensure they adhere to the COLREG, and in addition, the European Commission recently introduced the EU AI act. To do assurance of autonomous and AI-enabled systems and applications, i.e. gather evidence for justified confidence in the systems, DNV is developing a digital assurance framework. Methods for gathering such evidence include simulation-based testing, evidence-based argumentation, risk-based approaches, real-world testing, etc. In this lecture, I will introduce concepts for simulation-based testing of autonomous systems, including co-simulation frameworks and smart testing methods, such as using Bayesian Optimization for design of experiments. In addition, I will show use cases from ongoing research projects for testing autonomous navigation systems of ships and ferries.

02.10.2024
11:00 – 11:45
MAROB
Stephanie Kemna

Stephanie Kemna *is a Principal Researcher/Engineer at DNV in the Simulation Technologies team, as part of Group Research & Development. She obtained a BSc and MSc in Artificial Intelligence from the University of Groningen (2008, Netherlands), participated in the HiTecMasterclass (2008, TNO/Navy, Netherlands) and subsequently worked at the NATO STO Centre for Maritime Research and Experimentation on software development and mission planning for autonomous underwater vehicles (AUVs) (2009-2012, Italy). She then pursued obtained a PhD in Computer Science from the University of Southern California (USA, 2018), focusing on adaptive informative sampling using AUVs, and multi-robot strategies therefore. During her PhD, she also did internships with ATLAS Elektronik (Germany), the Army research lab (USA), and Amazon Robotics (USA). From 2018-2023, she worked first as a software developer, later as project manager and research manager at Maritime Robotics in Trondheim, a company that develops autonomous surface vehicles (ASVs). She has over 14 years of experience developing adaptive behaviors, autonomy and mission planning for aquatic robots, including AUVs and ASVs. Since 2023, she works at DNV as an AI researcher within the digital assurance program on topics related to smart testing of simulation models / digital twins, and on projects related to testing autonomous navigation systems for autonomous vessels.*

Enhancing Cetacean Research Through Whale-Watching Tourism In The Mid-Atlantic

Laura González García, Futurismo Azores Adventures / Institute of Marine Sciences -OKEANOS, Portugal

Long-term data series have become increasingly relevant to address global changes largely triggered by anthropogenic activities. In cetacean research, continuous advances in technology have allowed to increase and improve data collection (e.g. drones, PAM systems fixed, drifting or based on AUV, eDNA); and the growing availability of opportunistic data sources has provided data otherwise likely unavailable (e.g.whale-watching, shipping, fisheries, cruising).

In the Azores, a hotspot for cetaceans in the mid-Atlantic, long-term initiatives for cetacean monitoring have created a successful network of collaborative efforts between whale-watching (WW) and science. Since 2008, more than 30000 sightings of cetaceans have been recorded, mostly managed by the MONICET project (University of the Azores) and Futurismo Azores Adventures (local WW company). Photos for individual identification have already yielded at least 11 active photo-identification catalogues with little to no technological aid.

In the last few years, hydrophones have been used in the daily operation to assist in sperm whale search. At Futurismo, acoustic data collection has been combined with tourism providing numerous sampling opportunities to record frequently sighted species, but also cryptic or rare ones, or even extraordinary behaviours (e.g. sperm whale trumpets in the Azores, hunting behaviour of orcas, or foraging false killer whales). We have recently started to characterize the sounds of WW boats to describe the current WW scenario, and create a set of guidelines to foster good WW practices among the operators. Taking advantage of the strong commitment and acceptance of the industry is now the right moment to improve current practices, foster synergies with science and ensure a more responsible future.

Laura González García *is a marine biologist and oceanographer from Galicia (Spain). She holds a PhD in Marine Science, Technology and Management from the University of Vigo finished in 2019. With expertise in habitat modelling and physical oceanography, her research focuses on cetacean ecology and distribution in the Atlantic and mainly in the Azores, where she lives since 2010. Her work highlights the importance of long-term data series for the study of cetaceans, and how tourism contribute this way to science. With extensive hands-on experience in the field with cetaceans, she has been working at the University of the Azores as a post-doctoral researcher since 2020, and is now leading the research efforts at Futurismo Azores Adventures, one of the main whale-watching companies in the Azores. She has participated in projects such as MONICET (regarding cetacean data*

04.10.2024
10:45 – 11:30
MARBIO
Laura González García

linked to whale watching),LIFE-IP AZORES NATURA (citizen science and maritime tourism in the Azores), MARCET II (enhancing sustainable blue ecotourism in Macaronesia), or the K2D- Knowledge and Datafrom the Deep to the Space (smart subsea cables for ocean monitoring). She has supervised dozens of bachelor and master students in their internships and dissertations, has organized multiple scientific events, and maintains collaboration with cetacean researchers all over the Atlantic.

Monusen Centre: Achievements In Underwater Sensor Networks And Marine Robotics

Slavica Tomović, Igor Radusinovic, University of Montenegro, Faculty of Electrical Engineering, Montenegro

This lecture presents the results from the first two years of the Horizon Europe Twinning project MONUSEN (Montenegrin Centre for Underwater Sensor Networks). The project involves collaborative research by the University of Montenegro, the National Research Council of Italy, the University of Zagreb Faculty of Electrical Engineering and Computing, and Newcastle University. The joint efforts are directed towards developing efficient and secure underwater sensor networks (USNs) suitable for both fixed and dynamic topologies. Key advancements include the design and implementation of (i) communication protocols for event-driven underwater sensor networks, (ii) lightweight authentication schemes and data confidentiality protection solutions, and (iii) cooperative control protocols for multi-vehicle USNs. These innovations aim to significantly improve the reliability, security, and efficiency of underwater sensing and robotic systems, fostering advancements in marine research, environment monitoring and protection.

Slavica Tomović *received her Master's degree inT elecommunications in 2015, and her PhD in 2019, all from the Faculty of Electrical Engineering, University of Montenegro. Her research focuses on network quality of service management, underwater acoustic communications, network optimization, and software-defined networking. She has published 50 scientific papers and received the Best Young Scientist Award from the Ministry of Science of Montenegro in 2019. She is a member oft he IEEE Association and a reviewer for several renowned SCI/SCIE journals. Currently, she is an Assistant Professor at the Faculty of Electrical Engineering, University of Montenegro.*

Igor Radusinovic *received his BSc from the University of Montenegro in 1994 and his MSc and PhD in telecommunication networks from the University of Belgrade in 1997 and 2003, respectively. Since 1994, he has been at the Faculty of Electrical Engineering, University of Montenegro, advancing from teaching assistant to Full Professor in 2013. He has held various leadership roles, including Head of the*

04.10.2024
11:30 – 12:00
MAROB
Slavica Tomović
Igor Radusinovic

Department of Communications and member of the University's Management Board and Senate. Radusinovic has published over 150 papers in peer-reviewed journals and conferences, is a reviewer for international journals, and a member of several professional associations and conference committees. He has managed or participated in over twenty projects and is the coordinator of the Montenegrin Centre for Underwater Sensor Networks. His research interests include Software Defined Networking, Acoustic Communications, Network Function Virtualization, IoT, AI, and Blockchain.

Tutorials

Uncovering The Communication Of Sperm Whales

Guy Gubnitsky, University of Haifa, Israel

Recent advances in the field of neural networks enable translation between languages even in cases where no dictionary is available, such as ancient languages. The backbone of this capability is access to vast amounts of training data. Given this breakthrough, there has been a great deal of interest in recent years in the application of unsupervised machine translation (UMT) methods to decipher the communication of potentially intelligent animals, with most efforts focused on sperm whales, which have a unique communication system. However, to cope with the amount of data required for UMT, an automated tool to detect and annotate these signals is a prerequisite. In this talk, we will present a detector-based annotator for sperm whale communication signals. We will describe the main ideas and the theoretical formulation. Participants will then apply the annotation software to a sample recording of a short conversation between two whales. Finally, participants will be divided into groups and given time to try to match the annotated signals to their corresponding speaker based on the features extracted by the software. Teams that successfully complete this task will be able to uncover the "language-like" structure of sperm whales.

Guy Gubnitsky *received his bachelor's degree in electrical engineering from Ariel University in 2018, specializing in electro-optics and medical imaging. In October 2019, he completed his master's degree at the Department of Marine Technologies at the university of Haifa, specializing in underwater signal and image processing. Guy is currently working on his PhD thesis, which deals with acoustic detection, classification and separation of sperm whale signals.*

30.9.2024
14:00 – 14:45
Tutorial
Lecture Room
Guy Gubnitsky

Identifying Wrecks Of The Deep

Stephanie Blankshein, Felix Pedrotti, University of Southampton, UK

The Black Sea Maritime Archaeological Project (BSMAP) was an ambitious exploration of sea level rise in the Black Sea by the University of Southampton's Centre for Maritime Archaeology. Offshore explorations brought together an interdisciplinary team specialised in the use of advanced seafloor mapping equipment and the generation and analysis of high-resolution digital models. During their investigations, geophysical data was collected over a large area along the Bulgarian coast, characterised on the fly and investigated by ROVs. This led to the discovery of 65 previously unknown shipwrecks from various historical periods. According to UNESCO, there are an estimated 3 million shipwrecks on the ocean floor, each offering a unique glimpse into past lives and societies. Digital replicas of these shipwrecks made by BSMAP team members bring to the surface but a small glimpse of the vast and exciting record of underwater cultural heritage that awaits to be discovered.

