BREAKING THE SURFACE 2014 – List of lectures

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José Pinto	University of Porto (Portugal)	Coordinated Aerial, Surface and Underwater measurements using Networked Robotic Control
Antonio Pascoal	University of Lisbon (Portugal)	Exploring the frontier of cooperative marine robotics: Motion planning, navigation, and control
Enrica Zereik	National Research Council (Italy)	Performance Indices for Evaluation and Comparison of Unmanned Marine Vehicles' Guidance Systems
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Martin Dean	University of St Andrews (Scotland)	It's not what you do it's the way that you do it: A comparison between high-resolution geophysical wreck survey techniques.
John Odin Jensen	Woods Hole and University of Rhode Island (USA)	Marine Technology, Archeology and Dangerous Landscapes
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Lecturer	Institution	Title
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:Marine Security Session (MARSEC):		
Stefano Fioravanti	Centre for Maritime research and Experimentation (Italy)	ICARUS Project: Sensor Suite Integration and Implementation of Autonomous Behaviors on Unmanned Surface Vehicles for Search and Rescue Operations at Sea
Margo Edwards	University of Hawaii at Manoa (USA)	Techniques And Results For Munitions Assessments
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Mirko Orlić	Faculty of Science (Croatia)	Climate change, sea-level rise and coastal flooding

Abstract

MORPH project

MORPH project (http://www.morph-project.eu/), coordinated by ATLAS ELEKTRONIK (Dr. Joerg Kalwa), gathers a consortium of 7 partners (NATO-STO, Jacobs University, TU Ilmenau, University of Girona, IMAR – Instituto do Mar, Consiglio Nazionalle delle Ricerche, IFREMER, Instituto Superior Tecnico). The project proposes a novel concept of an underwater robotic system that emerges out of integrating, albeit in a non-physical manner, different mobile robot-modules with distinct and complementary resources. It will provide efficient methods to map the underwater environment with great accuracy in situations that defy existing technology: namely underwater surveys over rugged terrain and structures with full 3D complexity, including walls with a negative slope.

Biography:

Dr.-Ing. Thomas Glotzbach

Dr.-Ing. Thomas Glotzbach studied electrical engineering with the focus on automation engineering at the University of Applied Sciences in Fulda. From 2001 to 2010, he was with the Ilmenau Technical University and the Fraunhofer Application Center System Technology (AST). He received his doctoral degree in 2009 in the area of mission and manoeuvre management for autonomous mobile systems with different levels of autonomy. He participated in the European research project GREX Project in the topics mission planning, control algorithms and control design. In 2010 and 2011, he was with the Instituto Superior Técnico in Lisbon, Portugal in the framework of a Marie Curie Intra-European Fellowship, doing research in the areas of cognitive robotics, cooperative control and navigation of multiple marine robots. Since 2011, he is back at Ilmenau University of Technology as a senior researcher in preparation of his Habilitation, participating in the MORPH project with a focus on absolute and relative navigation for multiple unmanned marine vehicles with employment in real unstructured, 3D environments by use of acoustic / laser distance measurement and sensor data fusion as well as team mission planning for scenarios without a priori known vehicle paths and event driven planning paradigms.

Abstract:

Underwater communications: fundamentals, challenges and trends

The interest in underwater communication has grown rapidly in the last few decades as the ability to deploy assets in the sea with increased levels of autonomy led to the problem of getting data to and from these assets. In addition, as AUV technology has matured, the interest in using teams of AUVs has emerged as a powerful paradigm. It has therefore become clear that underwater communication plays a critical enabling role for the marine technology community.

Underwater communications suffer from limitations not seen in typical ubiquitous terrestrial systems. In fact, the underwater acoustic channel is possibly nature's most unforgiving wireless communication medium. The speed of sound in the water (around 1500 m/s) is very slow when compared to propagation of electromagnetic waves in air and can lead to significant Doppler and delay spreads.

The usable bandwidth is limited by the environmental noise and absorption, leaving a usable frequency range between some hundred hertz and some tens of kilohertz. Time-varying multipath, introduced by reflection, refraction and scattering is also a key factor that limits the performance of underwater acoustic communication systems.

This talk will give an overview of the limitations of underwater communications, and present the current state-of-the-art in terms of techniques to tackle the challenges at the different layers of the communication system . The current initiatives ongoing at CMRE will be presented and will motivate the introduction of future research directions.