This tutorial will delve into the archaeological investigations of the BSMAP team. From the characterisation and interpretation of side scan sonar and bathymetric data, to the identification and investigation of seafloor features with an ROV, participants will have the opportunity to explore digital and hands-on data that showcase the use of state-of-the-art robotics in maritime archaeology. The features found within these datasets will be presented through an exploration of their digital twins, and participants will have the opportunity to explore thesediscoveries further through a virtual experience.

01.10.2024
13:45 – 14:30
Tutorial
Stephanie Blankshein
Felix Pedrotti

Dr Stephanie Blankshein *is a prehistoric maritime archaeologist specialising in the application of digital approaches to archaeological and environmental questions. Areas of expertise include geographic information systems, remote sensing, computational modelling and scientific diving. Stephanie is currently a Research Fellow in Archaeology at the University of Southampton. Her post-doctoral research investigates Neolithic crannogs, or artificial islands, in Scotland. She has also led projects on the application of water penetrating radar to freshwater archaeological sites and the creation of accessible digital heritage experiences. Throughout her education and early career she has been fortunate enough to work on terrestrial and underwater survey and excavation projects across Europe,including the Black Sea Maritime Archaeology Project.*

Dr Felix Pedrotti *is a maritime archaeologist and Research Fellow at the Southampton Marine and Maritime Institute (SMMI). His research involves developing methodologies for creating, evaluating, and visualizing digital assets. He has experience in both terrestrial and underwater digital twins and scientific diving operations. Dr. Pedrotti contributed to the Black Sea Maritime Archaeology Project (BSMAP) and the Islands of Stone Project, where he helped design and implement techniques for*

integrated surveys of deep-sea, shallow water, and terrestrial environments using remote sensing and geophysical datasets. He also has a solid understanding of GIS and riverine processes, enabling him to integrate deposit models and geophysical data into broader archaeological contexts.

The Seaclear Project: A Use-Case For Robotic Marine Litter Collection And Recycling Aspects

Stefan Sosnowski, Technical University of Munich (TUM), Germany
Shahab Heshmati-Alamdari Aalborg University, Denmark
Iva Pozniak, University of Dubrovnik, Croatia

Today's oceans contain tens of millions tons of waste, with approximately 94% located on the seafloor. Existing collection efforts have focused mostly on surface waste, with only a few local efforts to gather underwater waste, always using human divers. This tutorial aims at sharing the latest advancements in the SeaClear project, highlighting key challenges, current developments and first results from trials of the SeaClear system for collecting litter from the seabed under varying environmental conditions and the lifecycle of collected materials. In the first part of the tutorial, we will cover control aspects of marine robotics in disturbance-prone underwater environments for collecting small-scale objects from the seafloor, presenting on a technical and methodological level that could be transferable to other projects. In the second part, we will discuss the phase after collection, involving the up-/re-cycling of marine litter.

Stefan Sosnowski *is a lecturer at the Technical University of Munich (TUM), Germany, with the Chair of Information-oriented Control and group leader of the underwater robotics group. He received the Dipl.-Ing. degree and Dr.-Ing. degree (PhD) in electrical engineering from TUM in 2007 and 2014, respectively. He has (co)authored more than 50 journal papers, refereed conference papers, and book chapters on bioinspired and underwater robotics, nonlinear control, distributed dynamical systems, and multi-agent systems.*

Shahab Heshmati-Alamdari *is an Associate Professor at the Section of Automation & Control, Aalborg University, Denmark, since 2023 and has been an Assistant Professor since 2021. He received a Diploma in Mechanical Engineering, an M.Sc. in Robotics and Automatic Control, and a PhD in Mechanical Engineering from the National Technical University of Athens (NTUA), Greece, in 2009, 2012,*

and 2018, respectively. He has held postdoctoral positions at KTH Royal Institute of Technology, Sweden, and TUM, Germany. He is interested in safe navigation and AI-based control of autonomous vehicles, task planning, and distributed control of multi-robot systems.

***Iva Pozniak** is a PhD student at the Laboratory for Intelligent Autonomous Systems (LARIAT), University of Dubrovnik. She earned an M.Sc. in Mariculture from the University of Dubrovnik in 2010. In 2019, she began postgraduate studies in Applied Marine Science at the Universities of Split and Dubrovnik. With over a decade of experience as a senior associate at the Regional Agency DUNEA, Iva has extensive expertise in managing (inter)national projects. Her work focuses on environmental conservation, Integrated Coastal Zone Management, biodiversity, waste- and marine environment management.*

01.10.2024
14:30 – 15:15
Tutorial
Stefan Sosnowski
Shahab Heshmati-Alamdari
Iva Pozniak

Underwater Photogrammetry Systems: Optical Design, Calibration And Metrical Performances

Fabio Menna, Università Degli Studi Di Sassari, Italy

Underwater photogrammetry has become a key technique for studying and understanding the underwater world in many application fields, such as exploration and mapping, industry and metrology, archeology, biology, etc. Nevertheless, producing accurate three-dimensional measurements underwater is still a challenge if compared to photogrammetric applications on land. The availability of highly customizable and non-standardized underwater photography equipment (e.g. different pressure housings designs, size and materials, dome and flat ports, corrective elements such as the Ivanoff-Rebikoff) poses additional complexity to the process of image formation underwater with subsequent adverse effect to the accuracy of photogrammetric measurements. The tutorial aims at providing the audience with an introduction to the crucial aspects of underwater photogrammetry as 3D surveying technique and independent methods for the assessment of its accuracy potential. The participants will go through the optical fundamentals of underwater imaging, camera calibration approaches, like implicit vs explicit modeling of refraction and their influence on the accuracy of the derived 3D photogrammetric products. During the hands-on session the participants will experience with real as well as simulated underwater datasets (for example through the ISPRS POSER simulator) from archaeology, ecology and subsea metrology applications to critically understand the limits and the benefits of current state-of-the-art photogrammetric processing techniques. Covered topics will include optical design and system setup for single as well as multiple camera configurations, camera network requirements for the determinability of calibration parameters, and accuracy assessment.

02.10.2024
14:00 – 14:45
Tutorial
Fabio Menna

Dr. Fabio Menna *is a researcher at the Department of SCIENZE CHIMICHE, FISICHE, MATEMATICHE E NATURALI – Università Degli Studi Di Sassari – Italy. His main interests are in photogrammetry, range sensors, geodetic surveying, 3D modelling, metrology. He is a scientific diver with more than 15 years' experience in the domain of underwater photogrammetry, in particular for engineering and industrial applications (Costa Concordia photogrammetric survey, research and development for the COMEX ORUS3D subsea photogrammetry systems, FBK 3DOM metrology lab). He is Cochair of the ISPRS WG II/7: Underwater Data Acquisition and Processing. He has organized a number of scientific events related to underwater photogrammetry and edited special issues on photogrammetry and underwater 3D recording and modelling. He has tutored more than 15 international summer schools and tutorials. He is the PI of the ISPRS ECBI 2024 POSER – an oPen sOurce Simulation platform for tEaching and tRaining underwater photogrammetry.*

Underwater Optical 3D Imaging

Tomislav Petković, UNIZG FER, Croatia

A pinhole camera model forms a basis of in-the-air imaging and is characterized by a single focal point. In underwater imaging camera is enclosed and observes the underwater environment through an optical interface which refracts and reflects light. Unless specifically designed, the interface causes focal spread making the simple pinhole model inapplicable. The tutorial will give an overview of geometrical image formation models which are used in underwater imaging. Then, three common tasks of camera calibration, image acquisition, and 3D reconstruction will be introduced and discussed. Next, a concept of structured light 3D imaging will be introduced. In structured light a projector, which is modeled as an inverse camera, illuminates the scene using predefined patterns with the intent to simplify 3D reconstruction. Projected patterns are always slightly blurred and can also be affected by backscatter and inter-reflections. Two common approaches which mitigate these problems, sinusoidal phase-shifted fringe patterns and Fourier profilometry will be briefly introduced and discussed.

02.10.2024
14:45 – 15:30
Tutorial
Tomislav Petković

Tomislav Petković *is Associate Professor at the University of Zagreb Faculty of Electrical Engineering and Computing. He received the engineer's degree, the magister degree, and Ph.D.in electrical engineering all from the University of Zagreb, in 2002, 2006 and 2010 respectively. His main fields of research interest are digital image processing and analysis, 3D imaging,and computational imaging, and in underwater applications of 3D imaging. He teaches several graduate courses in the field of digital signal and image processing. He is a member of IEEE and ACM.*

Autonomous Drones In GNSS-Denied Operation For Search And Object Manipulation At Sea By Unizg-Fer

Marko Car, Matko Orsag, Marijana Peti, Robert Milijaš, Jakob Domislović, Antun Ivanović, Barbara Arbanas Ferreira, UNIZG FER, Croatia

In this tutorial, we will present advanced solutions from the MBZIRC 2023 competition, focusing on unmanned aerial vehicles (UAVs) for search and object manipulation at sea. Participants will gain insight into GNSS-denied navigation of UAVs, particularly in maritime areas where traditional methods, such as visual SLAM, are insufficient. The tutorial will cover enabling algorithms, providing a comprehensive understanding of their functionality. Additionally, there will be a live demonstration of UAVs picking up small objects using LIDAR positioning feedback for navigation. By the end of this tutorial, participants will be familiarized with advanced technologies for GNSS-denied navigation of UAVs, as well as the state-of-the-art approaches to object aerial manipulation in maritime environments.

Marko Car *was born in Čakovec on 1st February 1992. He obtained his PhD degree from the University of Zagreb Faculty of Electrical Engineering and Computing (UNIZG-FER) in 2023, with the thesis titled "Control system for an unmanned aerial manipulator interacting with the environment based on a generalized model". During his undergraduate studies, he received a Rector's award for his work entitled "Augmented human machine interface for aerial manipulators". He is currently a postdoctoral researcher at FER. His research interests are in the field of robotics, unmanned aerial vehicles, aerial manipulation, and compliant control. As a Ph.D. student, he participated in several national and EU-funded projects. He has published over 20 peer-reviewed papers in conferences and journals.*

Matko Orsag *is an associate professor at the University of Zagreb Faculty of Electrical Engineering and Computing (UNIZG-FER). He has been involved as a researcher in various projects financed by the government and industry. In 2011/2012, he worked as a visiting researcher at the Drexel University, Philadelphia, USA as a recipient of the Fulbright exchange grant.*

As a researcher, he participated in national and international research projects in the field of robotics, control, and automation. Currently, he is working as the principal investigator of the Croatian Scientific Foundation project Specularia – Structured Ecological CULtivation with Autonomous Robots In Agriculture. He co-authored over 60 scientific and professional journal and conference papers, a book chapter, and a monography in the area of aerial robotics.

He serves as a reviewer in journals and conferences, and as an editor and guest editor of several journals

(Automatika, JINT, etc.). He is a member of IEEE, currently serving as IEEE Robotics and Automation Society Chapter Chair of IEEE Croatia Section, and a member of the Aerial Robotics Topic Group. He is a member of Scientific and Professional Council of Innovation Centre Nikola Tesla (ICENT). In 2019 he received a Croatian Academy of Engineering young scientist award „Vera Johanides".

Marijana Peti, *mag. ing. was born in Zagreb, Croatia in 1996. She graduated with a master's degree from the University of Zagreb, Faculty of Electrical Engineering and Computing in the year 2020 and joined LARICS the same year, where she is currently working. During her education, she received three "Josip Lončar" Awards and the City of Zagreb scholarships due to her academic success. Her research interests include multi-agent systems and unmanned aerial vehicles.*

Robert Milijaš *is a Ph.D. student and young researcher in the Laboratory for Robotics and Intelligent Control Systems (LARICS) at the Department of Control and Computer Engineering, University of Zagreb Faculty of Electrical Engineering and Computing (UNIZG-FER). During his graduate studies he became one of the first recipients of the Laboratory for Robotics and Intelligent Control Systems (LARICS) scholarship. He joined the group shortly after receiving his master's degree from UNIZG-FER in 2019. His research interests include SLAM, unmanned aerial vehicles and perception. As a PhD student he participated in MBZIRC2020 (Mohamed Bin Zayed International Robotics Challenge) and he's currently working on the EC H2020 ENCORE and EKOKOMVOZ projects.*

Jakob Domislović *is a researcher and PhD candidate at the Laboratory of Robotics and Intelligent Control Systems (LARICS) within the Faculty of Electrical Engineering and Computing (FER) at the University of Zagreb. He specializes in UAVs, GNSS-denied navigation, and aerial manipulation. Jakob has contributed to high-profile competitions like MBZIRC, showcasing innovative solutions for search and object manipulation in maritime environments. He holds a strong background in algorithms and system integration, ensuring robust and efficient performance of autonomous vehicles in challenging conditions.*

Antun Ivanović *is a postdoctoral researcher at the Laboratory for Robotics and Intelligent Control Systems within the University of Zagreb Faculty of Electrical Engineering and Computing (UNIZG-FER). He obtained his PhD degree in 2023 at UNIZG-FER with a thesis titled „Model based motion planning for manipulation with heterogeneous robotic systems under constraints". During his undergraduate studies, he received a Rector's award for the work entitled "Augmented human machine interface for aerial manipulators". His research interests are robotics, unmanned aerial vehicles, aerial manipulation*

and motion planning. As a Ph.D. student, he participated in a EuRoC (European Robotics Challenge), MBZIRC2020 (Mohamed Bin Zayed International Robotics Challenge) and MORUS projects (Unmanned system for maritime security and environmental). He is currently working on several EU or nationally funded projects including Specularia, ENCORE, and AeRoTwin. In 2018, he was a visiting researcher at United States Military Academy West Point, USA, where he collaborated work related to aerial-ground cooperative manipulation.

***Barbara Arbanas Ferreira** received her Ph.D. degree from the Faculty of Electrical Engineering and Computing (FER), University of Zagreb (UNIZG), in February 2022. Her research focused on the decentralized coordination of heterogeneous multi-robot systems, conducted under the co-supervision of Prof. Stjepan Bogdan and Prof. Martínez-de Dios. She is currently a Postdoctoral Researcher with the Laboratory for Underwater Systems and Technologies (LABUST) at UNIZG-FER. To date, she has authored or co-authored one book chapter, seven journal articles, and nine conference papers. Her research interests include multi-robot coordination and planning, distributed artificial intelligence, scheduling, and optimization. She has been involved in several international and national research projects, including the H2020 project subCULTron, FP7 EuRoC, and the Croatian Science Foundation project SPECULARIA. Additionally, she participated in the ERL Emergency Robots 2019 and MBZIRC 2020 Robotics Competitions as a member of the LARICS Team. She is currently working on the Horizon Europe project SeaTecHub and was the Team Leader of UNIZG-FER, which won the MBZIRC 2023 Competition.*

03.10.2024
09:30 – 10:15
Tutorial
Marko Car
Matko Orsag
Marijana Peti
Robert Milijaš
Jakob Domislović
Antun Ivanović
Barbara Arbanas Ferreira

Operation Of Heterogeneous UAV-USV System In A GNSS-Denied Maritime Environment

Shaoming He, Beijing Institute of Technology, China

In the evolving landscape of autonomous maritime operations,the synergy between Unmanned Aerial Vehicles (UAVs) and Unmanned Surface Vehicles (USVs) represents a frontier of technological innovation and strategic advantage. The operation of heterogeneous UAV-USV systems in GNSS-denied maritime environments demands a multifaceted approach, leveraging the latest in sensor fusion, artificial intelligence, and robust communication frameworks. These technologies enable UAVs and USVs to perform complex navigation, coordination, and mission execution tasks without relying on external satellite signals. The importance of this capability cannot be overstated,as it not only enhances the resilience and versatility of maritime operations but also ensures that critical missions can proceed uninterrupted in the face of sophisticated electronic warfare tactics or natural signal interferences.

This talk aims to delve into the intricate operation of UAV-USV systems in such challenging environments. We will explore the current state of technology, including the integration of vision-based guidance, and machine learning algorithms for dynamic decision-making and obstacle avoidance. Furthermore, we will examine real-world applications and a case study in MBZIRC 2024 that highlights the strategic value and potential of these autonomous systems in enhancing maritime security, environmental conservation, and search and rescue efforts.

03.10.2024
10:15 – 11:00
Tutorial
Shaoming He

Shaoming He *received the B.Sc. degree and the M.Sc. degreein aerospace engineering from Beijing Institute of Technology, Beijing, China, in 2013 and 2016, respectively, and the Ph.D.degree in aerospace engineering from Cranfield University, Cranfield, U.K., in 2019. He is currently a Professor with Schoolof Aerospace Engineering, Beijing Institute of Technology and also a recognized teaching staff with School of Aerospace, Transport and Manufacturing, Cranfield University and visiting Researcher at Centre for Autonomous Robotic Systems, Khalifa University. His research interests include aerospace guidance, multitarget tracking and trajectory optimization. Dr. He received the Lord Kings Norton Medal award from Cranfield University as the most outstanding doctoral student in 2020.*

Autonomous Catamaran In GNSS-Denied Operation For Search And Intervention At Sea By UNIZG-FER

Juraj Obradović, Matko Batoš, Fausto Ferreira. Barbara Arbanas Ferreira, Natko Kraševa, Luka Mandić,
UNIZG FER, Croatia

In this tutorial, we will explore advanced solutions from the MBZIRC 2023 competition, specifically focusing on GNSS-denied navigation and the identification and tracking of a target vessel in a large marine environment. The tutorial is divided into two sections. The first section addresses GNSS-denied navigation, demonstrating how an autonomous USV operates without global localization systems. Participants will delve into the enabling algorithms and gain a comprehensive understanding of their functionality. The second section focuses on tracking a target object using LIDAR scans onboard the vehicle. Participants will learn about the capabilities of LIDAR technology for clustering and tracking objects, which is particularly useful for autonomous navigation and collision avoidance at sea. By the end of this tutorial, participants will have a solid grasp of using LIDAR technology in modern autonomous systems for marine environments.