Biography:

João Alves (PRT):

João Alves (PRT, male): received his B.Sc. and M.Sc. degrees in Electrotechnical Engineering, Control and Robotics, from the Technical University of Lisbon, Portugal. He started working in real-time systems applied to underwater robotics and had a key role in the development of the hardware and software architectures for the INFANTE autonomous underwater vehicle and the DELFIM autonomous surface craft, both developed at IST/ISR. In 2003 he co-founded the private start-up company Blue Edge – Systems Engineering, offering maritime technology services. In late 2009 João joined the NATO Undersea Research Centre (NURC), now Centre for Maritime Research and Experimentation (CMRE) as scientist to work on underwater communication systems. He has developed work in underwater communication protocols and standards with particular focus in ad hoc networking for autonomous maritime vehicles. Since 2012 João has taken the duties of Project Leader in CMRE as the lead scientist in the EC funded project MORPH, a European lighthouse endeavour in underwater robotics. Since May 2014 João is CMRE's project leader for the "Communications in the Maritime Environment" project. He was the Scientist-In-Charge in major sea trials including REP14-Atlantic, a month-long expedition on board the NATO Research Vessel "Alliance", off the coast of Portugal. João was also a capability leader during the 2014 NATO Coalition Warrior Interoperability eXploration, eXperimentation, eXamination, eXercise (CWIX 2014) presenting for the first time an underwater dimension to the exercise. Recently João was one of the co-organizers of the second IEEE OES UComms conference on underwater communications conference that took place in Sestri Levante, Italy.

João is a member of the IEEE, OES, AFCEA, ACM and AUVSI.

Abstract:

Cognitive autonomous diving buddy – CADDDY FP7 project

Divers operate in harsh and poorly monitored environments in which the slightest unexpected disturbance, technical malfunction, or lack of attention can have catastrophic consequences. They maneuver in complex 3D environments, carry cumbersome equipment, while performing the mission. To overcome the above problems, CADDY aims to establish an innovative set-up between a diver and companion autonomous robots (underwater and surface) that exhibit cognitive behaviour through learning, interpreting, and adapting to the diver's behaviour, physical state, and actions.

The CADDY project replaces a human buddy diver with autonomous underwater vehicle and adds a new autonomous surface vehicle to improve monitoring, assistance and safety of the diver's mission. This refers to a threefold role similar to those that a human buddy diver should have: *i)* the buddy "observer" that continuously monitors the diver; *ii)* the buddy "slave" that is the diver's "extended hand" during underwater operations performing tasks such as "do a mosaic of that area", "take a photo of that" or "illuminate that"; and *iii)* the buddy "guide" that leads the diver through the underwater environment.

The envisioned threefold functionality will be realized through S&T objectives which are to be achieved within three core research themes: the **"Seeing the Diver"** research theme focuses on 3D reconstruction of the diver model (pose estimation and recognition of hand gestures) through remote and local sensing technologies, thus enabling behaviour interpretation; the **"Understanding the Diver"** research theme focuses on adaptive interpretation of the model and physiological measurements of the diver in order to determine the state of the diver; while the "**Diver-Robot Cooperation and Control"** theme is the link that enables diver interaction with underwater vehicles with rich sensory-motor skills, focusing on cooperative control and optimal formation keeping with the diver as an integral part of the formation.

Biography:

Nikola Mišković (MSc 2005, PhD 2010) is an assistant professor at the University of Zagreb where he teaches control engineering related courses. He is a project coordinator of European Commissions seventh framework (FP7) project Cognitive autonomous diving buddy – CADDY. He was an assistant project manager and researcher in the FP7 CURE project, a researcher in FP7 CART, NATO-NURC collaboration project and FP7 EUROFLEETS2 project. He is the Programme Chair of "Breaking the Surface" workshops. He was a visiting researcher at Consiglio Nazionale delle Ricerche, ISSIA, Genova, Italy in 2008. He is a member of the IEEE Oceanic Engineering Society, the European Embedded Control Institute and the Association for Unmanned Vehicle Systems International. He is the author of 2 book chapters and more than 30 papers in journals and international conferences. His research interests include mathematical modeling, cooperative guidance, control and navigation of marine vessels (surface and underwater), nonlinear control theory and its applications in marine robotics.