Juraj Obradović *is a researcher and PhD candidate at the Laboratory of Underwater Systems and Technologies (LABUST) within the Faculty of Electrical Engineering and Computing (FER) at the University of Zagreb. He completed his Master of Science degree in electrical engineering and information technology at FER in 2021 and joined LABUST upon graduation. During his undergraduate years, Juraj participated in many robotics projects, developing interest in areas such as Simultaneous Localization and Mapping (SLAM), reinforcement learning, and LiDAR perception. His current primary focus is on contributing to the development of perception systems in the marine environment.*

Matko Batoš *graduated in July 2022 with a master's degree in electrical engineering and information technology on the topic of "Unmanned aerial vehicle navigation based on magnetic field" at the Faculty of Electrical Engineering and Computing, University of Zagreb (UNIZG), Croatia. Part of the Laboratory for Underwater Systems and Technologies (LABUST) at UNIZG-FER since 2023, with a focus on pursuing a PhD in data-driven modeling of maritime systems for predictive maintenance and fault detection.*

Dr. Fausto Ferreira *is an Assistant Professor at the University of Zagreb, Faculty of Electrical Engineering and Computing, working in the Laboratory for Underwater Systems and Technologies (LABUST). He has participated in 15 EU projects and 2 Office of Naval Research Global projects, including a Visiting Scientist Program grant. He coordinates the Erasmus+ project Marine Robots for better Sea Knowledge awareness (MASK) and has held key roles in several robotics competitions. Currently, he is the PI of two EU-funded projects.*

Dr. Ferreira is a senior IEEE member and has served as Vice-President for Workshops and Symposia of the IEEE Oceanic Engineering Society (OES). He is an Associate Editor of the IEEE Journal of Oceanic Engineering and the General Chair of EMRA' 2023 Workshop. He has contributed to many conferences, including as Technical Co-chair of OCEANS 2021 San Diego – Porto, and received the 2023 IEEE OES Distinguished Service Award. With over 60 peer-reviewed papers, a patent, and two book chapters, his research interests include underwater computer vision, sonar processing, marine law for unmanned vehicles, robotics competitions, and educational robotics.

He holds a PhD in Robotics, an Integrated Master's in Electrical and Computer Engineering, and a Bachelor's in Political Science with a thesis on regulatory aspects of autonomous surface vessels.

Barbara Arbanas Ferreira *received her Ph.D. degree from the Faculty of Electrical Engineering and Computing (FER), University of Zagreb (UNIZG), in February 2022. Her research focused on the decentralized coordination of heterogeneous multi-robot systems, conducted under the co-supervision of Prof. Stjepan Bogdan and Prof. Martínez-de Dios. She is currently a Postdoctoral Researcher with the Laboratory for Underwater Systems and Technologies (LABUST) at UNIZG-FER. To date, she has authored or co-authored one book chapter, seven journal articles, and nine conference papers. Her research interests include multi-robot coordination and planning, distributed artificial intelligence, scheduling, and optimization. She has been involved in several international and national research projects, including the H2020 project subCULTron, FP7 EuRoC, and the Croatian Science Foundation project SPECULARIA. Additionally, she participated in the ERL Emergency Robots 2019 and MBZIRC 2020 Robotics Competitions as a member of the LARICS Team. She is currently working on the Horizon Europe project SeaTecHub and was the Team Leader of UNIZG-FER, which won the MBZIRC 2023 Competition.*

Natko Kraševac *received a MSc in Computer Science from the University of Zagreb Faculty of Electrical Engineering and Computing – UNIZG FER in Zagreb (Croatia) in 2020. During the studies, his background was mainly computer vision, deep learning and AI with focus on application in autonomous driving. After graduation, Natko worked briefly in the web development field before diving into marine robotics. Since 2021, he is a researcher in Laboratory for Underwater Systems and Technologies – LABUST at UNIZG FER where he is pursuing a PhD in digital twins in marine environment.*

Luka Mandić *received a Master's degree in Electrical Engineering in 2018. He is currently working in the Laboratory of Underwater Systems and Technologies at the Department for Control Engineering and Computing in Zagreb, where he is pursuing his PhD. He is currently involved in the ONR NICOP project ROADMAP – Robot Aided Diver Navigation in Mapped Environments. His research interests include data-driven control, application of machine learning in internal navigation systems, design and modeling of nonlinear systems and their application to marine surface and underwater vehicles.*

03.10.2024
14:15 – 15:00
Tutorial
Juraj Obradović
Matko Batoš
Fausto Ferreira
Barbara Arbanas Ferreira
Natko Kraševac
Luka Mandić

GNSS-Denied Over-Water Navigation For UAVs And USV By Nomagic Warsaw Mimotaurs

Karol Pieniący, University of Warsaw, Poland

This tutorial dives into Nomagic Warsaw MIMotaurs' solution for a drone and USV competition that demanded over-water navigation without visual cues. In this entirely radio-based system (operating within the 2.4GHz band), radio beacons strategically placed onshore work in conjunction with direction finding and ranging techniques. Data is then aggregated, processed by a centralized position solver, and distributed back to the vehicles' autopilots. Participants will gain the knowledge and practical skills to build their own simulated GNSS-denied navigation system. Through real-world scenarios and exercises, you'll explore: design and deployment considerations for radio beacons, techniques for radio-based direction finding and ranging, data aggregation and fusion methods for robust positioning, centralized position solving algorithms for real-time navigation and integration with autopilots to guide UAVs and USVs. Witness the power of radio navigation firsthand! We'll unveil a live demonstration of a full-size beacon used during the competition, showcasing its design and functionality in reliably guiding autonomous vehicles at kilometers range over maritime environments.

03.10.2024
15:00 – 15:45
Tutorial
Karol Pieniący

Karol Pieniący *is a PhD student at the University of Warsaw's Faculty of Mathematics, Informatics and Mechanics. An expert in unmanned aerial systems, dedicating all of his academic work to designing, building and programming drones and ground elements of autonomous systems. Has worked in commercial projects both hands-on and in a consulting role on all types of robots including wheeled, walking, swimming and underwater robots, production lines, manipulators, multirotors, VTOLs and fixed-wings with electric, combustion, and hybrid drives. Specializes in system architecture, system integration, project management, and team management. Karol is a proven leader and great driving force in academic competition teams. Programming challenges are his second nature with 15 years of continuous competing experience, most of which on management roles. After helping University of Warsaw Rover Team getting to URC 2017 and URC 2018 he assembled and led Warsaw MIMotaurs all the way to the world's top 3 final run in the AlphaPilot challenge organized in 2019 by Lockheed Martin. His most recent endeavor involved leading the Warsaw MIMotaurs to a top five global finish at the MBZIRC23 competition held in Abu Dhabi.*

The Maritime Computer Vision Initiative (MaCVi)

Janez Perš, University of Ljubljana, Slovenia
Benjamin Kiefer, University of Tuebingen, Germany

In this tutorial, we discuss the computer vision aspects of maritime robotics, spotlighting the MaCVi initiative—a collaborative effort originating from the success of the 1st Workshop on Maritime Computer Vision. Through the lens ofvarious multi-year projects and the founding of a startup, we present applications ranging from UAVs in search and rescue missions to assistance systems for boaters. This session is a gateway to understanding how computer vision and AI technologies are utilized in maritime operations. The hands-on segment invites participants to engage with pre-trained models from previous competitions through Google Colab exercises to get a better understanding of the underlying competitions, their used models and evaluation metrics and benchmarking webserver.

04.10.2024
13:45 – 14:30
Tutorial
Janez Perš
Benjamin Kiefer

Janez Perš *received his Ph.D. degree in Electrical Engineering at the Faculty of Electrical Engineering (FE), University of Ljubljana in 2004. He is currently Assistant Professor at the Laboratory for Machine Intelligence at the FE, University of Ljubljana. His research interests lie in object tracking, human motion analysis, dynamic-motion-based biometry, machine vision, autonomous vehicles and distributed systems. According to Google Scholar, he has 2400 citations and a h-index of 27.*

Benjamin Kiefer *received his Ph.D from the Cognitive Systems Group at University of Tuebingen in 2023. Together with the other organizers, he initiated and organized the 1st Workshop on Maritime Computer Vision. He co-lead multiple state-funded research projects, such as Avalon. This multi-consortium project's goal is to develop an unmanned aerial vehicle to assist in humanitarian Search and Rescue scenarios. Currently, he is the CTO of the startup LOOKOUT, focusing on assistance systems for recreational boaters. He has been a teaching assistant for over six years, teaching lectures in maths, technical informatics and deep learning.*

Integration Of Interdisciplinary Data For Landscape Mapping Of Submerged Ancient Cities: The uBlueTec Approach

Jordy Moies, Jafar Anbar, Kalliopi Baika, Aix-Marseille University (AMU), France

In this tutorial, we will work on the treatment of a series of interdisciplinary data from an archaeological submerged site, that was a pilot of the EU uBlueTec project (www.ubluetec.eu). The data were collected in the maritime façade of the ancient city of Aigina, Greece, dating at the 6th c. BC. The extensive archaeological remains consist of submerged harbour structures and fortification walls, two breakwaters more than 300 m long, a naval harbour, and an outer defence fortification system.
The databases are issued from Total Station topographical surveys, UW photogrammetry treated in @Metashape and SSS/ multibeam prospections. Firstly, data will be treated in order to generate a Digital Elevation Model (DEM). Secondly, they will be integrated in a Geographic Information System(GIS) database using @QGIS software, in order to perform different levels of data analysis (Extraction of contours – Sections – Visualisation – Exporting maps, etc).

Jordy Moies *is a PhD candidate in maritime archaeology and working on the impacts of natural processes on submerged archaeological sites, specilased in multibeam for preservation monitoring of historic wrecks in the North Sea.*

Jafar Anbar *is a PhD candidate in maritime archaeology and coastal geoarchaeology in the Eastern Mediterranean, CIVIS joint PhD degree between Aix-Marseille University (AMU) and the National and Kapodistrian University of Athens (NKUA). He is specialised in UW techniques related AUV piloting, topographic surveys, underwater photogrammetric documentation, and 3D reconstruction.*

Prof. Kalliopi Baika *is Associate Professor of Mediterranean Maritime Archaeology at Aix-Marseille University. Since 2023, she is chairing the UNESCO-UNITWIN network of UnderwaterArchaeology that reassembles all Universities, higher education institutions and actors worldwide offering academic training andquality research in underwater archaeology.*

04.10.2024
14:30 – 15:15
Tutorial
Jordy Moies
Jafar Anbar
Kalliopi Baika

Demonstrations

AI Zerocaliber Ltd

Jerry Pylarinos, Alexopoulos Ilias, AI Zerocaliber Ltd

AI ZeroCaliber Ltd is a design and consultancy company with more than 25 years of expertise in embedded systems design, low power consumption, hardware acceleration, FPGAs, edge processing, mechatronic systems, sensing and test automation. The current customer portfolio includes companies in the commercial, research, semiconductor and space sectors. The company provides high quality hardware design services and embedded firmware design and development and product consultancy. Currently, the company offers specialized power management systems for Unmanned Vehicles and Buoys, and have plans to introduce hydrophones array processing systems. The company had successfully demonstrated TRL6 of the first generation of power management systems.

30.9.2024
17:45 – 18:45
Demonstration
Jerry Pylarinos
Alexopoulos Ilias

Mr Jerry Pylarinos *is the Embedded Systems Expert at AI Zerocaliber Ltd. He received his B.S. degree in Electrical & Computer Systems Engineering from Monash University, Victoria, Australia, in 1992 and his MS degree in Data Communications from Brunel University in 1999. Jerry has worked on numerous embedded projects in his career, like cash registers, energy metering systems, and train braking systems. He also has experience in safety-critical (SIL-3) embedded firmware and has worked with multiple methodologies, including Test-Driven Development (TDD), Real-Time Operating Systems (RTOS) and microcontrollers. In previous roles he held positions as a team leader and Principal Innovation Embedded engineer.*

Mr Alexopoulos Ilias *is the founder and director of AI Zerocaliber Ltd. He received his B.S. degree from the Automation Department of the Technological Educational Institute (T.E.I.) of Piraeus in Athens Greece in 1996 and his MS degree from Brunel University in 1999. He is currently an engineering PhD candidate at the University of Nicosia. With more than 28 years of experience in embedded system design, product development and lifecycle and involved in numerous projects, he gained experience in multiple domains in sensing, DC motors, prototyping, control systems, DSP, FPGAs, RF, Hydrophones, Unmanned Surface Vehicles, Certifications, testing and system engineering. He is also an inventor with patents in various territories (US, EU, Australia), and awarded recognition of work within companies and the open-source community.*

Sea Cras d.o.o.

Mario Špadina, Davor Blaženčić, Sea Crass d.o.o.

Sea Cras, a Croatian company, specializes in cutting-edge sustainable marine environmental monitoring and surveillance services by satellites. With our strong roots in the Adriatic region, we have all the expertise needed to solve the problem of difficult and expensive marine monitoring. Our solution: utilizing advanced AI analysis of high-resolution satellite data, Sea Cras provides comprehensive monitoring of the sea and surveillance of marinas on a larger scale, with greater frequency, and early warning capabilities. Remarkably, our solution offers superior affordability compared to traditional hardware-based methods, coupled with a remarkable reduction of over 10-fold in greenhouse gas emissions. Sea Cras proudly stands as the most eco-friendly option in the maritimea pplications market. ESG Compliance and Reporting: In today's business landscape, EU companies and ones associated with the EU's value-chain, face increasing demands brought forth by new ESG legislation. Sea Cras not only assists in compliance with these regulations but goes a step further. Our in-house data analytics empowers data-driven reporting for ESG marine resource compliance, enhancing your sustainability profile.

Mario Špadina *Ph.D at French Atomic Energy and Alternative Energies Commissions, University of Montpellier. 13+ published scientific papers in areas of physics, chemistry and applied mathematics. Named as Emerging Leaders under 40 years by European Forum Alpbach 2022.*

Davor Blaženčić *holds a degree in economics from La Sapienza University. Davor's expertise lies in banking, risk management and process optimization. Raiffeisenbank Austria – Head of Credit Risk Management, Ericsson NT (Croatia) – head of Treasury and Controlling KPMG – Corporate Audit.*

30.9.2024
17:45 – 18:45
Demonstration
Mario Špadina
Davor Blaženčić

dive-IT d.o.o.

Željko Pavlaković, dive-IT d.o.o.

dive-IT d.o.o. is a Croatian company dedicated to underwater robots and technologies, as well as professional services of underwater recording, measurements, inspections, extractions and search&rescue in sea, lakes and rivers. There are five models of Qysea Fifish underwater robots in current offer-consumer level, two professional level and two industrial level ROVs, as well as ROV accessories.

30.9.2024
17:45 – 18:45
Demonstration
Željko Pavlaković

Željko Pavlaković *is a technology driven "icebreaker", explorer and motivator, with the proactive approach to the world of business and technology, always keen to keep track of the newest services, technologiesand trends in modern world. Extensive experience in General management, Business development, Technical support, Human resources management, Quality and Environmental management, B2B/B2C (after)sales channels structuring, developing and support. After 22 years in ICT business, Željko decided to apply his tech knowledge and experience to his all-time passion – water. He is OWD licenced diver (JVP Zagreb), old member of swimming club Mladost/Zagreb, passionate fisherman and loves anything related to water activities. Therefore, entering the world of ROV technologies was perfect merge of pleasure and business. After 3 years of providing ROV technologies to Adriatic market, dive-IT reference list contains many respectable institutions, universities, municipals and companies in underwater works and research. And this is just the beginning of blue growth which dive-IT is introducing to science, industrial, business and consumer Adriatic market.*

Calirad Ltd.

Marin Vuković, Juraj Peršić, Calirad Ltd.

Calirad is an engineering company, focusing on hardware and software development in robotic applications, while the founders and employees share passion for car racing, specifically rally events. Based on their experience in rally racing and knowledge in the IT field, they identified rally spectator safety as a one of the major challenges, where robotic perception could significantly increase the overall safety. Currently, they are developing rally safety solution and improving machine vision performance. In mid and long term, the goal is to expand to other areas where the developed platform can be used for other detection purposes in various and harsh environments.