Abstract

Coordinated Aerial, Surface and Underwater measurements using Networked Robotic Control

Boosted by recent advances in sensor technology and computational methods in Artificial Intelligence and Robotics, it has become increasingly viable to operate inexpensive multiple platforms across aerial, surface and underwater domains. In doing so, tantalizing new observation methods are possible that hitherto were unavailable for ocean exploration and doing so in coordinated ways to obtain synoptic and qusi-synoptic views of the changing ocean towards exploration of frontal zones, plumes, harmful algal blooms and anoxic zones over the meso-scale.

Yet there are substantial challenges which require careful thought to how such observations need to be conducted and under what operating conditions. In this talk I will articulate work in novel methods in Artificial Intelligence merged applied towards platform command and control at MBARI and networked robotics at the Univ. of Porto and how these have and could further jointly have a substantial impact in how we observe our changing oceans.

I will highlight the overall architecture of the Teleo-Reactive EXecutive (T-REX) an advanced control system for autonomous underwater vehicle, its divide-and-conquer strategy to solve complex mission planning and synthesis problems and the use of Machine Learning techniques which inform Sampling and adaptation of robotic vehicles in the water-column. And so in the context of the ecosystem of an advanced tool chain developed over the years at FEUP. These have now been merged and this talk will highlight the synergies and challenges that it has created.

I will endeavor to articulate how biological oceanography in particular can reap benefits of such advanced capabilities derived from decades of work in Artificial Intelligence, Robotics and Control and do so with actual examples of upper water-column sampling. I also describe joint operations in Portugal and Monterey Bay with the FEUP, Univ of Porto and with the use of deliberation for AUVs and UAVs and the way forward towards persistent exploration with such dual-use technology.

Biography

Jose Pinto has a Computer Science degree (2005) and specialization on Software Engineering (2007) from Porto University. Currently he is pursuing a PhD degree from Porto, Aveiro and Minho Universities on the topic "Software Infrastructures for Coordinated Networked Vehicle Systems".

Since 2004, Jose Pinto has been doing research at the Underwater Systems and Technology Laboratory (Porto University). There, he is one of the main developers of the Neptus Software Framework and has contributed to IMC and DUNE, all part of the open source LSTS toolchain for Networked Vehicle Systems. He has also gained more than 10 years of experience in the deployment and operation of AUVs.

Recently, he has been collaborating with MBARI for the extension of the LSTS toolchain towards onboard deliberative planning on AUVs, ASVs and UAVs.

Abstract

Exploring the frontier of cooperative marine robotics: Motion planning, navigation, and control

The last decade has witnessed tremendous progress in the development of marine technologies that are steadily affording scientists advanced equipment and methods for ocean exploration and exploitation. Recent advances in marine robotics, sensors, computers, communications, and information systems are being applied to the development of sophisticated technologies that will lead to safer, faster, and far more efficient ways of exploring the ocean frontier, especially in hazardous conditions. As part of this trend, there has been a surge of interest worldwide in the development of autonomous marine robots capable of roaming the oceans freely and collecting data at the surface of the ocean and underwater on an unprecedented scale. Representative examples are autonomous surface craft (ASC) and autonomous underwater vehicles (AUVs). The mission scenarios envisioned call for the control of single or multiple AUVs acting in cooperation to execute challenging tasks without close supervision of human operators.

This talk addresses the general topic of *cooperative motion planning, navigation, and control* of marine vehicles both from a theoretical and a practical standpoint. The presentation is rooted in practical developments and experiments. Examples of scientific mission scenarios with ASCs and AUVs, acting alone or in cooperation, set the stage for the main contents of the presentation. Especial emphasis is placed on the problem of operating groups of vehicles for scientific exploration and habitat mapping in complex 3D environments. From a theoretical standpoint, a number of challenging problems are addressed: *i) cooperative motion planning and control of groups of autonomous vehicles,* ii) *optimal sensor placement for multiple underwater vehicle localization with acoustic range measurements, and ii) underwater vehicle navigation using single-beacon measurements*. The results obtained are illustrated with videos from actual field tests with multiple marine robots. The core material presented in the talk was obtained in the scope of the MORPH (http://morph-project.eu/) and CADDY (http://www.caddy-fp7.eu/) projects of the EC.

Biography:

Antonio Pascoal received his PhD in Control Science from the University of Minnesota, Minneapolis, MN, USA. Assoc. Professor of Control and Robotics at IST, University of Lisbon, Portugal. Member, Scientific Council of the Institute for Systems and Robotics, Lisbon. Adjunct Scientist, National Institute of Oceanography (NIO), Goa India. Expertise in Dynamical Systems Theory, Robotics, Navigation, Guidance, and Control of Autonomous Vehicles, and Networked Control and Estimation. Elected Chair, IFAC Technical Committee Marine Systems, 2008. He was IST´s responsible scientist for eight EU funded collaborative research projects and several national research projects, all in the area of dynamical systems and ocean robotics. He has cooperated extensively with groups in Europe, US, and India on the development and testing of advanced robotic systems for ocean exploration. He is the author of more than 150 papers and communications on the subject, published in international journal and proceedings of conferences. His long-term goal is to contribute to the development of advanced robotic systems for ocean exploration and exploitation.

Abstract

Performance Indices for Evaluation and Comparison of Unmanned Marine Vehicles' Guidance Systems

Robotics is gradually becoming part of our daily life, starting from the first and simplest applications such as in domotics and assistance robotics. Foreseeing a context where both robots and humans are present, it is absolutely necessary to be able to assess robotic systems' performances (e.g. to ensure safety, reliability and effectiveness) according to actual and significant criteria. From such considerations, the need to establish common performance evaluation indices and to spread them among the robotic community arises.

In particular, within the marine context, the application of such indices allows the comparison of different architectures and robots, detecting the effectiveness of a specific algorithm with respect to another and, when teams from different institutions work together (e.g. within European projects), the objective and quantitative evaluation of the project overall performances. Broadly speaking, good methodologies and standard guidelines for the design of experiments are needed in the field of marine robotics, being this last very affected by experimental constraints such as controllability of the conditions (e.g. waves, sea currents, recreational and commercial traffic), restricted number of executable experiments (due to cost and logistic issues), uncertainty in the robot inputs (as, due to hydrodynamic interactions, forces and torques assigned to the system are known with uncertainty). Moreover, the assessment of a control algorithm can be helpful for the experimenter to conduct a field trial and to notice possible unusual responses, due for example to heavy disturbances or mechanical damages.

The theoretical basis and the preliminary experimental results for an implementation of performance indices to quantitatively measure the performance of a marine robotic system will be addressed in the talk, mainly speaking in a path-following context.

Biography

Enrica Zereik received her Master degree in Computer Engineering in 2006 at the University of Genoa, with a thesis focused on the design and implementation of a decentralized and self-organizing coordination and control architecture for a robotic hand-arm system. Since the same year she worked as a PhD student at the University of Genoa focusing her research activity on space robotics, closely working with Thales Alenia Space – Italy on different space robotics projects also involving the European Space Agency. In 2010 she received her PhD Degree in Electronic and Computer Engineering, Robotics and Telecommunications, discussing a thesis about the development and control of a robot prototype able both to cooperate with astronauts and to autonomously work alone on a planet surface, preparing the site for the human arrival. These work included research topics such as computer vision and force-based manipulation, visual odometry for mobile robot localization, environment perception and data fusion, coordination and control of complex robotic structures. She continued her research on space robotics at the University of Genoa as a postdoc, carrying on the collaboration with Thales Alenia Space – Italy. In the meantime, she broadened her research interests focusing also on underwater intervention robotics and contributing to Italian and European projects; in particular her research activity involved underwater manipulation based on visual feedback, coordination and control algorithms for unmanned marine vehicles. In 2012 she joined the Italian National Research Council, focusing her research activity on underwater manipulation, computer vision, advanced algorithms for navigation guidance and control of marine vehicles, evaluation indices and metrics for the experimental assessment of marine platforms' performance, coordination and control algorithms for multi-robot systems. She has active roles in the framework of different Italian and European Projects.

Abstract:

THESAURUS and ARROWS: trying to do something useful for underwater archaeologists

The talk will describe some experiences made in specifying, designing, building, and operating autonomous underwater vehicles devoted to underwater archaeology.