30.9.2024
17:45 – 18:45
Demonstration
Marin Vuković
Juraj Peršić

Marin Vuković *is an Associate Professor at the Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia (UNIZG-FER). He received his PhD degree in 2006 at the UNIZG-FER. Marin Vuković has co-authored over 50 journal and conference papers and reviewed a number of papers for international conferences and journals. He is a co-author of a patent at the Croatian Institute for Intellectual Property. During his professional career, Marin Vuković has participated in scientific projects financed by the Ministry of Science, Education and Sports of the Republic of Croatia, projects financed from the EU funds as well as many industrial projects. Marin Vuković is a deputy director of "Laboratory for Security and Privacy (SPL)" and "Laboratory for Assistive Technology and Alternative and Augmentative Communication (ICT-AAC)" at the University of Zagreb, Faculty of Electrical Engineering and Computing. He is a senior member of IEEE Communications Society.*

Juraj Peršić, *PhD, is a co-founder and CEO of Calirad, a company dedicated to keeping motorsport fans safe. Prior to his role at Calirad, he obtained his doctoral degree in robotics from the University of Zagreb, within the LAMOR group at the Faculty of Electrical Engineering and Computing. Throughout his career,,he has worked with various small, medium, and large companies in the robotics and autonomous driving sectors. His primary research interests include multi-sensor calibration and fusion, with an emphasis on the automotive domain and radar data processing. During his studies, he collaborated with several international partners across Europe and was a visiting researcher at the University of Toronto with the STARS group. In addition to publishing his work in prestigious international conferences and journals, he received the silver plaque "Lončar" and the "Končar" award for his dissertation, which made significant academic and industry contributions.*

Comparison of Ship Hull Structures and Employment of Maritime Robots for Environmental Protection

Cathrin Schröder, Dirk Meyer, Thomas Glotzbach, University of Applied Sciences (THM), Germany

The NUMAR research group (Nautics and Maritime Robotics) ofthe Technische Hochschule Mittelhessen – University of Applied Sciences (THM) focuses on the development of boats and maritime robots, as well as their guidance, control and navigation. The common demonstration at BtS 2014 focuses on two main points:

Firstly, one of the primary goals of the research group is to compare the V- and M-hull structures of conventional boats in terms of pitch and roll angles, with the objective of achieving the lowest possible flow resistance. This is primarily intended to be achieved by reducing the wetted hull surface area for the M-hull. The long-term goal is to develop lightweight boats with correspondingly smaller drives that can achieve comparable performance parameters. In the demonstration, the M-hull boat is presented, and through parameter variations (adjustable trim flaps, hull elongation, prop mounting height and trim angle, as well as centre of gravity shift), it will be demonstrated which parameters have the greatest impact on flow resistance

Secondly, the group presents the results of a student project of undergraduate students in their second study semester. The students were given a prototype of a low-cost marine surface robot and had the task to find and retrieve a plastic bottle placed at a random position in a defined sea area. This is in the scopeo f addressing the problem of pollution of the world's oceans by plastic, which is a serious problem of our current time. Their proposed solution is presented as well as the prototype robot itself, which is a further development of the one shown at last year's BtS.

Cathrin Schröder *studied Electrical Engineering, specializing in Automation Technology, with a focus on Measurement and Control Engineering, at Leibniz University Hannover, earning a degree as a Diploma Engineer in 2004. Subsequently, she began her doctoral project at Clausthal University of Technology, sponsored by an energy supply company. In her dissertation, which led to her PhD in Engineering in 2009, she developed asimulation method for gas distribution networks based on control engineering approaches. Since 2013, she holds the Professorship of Electrical Power Engineering and Control Systems at THM in the Department of Electrical Engineering and Information Technology.*

Dirk Meyer *holds a professor position at THM in the Department of Mechanical Engineering and Energy Technology since 2012. His fields of teaching are Vehicle Propulsion Systems, Vehicle Lightweight Design, Game Development with Unity 3d, and Vehicle Body Design. He received his engineering diploma at the UAS Cologne, his Master Degree in automotive systems engineering at Loughborough University, UK, and his PhD-Degree at the University of Duisburg-Essen in Germany.*

30.9.2024
17:45 – 18:45
Demonstration
Cathrin Schröder
Dirk Meyer
Thomas Glotzbach

Thomas Glotzbach *studied electrical engineering at the University of Applied Sciences in Fulda and received his doctoral degree in 2009 and his habilitation degree in 2018 from Technische Universitaet Ilmenau. Since 2019, he is Professor of Control Engineering and Robotics at Technische Hochschule Mittelhessen – University of Applied Sciences (THM), Department of Electrical Engineering and Information Technology. His research interests are in the area of control and navigation for teams of marine robots, both in surface and underwater missions.*

MASK Project

Fausto Ferreira, Đula Nađ, Lovro Maglić UNIZG FER, Croatia
Lovro Maglić, Antonio Blažina, University of Rijeka, Faculty of Maritime Studies, Croatia
Francesco Maurelli, Constructor University, Germany

MASK – Marine Robots for better Sea Knowledge awareness project focuses on the teaching, learning, and training of late high school students and their teachers in the area of marine robotics and artificial intelligence applied to environmental monitoring and protection and giving special attention to the possibilities introduced by remote access to infrastructures (telerobotics). In particular, the project:

- will encourage interest in both students and teachers towards robotics, artificial intelligence, and STEM in general, by stimulating students to work in STEM-related projects and use marine robots;
- will engage and keep students motivated, with the goals of a) contributing to a decrease in dropout rates and b) encourage a STEM career for every student, with particular attention to underrepresented groups.
- will increase the digital competences and skills of both students and teachers, with an emphasis on applications in new technologies, robotics and artificial intelligence;
- will exploit the possibilities introduced by remote access/remote learning to provide high quality lectures by university experts and perform remote robotic trials contributing to sustainable development and avoiding unnecessary travels.
- will raise awareness about climate change and environmental protection and mitigation, using marine robotics as an application field, in particular applied to detection, recognition and removal of seabed litter.

Đula Nađ *is an assistant professor University of Zagreb Faculty of Electrical Engineering and Computing within the Laboratory of Underwater Systems and Technologies (LABUST). He participated in multiple European projects over past years. His research interest includes navigation, guidance, and control of underwater vehicles, localization aiding, and diver-robot cooperation.*

Lovro Maglić, *PhD, is Head of Center for Marine Technologies. His teaching and research interests focus on: maritime safety, prevention of marine pollution, marine robots, human factor and navigation information systems. He worked on more than 10 national and international projects, he is an author of more than 40 scientific publications and more than 50 professional projects and studies related to the planning and management of ports and terminals. He is a diver and acting as an ROV supervisor and operator for underwater activities (structures and ship hulls inspection, seabed survey and pollution control).*

Antonio Blažina *was born on February 25, 1988 in Rijeka, Croatia, where he finished Faculty of Maritime Studies in 2011 and obtained Master's degree in Nautical studies and Maritime Transport Technology. Shortly after, he started his career at sea on container ships and multi-purpose ships and then moved to cruise ships in 2016. He holds the certificate of Master of a ship of 3.000 GT or more. With a desire to pass on his experience at sea to future seafarers, in April 2021 he has been employed at the Faculty of maritime studies in Rijeka as an assistant in the department of Nautical Sciences. He has been teaching students the following subjects: Cargo Handling, Ship Maintenance and Ship Handling. He also works in the Maritime Training Centre and Life-long Learning (organizational unit of the Faculty), where he deals with the training of seafarers according to the international conventions and with matters related to the lifelong learning programs (e.g. development of new courses). He is also involved in various EU and national projects as a researcher and works on maritime studies. At the faculty he is ROV operator for all underwater activities.*

Prof. Francesco Maurelli *obtained his PhD in Electrical Engineering from Heriot-Watt University, in Edinburgh, Scotland, with a thesis focused on intelligent localization of autonomous underwater vehicles. He has worked for more than a decade in the field of autonomous marine robots. He is the Principal Investigator of the Horizon2020 MSCA projet TIC-AUV, in collaboration with Massachusetts Insitute of Technology (MIT), where he spent one year as research scholar, and Jacobs University Bremen. He is the PI of the Erasmus+ IMPACT project for Jacobs University, focused on education and research in marine systems, as well as the PI of the DAAD-funded project "Intelligence and autonomy extension for low cost freshwater inspection vehicles". He is chair of Robotics and Intelligent Systems program at Jacobs University, and co-chair of the IEEE Robotics and Automation Society Marine Robotics Technical Committee. He has been involved in several projects, funded by EU FP6, EU FP7, EU H2020 (FreeSubNet, ARROWS, PANDORA, ECHORD++, TIC-AUV), and from British, Canadian and German national fundings.*

Dr. Fausto Ferreira *is an Assistant Professor at the University of Zagreb, Faculty of Electrical Engineering and Computing, working in the Laboratory for Underwater Systems and Technologies (LABUST). He has participated in 15 EU projects and 2 Office of Naval Research Global projects, including a Visiting Scientist Program grant. He coordinates the Erasmus+ project Marine Robots for better Sea Knowledge awareness (MASK) and has held key roles in several robotics competitions. Currently, he is the PI of two EU-funded projects.*

01.10.2024
17:30 – 18:30
Demonstration
Fausto Ferreira
Đula Nađ,
Lovro Maglić
Antonio Blažina Francesco Maurelli

Dr. Ferreira is a senior IEEE member and has served as Vice-President for Workshops and Symposia of the IEEE Oceanic Engineering Society (OES). He is an Associate Editor of the IEEE Journal of Oceanic Engineering and the General Chair of EMRA' 2023 Workshop. He has contributed to many conferences, including as Technical Co-chair of OCEANS 2021 San Diego – Porto, and received the 2023 IEEE OES Distinguished Service Award. With over 60 peer-reviewed papers, a patent, and two book chapters, his research interests include underwater computer vision, sonar processing, marine law for unmanned vehicles, robotics competitions, and educational robotics.
He holds a PhD in Robotics, an Integrated Master's in Electrical and Computer Engineering, and a Bachelor's in Political Science with a thesis on regulatory aspects of autonomous surface vessels.

Mepeco & Seaber

Océane Barre, Seaber, France
Roberto Balistrieri, Mepeco, Italy

Mepeco focuses on technology designed for extreme conditions,challenging the most prohibitive environments from the polar regions to the most inaccessible deserts. Diving to the crushing pressure of the deepest ocean trenches, surviving the intense subterranean temperatures, and safely working with the most dangerous elements, we preservei ntegrity ensuring maximum accuracy, performance and reliability. Mepeco will be joined at BTS 2024 by Seaber, France. Seaber is an innovative company that designs and manufactures highly reliable micro-AUVs navigating down to 300m depth with 8-10 hours autonomy, weighing 10 kg and measuring 1m long.

After years of experience and with a shared obsession for robotics and marine technologies, we decided to use our expertise and knowledge to develop the first micro-AUV that meets the specific needs of oceanographic researchers and navies. The YUCO aims to be used for research and commercial oceanographic applications.

Océane Barre *is Sales and Marketing Manager at SEABER and hasbeen immersed in the field of oceanography since completingher Business Development studies in 2018. She is passionateabout new technologies to explore the depths of the ocean andhas a keen interest in bridging the gap between business andscience. Objective achieved, as SEABER is committed tomaking AUV technology accessible to all by setting the standardof underwater exploration.*

1st OCT Tue

01.10.2024
17:30 – 18:30
Demonstration
Océane Barre
Roberto Balistrieri

Roberto Balistrieri *has 30 years of experience in promoting, marketing and providing high-tech solutions and scientific instrumentation for energy projects and surface water sciences.*

4th OCT Fri

Diver-robot monitoring and interaction (ROADMAP)

Igor Kvasić, Vladimir Slošić UNIZG FER, Croatia
Derek Orbaugh, University of Auckland, Auckland Bioengineering Institute, NZ

Using robot as a diving buddy can ease real-time monitoring ofthe divers during the mission. On this tutorial, a diving suit, diving glove and robot will be demonstrated. Near real-time diver kinematics will be captured during the dive. Heart rate and respiration measurements will be transmitted to measure diver physiological state. Additionally, the diver will be able to communicate with the diving glove towards the surface and underwater diving buddy.

Igor Kvasić *is a researcher and PhD student at the University of Zagreb Faculty of Electrical Engineering and Computing and a member of the Laboratory for Underwater Systems and Technologies, where he received his MSc in Electrical Engineering and Computing. His research interests include underwater vision, sonar image processing, human-robot interaction and is currently involved in the ONR NICOP project called ADRIATIC – Advancing Diver-Robot Interaction Capabilities. He is the Vice-chair of the IEEE Oceanic Engineering Society Student Branch Chapter of the University of Zagreb.*

Vladimir Slošić *is a PhD student at the Laboratory for Underwater Systems and Technologies (LABUST) at the Faculty of electrical engineering and computing, University of Zagreb (UNIZG-FER). During the bachelor and master studies, his background was mainly automation and robotics. In the second year of master, he participated in the Erasmus student exchange at the Karlsruhe Institute of Technology (KIT). In addition to robotics, during the exchange, he tried his hand at optics and photonics. After graduating master's degree at FER, Vladimir takes part in one startup where he got involved in marine robotics. Afterward, he started working in a spinoff company H2O Robotics and shortly after decided to enroll in doctoral studies at LABUST, FER.*

Derek Orbaugh *is currently working for the Biomimetics Laboratory as a postdoc researcher. He was born in Guatemala City, Guatemala, in 1990. He received a B.S. degree in electronics engineering from the Universidad del Valle de Guatemala, Guatemala City, in 2015, and an M.S. degree in smart systems from Furtwangen University, Furtwangen, Germany, in 2017. In 2023, he was awarded a Ph.D. degree from the University of Auckland in Bioengineering with the Biomimetics Laboratory. For his research he developed a smart dive glove for underwater diver communication. The glove is capable of recognizing hand gestures used in diving communication, convert them into a message and transmit the message acoustically. He has authored and co-authored three conference proceedings and four journal articles.*

04.10.2024
17:30 – 18:30
Demonstration
Igor Kvasić
Vladimir Slošić
Derek Orbaugh

Company presentations

XYLEM

Eloy Abascal, Rob Thomson

Xylem a global water solutions partner, offering Environmental Solutions and technologies to improve the health of natural waters and to better understand climate changes, by offering Instrumentation and systems to help Environmental Agencies, Researchers, Consultants, and Utilities understand the quality and quantity of water in lakes, rivers, streams, oceans and reservoirs with spot measurements or in real time with autonomous vehicles or telemetry stations. Our offer includes a large portfolio of autonomous water vehicle sand sensors to be integrated in 3rd party vehicles.

02.10.2024
11:45 – 12:15
Company presentation
Eloy Abascal
Rob Thomson

Eloy Abascal *is currently Environmental Solutions sales manager Xylem in Europe. Bachelor of Science for the University of Barcelona (Spain). With more than 20 years of international experience in the environmental sector, with focus on Natural Resources Monitoring/Water Quality Monitoring and Compliance/Gauging and Discharge/Waves and Currents/Oceans.*

Rob Thomson *12 years Air Force Air electronics weapons system operator radar and sonar. 12 years hydrometry scientist SEPA specialising in Hydro Acoustics discharge measurement and bathymetry velocity surveys. Sit on the British standards ISO committee for river discharge. 1 year with Xylem specialising in SonTek instruments and training/ technical support.*

Deep Trekker

Riccardo Caponi

Deep Trekker designs and manufactures rapid deployment, low logistics commercial ROVs with advanced survey capabilities that are ideal for a variety of industrial applications. Our open platform allows for easy integration with a variety of tools and sensors, including imaging and navigation sonars, USBL tracking systems, multi-function manipulators with a variety of attachments, laser scaling, and more. Deep Trekker ROVs offer a custom robotics solution that comes equipped with ultra high definition 4K cameras, offering precise data acquisition to optimize operations, meet regulations, and inform decisions.

02.10.2024
12:15 – 12:45
Company presentation
Riccardo Caponi

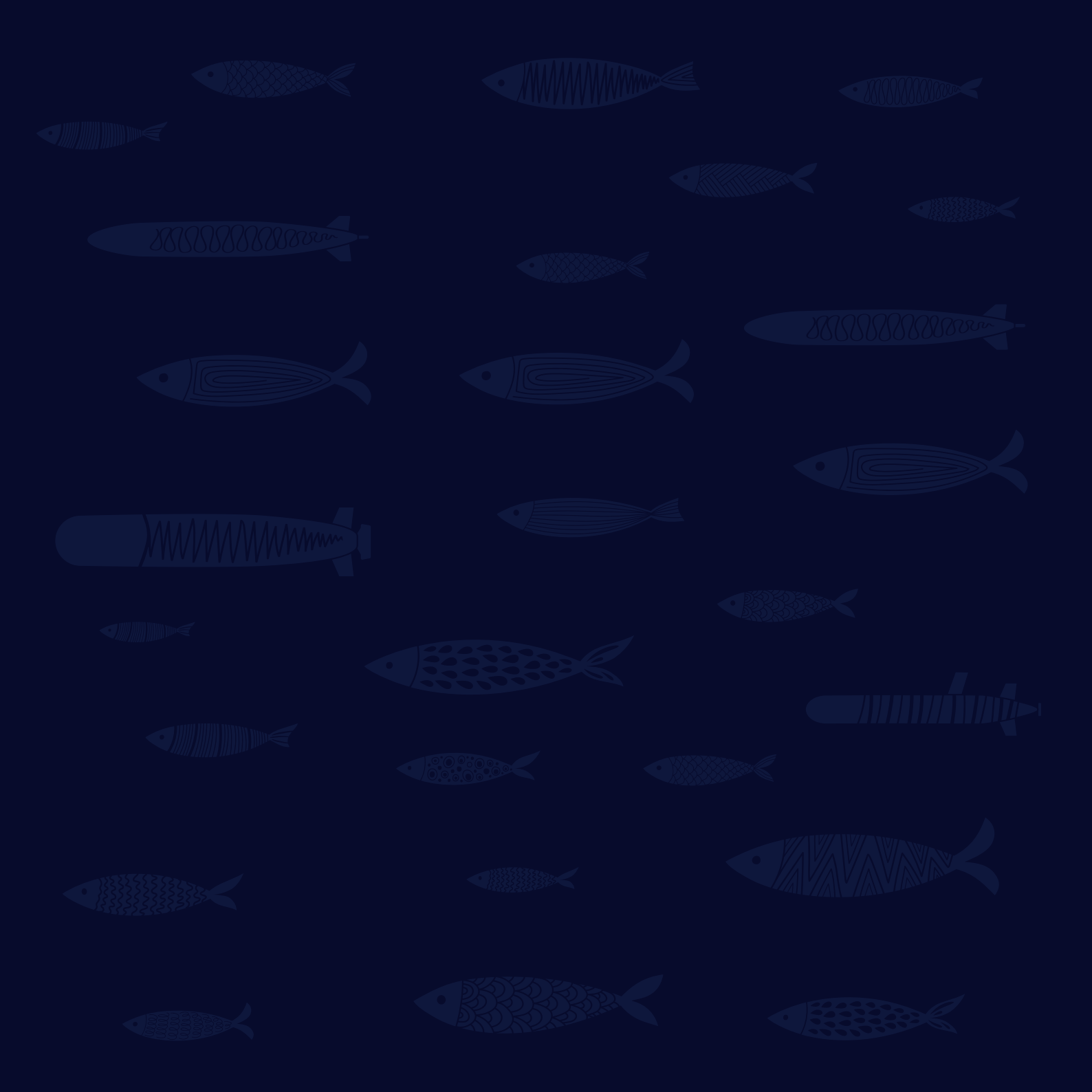
Riccardo Caponi *brings a unique blend of military discipline and strategic acumen to his role as an Export Sales Manager at Deep Trekker. With 12 years of distinguished service in the Italian Navy, including roles as a Submariner and Weapon Officer, Riccardo has honed his skills in leadership, negotiation,and management. Fluent in English, French, and Italian, he has successfully led marketing and business development efforts for ECA Robotics and ECA RSM, specializing in robotic systems,drone technology, and naval simulation. His extensive experience in aviation and naval unmanned vehicles, coupled with a private pilot license and boat license, underscores his commitment to excellence and versatility.*