The 30-months THESAURUS project, funded by Regione Toscana between 2011 and 2013, allowed the newcomer group to develop a class of vehicles, jokingly named "Typhoon" capable of operation at 300m depth, equipped with optical and acoustic payloads in order to perform data acquisition during underwater archaeology campaigns. The Typhoon vehicles are still work in progress towards the objective of being effective and reliable, shortly: "capable of doing something useful for archaeologists." However they have been operating in some mission in the Mediterranean sea (Italy and Israel) looking for new wrecks to be discovered or known archaeological sites to be monitored/documented.

The 36-months ARROWS project, funded by the EU between 2012 and 2015 aims at developing a group of heterogeneous AUVs for different purposes, capable of communicating and cooperating. In particular the design of the MARTA vehicle will be described and compared with the Typhoon design.

Finally, based on the above experiences, the speaker will try to depict the "ideal set of robotics tools and techniques" needed in an archaeological campaign.

Biography:

Benedetto Allotta was born in Agrigento, Italy, in 1963. In 1987 he received the laurea degree in Mechanical Engineering from the School of Engineering of the University of Pisa. In 1992 he received the Ph.D. degree in Robotics from the Scuola Superiore Sant'Anna, Pisa where he was an assistant professor of Mechanical Engineering from 1993 till 2001, first within the ARTS Lab, and then within the PERCRO Lab of the same University. From 2001 to 2005 served as an associate professor within the Section of Applied Mechanics of the Department of Energy Engineering "Sergio Stecco" of the University of Florence, Italy. In 2005 he was appointed as a full professor at the University of Florence. He is now with the Department of Industrial Engineering (DIEF) http://www.dief.unifi.it where he coordinates the MDM Lab http://www.mdm.unifi.it, i.e. Mechatronics and Dynamic Modeling Laboratory. He gives courses in "Robotics," "Mechatronics," and "Mechanism and Machine Design" within the 3 years study programs of Mechanical Engineering and Electronic Engineering as well as within the graduate study program of Electrical and Automation Engineering. From 2010 till 2013 he served as the dean's delegate in charge for counseling and job placement activities at the school of engineering of the University of Florence. His current research interests are: marine and underwater robotics, industrial robotics, automation in transport systems, Hardware In the Loop (HIL) simulation, control of robots, mechatronics, sensor-based navigation of vehicles. He is author of about 200 publications, including more than 40 papers on international peer reviewed journals, and 2 granted international patents. Prof. Allotta was one of the co-founders of the first start-up company of the Scuola Superiore Sant'Anna, Pisa, named Scienzia Machinale S.R.L., Pisa http://www.smrobotica.it and he was a shareholder of the company till 1996. Prof. Allotta is founder and shareholder of MDM Team S.R.L., an official start company of the University of Florence.

Prof. Allotta is responsible of several competitive research grants and contracts coming from public agencies as well as private companies for a total amount of several hundreds thousand Euro/year. Among these:

- He is Co-ordinator of the FP7 collaborative project ARROWS (ARchaeological RObot systems for the World's Seas, 2012-2015), funded by the European Commission with 3 MEuro under grant agreement no. 308724. ARROWS proposes to adapt and develop low cost autonomous underwater vehicle technologies to signi_cantly reduce the cost of archaeological operations, covering the full extent of archaeological campaign.
- He is Co-ordinator of project SUONO (Safe Underwater Operations iN Oceans, 2014-2016) funded by the Italian Ministry of University, Education, and Research in the framework of the competitive Call Smart Cities, challenge Sea Technologies. SUONO aims at increasing the safety level of deep sea operations through the development of a new intervention robot with autonomous manipulation capabilities and the development of an hyperbaric rescue vessel devoted to save the saturated underwater operators in case of wreck of the mother ship.

Abstract

Discovering the Sea: New Frontiers in Data Gathering and Analysis

The study of submarine environments is affecting a growing audience in the fields of science, technology and entertainment. The documentation and cataloging of underwater sites as well as the supervision and sampling of biological parameters have always involved researchers from different studies.

The research team from the Department of Information Engineering of Università Politecnica delle Marche working on Underwater Robotics has been developing Navigation, Guidance and Control Algorithms for many years, specifically directed to underwater documentation, producing 2D reconstruction in real-time and 3D models offline.