Fameline Energy (HMS)

Fameline Energy, Cyprus

Hull cleaning plays a crucial role in maintaining the integrity of the ship and reducing its environmental impact. Over time, biofouling accumulates on ship hulls and disrupts the ship's hydrodynamics, leading to increased fuel consumption and higher CO_2 emissions. Biofouling on ships also contributes to the spread of invasive species. In this presentation, we will introduce our solution for cleaning ship hulls using Remotely Operated Vehicles (ROVs). We will give a technical overview of the operation with video demonstrations of real activities at sea. We will also explain the environmental and operational benefits of our underwater services for ship owners and managers.

04.10.2024
12:00 – 12:30
Company presentation



List of participants

Registered participants until 15th September:

Aalborg University, DK
Shahab Heshmati-Alamdari

ABB, CZ
Matko Barisic

Auckland Bioengineering Institute, NZ
Iain Anderson
Cheng-Huan Lu

AI Zerocaliber Ltd, GR
Ilias Alexopoulos
Jerry Pylarinos

Aix Marseille Université, FR
Jafar Anbar
Kalliopi Barka
Jordy Moies
Antonio Montanari

ATHENA RC, GR
Lydia Papadaki

Beijing Institute of Technology, CN
Shaoming He

Clean Sea Solutions, NO
Gulleik Olsen
Per Elvestuen

Cyprus Marine and Maritime Institute, CY
Christos Constantinides
Carlo Cernicchiaro
Daniel Hayes
Christos Keleshis
Ioannis Kyriakides
Marina Loizidou
Alberto Sposito
Charalambos Rotsides
Antri Theodorou

CNR, Italy
Marco Bibuli
Massimo Caccia

Constructor University, DE
Francesco Maurelli
Shixin Sun
Muhammad Hamza Hussain
Muhammad Waqar Mughal

Deep Trekker Inc., IT
Riccardo Caponi

DIH Agrifood Croatia, HR
Matija Bumbak
Krešimir Kovač
Ivana Bujas Rupić

dive-IT, HR
Željko Pavlaković

DNV, NO
Stephanie Kemna

Duck Tape, HR
Petra Kovačević

Equinor ASA, NO
Jonas Sorensen
Georgy Ushakov

Europaschule Schulzentrum Utbremen, DE
Ben Bahrke

Exploring Our Deep World, US
Aaron Newman

Faculty of Maritime Studies, University of Rijeka, HR
Antonio Blažina
Lovro Maglić

Fameline Energy, CY
Yiannis Champidis
Constantinos Georgiou
George Kazamias
Stephanie Mogharbel

FRI, University of Ljubljana, SI
Vid Rijavec

High school Bedekovčina, HR
Damjan Galina
Sara Jurman
Kristijan Kveštak
Luka Majsec
Lucija Trdinšak
Daniela Usmiani

IIT Madras, IN
Abhilash Sharma Somayajula

IN2 d.o.o. Zagreb, HR
Bojan Colnago

INESC TEC; University of Porto, PT
Nuno Cruz

Institute of Marine Sciences – OKEANOS, PT
Laura Gonzalez
Margarida Rolim

INESC TEC; University of Porto, PT
Nuno Cruz

KSET, HR
Ena Džanko
Fran Halambek
Katarina Pavić
Ivona Šarić

Marine Explorers society 20000 Leagues, HR
Ivana Zubak Čižmek
Hrvoje Čižmek

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Mepeco S.r.l., IT
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Norwegian University of Science and Technology, NO
Antonio Vasilijević

Primotronic, HR
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RIT Croatia, HR
Staša Puškarić

Schmidt Marine Technology Partners, USA
Erika Montague

School of Zoology, Faculty of Life Sciences & The Steinhart Museum of Natural History, Tel Aviv University, IL
Jonathan Belmaker
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Schulzentrum UT Bremen, DE
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Seacras, HR
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Šibenik Knin County, HR
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Technische Hochschule Mittelhessen, DE
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University of Zagreb Faculty of Electrical Engineering and Computing, Croatia
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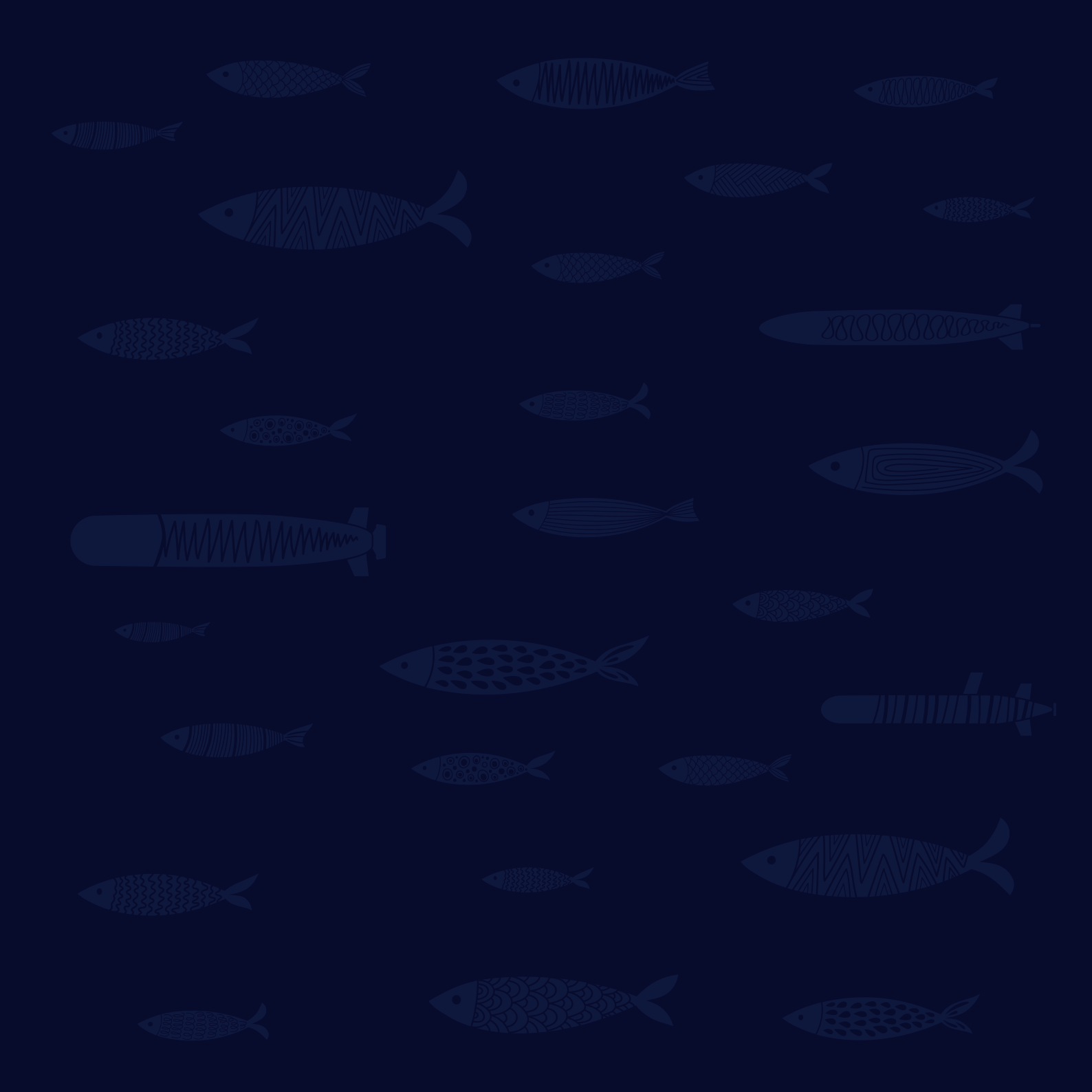


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