This talk will introduce to the public the different research fields and projects regarding Underwater Investigation and Documentation carried out at the Università Politecnica delle Marche. The speech will briefly recall results obtained during the last year regarding underwater robotics developments and improvements. New data gathering and elaboration systems under development will be presented, explaining a complete architecture able to make the image and information acquisition easy, to elaborate data in semi-real time and to give out detailed 2D mosaic and 3D reconstruction of the areas explored. Recent results obtained with the previous system on the coralligenous area of Rapallo (Genoa – Italy) and on the archaeological site of Gnalic (Croatia) will be showed.

Biography

David Scaradozzi is currently an assistant professor at the Dipartimento di Ingegneria dell'Informazione (DII) - Università Politecnica delle Marche, Ancona (IT) and Chercheur Associé at the LSIS - umr CNRS 6168, Laboratoire des Sciences de l'Information et des Systèmes Equipe I&M (ESIL), Marseille(Fr).

After the PhD in Artificial intelligent systems, he had worked at Innovation and Technology Dept. Of Indesit Company and at InterUniversity Center of Integrated Systems for Marine Environment (ISME) as senior scientist. His research activities are in the field of robotics and automation, with special interests devoted to all the aspects involving planning, motion and interaction control problems in distributed agents, rapid prototyping, mechatronics and home automation. He is, and has been involved in different research projects funded by the European Economic Community, in collaboration with several industrial companies and academic bodies both national and international, all in the field of robotics and automation. In particular he was technical manager in VENUS FP77 European Project, tasked with developing and performing acceptance tests of Italian vehicles. VENUS concerned the use of ROV and AUV for the virtual reconstruction of underwater archaeological sites. He is the author or co-author of many papers and one book on the subject. He is an accredited ROV pilot of the micro and small class category since 2001. Actually he is professor of Elements of Automatic, Modelling and Identification of Dynamical Systems and Methods and Techniques for Automation. He has recently launched an LLP-Erasmus program between the Università Politecnica delle Marche and the Universities of Limerick, Evry and Zagreb for the exchange of students and graduate students between the respective groups as part of research activities on technologies and underwater robotics and an Erasmus-Placements program with the LSIS lab (umr CNRS6168 (Fr)).

During last years he has been conducted the scientific documentation of sea operative surveys for archaeological sites study using ROVs and other technological devices. One of these missions is constituted by the five-years work on the "Dolia" shipwreck of Marciana Marina – Elba Island (Italy) founded by MIBAC (Ministere dei Beni e delle Attività Culturali); he has been following another important archaeological site study in Kolocep – Dubrovnik (Croatia) collaborating with the University of Zadar.

Abstract:

Challenges and Advances in Geophysical Navigation of Underwater Robotic Vehicles

Despite the remarkable advances achieved in the field of marine robotics in the last decades, autonomous navigation of underwater robotic vehicles is still a challenging problem. Efficient and affordable navigation methods are required to enable these vehicles with the capacity of executing long-range and long-term missions without human intervention. Among the methods proposed to complement the conventional techniques of navigation whose limitations are well-known, the geophysical navigation (GN) approach has already demonstrated great potential for the development of a new generation of reliable and affordable navigation systems. The by now conventional GN approach often designated as bathymetric navigation, consists essentially in matching a set of range measurements acquired with sonar sensors installed in the vehicle with a previously acquired map of the terrain to estimate its position. Simultaneous localization and mapping (SLAM) is an alternative approach which does not require a prior map for navigation. The method consists in sequentially mapping the features observed in the environment while concurrently improving and reusing the map for self-localization. Geophysical navigation and SLAM are particularly well

suited for the navigation of autonomous vehicles in areas that need to be surveyed repeatedly since the cost of acquiring the prior maps is increasingly diluted in time. Examples of such missions include: habitat mapping and monitoring of geologically active areas of the sea-floor, inspection of submarine cables and pipelines, and submarine intrusion and mine detection.

The current presentation introduces a novel approach to geophysical navigation that exploits the geomagnetic field anomalies commonly observed in the seafloor as terrain features that do not need to be mapped a priori. Geomagnetic navigation presents the advantages of being passive and economical in terms of energy; magnetic sensors do not emit disturbing signals and their typical power consumption is orders of magnitude lower than that required by active systems such as sonar. Hence, magnetic-based GN seem well-suited for long-term navigation of autonomous vehicles in sensitive ecosystems and for the execution of covert operations.

The new methods presented are designed to implement analytical and Monte Carlo inversions of geomagnetic fields in real-time obtaining localization solutions that can be integrated with GN and SLAM. An inversion procedure is also developed to track moving vehicles based on the resulting disturbance of the environmental magnetic field. The cost versus performance trade-offs associated to different sensor configurations and the suitability of each sensor suite to the different methods proposed are discussed. The work borrows from the theories of classical electrodynamics and geopotential field inversion and introduces new analytic formulations designed to stabilize the solution of the inverse problem in real-time applications. Theoretical developments are complemented with results of recent experimental work and computer simulations using realistic scenarios.

Keywords: navigation; tracking; magnetic methods; inverse problems; Monte Carlo methods.

Biography:

Francisco Curado Teixeira, Post-doc Researcher, Institute for Systems and Robotics - LarSys - Instituto Superior Técnico, Portugal.

Francisco Curado obtained his PhD in Electronic Engineering from Instituto Superior Técnico (IST) in 2007 after concluding a MSc degree in Oceanography from the University of Aveiro, Portugal. Before engaging in his PhD work, he worked as a researcher for Marine Geophysics at the Portuguese Geological Survey where he developed a strong interest in geopotential field theory and geomagnetic signal processing. In that context, he organized and participated in more than twenty oceanographic cruises (5 of them international). His doctoral thesis addressed the problem of geophysical navigation with particular emphasis in the utilization of geomagnetic fields for terrain-based navigation of autonomous underwater vehicles. From 2008 to 2013 he developed post-doc work on the subject of geophysical navigation of oceanic robotic vehicles at the University of Aveiro. He joined recently the Dynamical Systems and Ocean Robotics Laboratory at the Institute for Systems and Robotics of IST. He is also a collaborator member of the Associated Lab CESAM (Centre for Environmental and Marine Studies) of the University of Aveiro. Francisco is the principal investigator of the research project ATLAS-Geo supported by the Portuguese Foundation for Science and Technology, dedicated to the development of geophysical navigation methods for oceanic robotic vehicles, and integrates the IST teams participating in the EU projects MORPH and CADDY.

Abstract

Flow sensing: new opportunities in robotics and biology

All 30 000 fish species have a special organ for sensing flow - lateral line sensing. At the same time no underwater robot so far is equipped with such a sensing modality. This talk is about what we could gain from equipping our robots with a sense that has been inspired by Nature's solution for surviving in an underwater environment. It is also about how this bio-inpsired technology would help us better understand fish and to protect their environment. I will demonstrate and explain how we have developed and tested artificial lateral lines in Centre for Biorobotics in Tallinn University of Technology, how we have learned to perceive and interpret the information if flow and how we have built robots that can sense flow and control themselves with respect to flow. Also, I will talk about how we use those sensors to better understand river hydraulics and hydrodynamics of fishways.

Biography

Prof. Maarja Kruusmaa is a Professor of Biorobotics and a head of Centre for Biorobotics in Tallinn University of Technology (Estonia). Her research interests include underwater robotics, bio-inspired robotics, fish locomotion and sensing, flow sensing, hydrodynamic imaging and experimental fluid dynamics. She coordinated a team building the first flow sensing underwater robot in FP7 project FILOSE.

Abstract

Autonomous underwater vehicles for marine research: what are scientists looking for?

To understand and protect ocean ecosystems, marine scientists need to collect high resolution data on topography and nature of the seabed along with the distribution and extent of the different biological communities and their physical-chemical environment. Over the past decade, commercial AUVs have emerged as valuable tools for the exploration of the ocean environment. AUV systems have been shown to be effective tools for rapidly and cost-effectively delivering high-resolution, accurately geo-referenced, and precisely targeted optical and acoustic imagery of the seafloor for both ecological and geosciences applications. The development of new AUV capabilities for marine research requires the close collaboration between engineers and end-users (science, industry) in order to define potential application scenarios, identify the shortcomings, and help improve them.

This talk will address utilization of AUV systems within several study-case scenarios such as the study of deep-sea coral habitats, ocean observatories, and monitoring of environmental impacts. Emphasis will be given to the application requirements in terms of mapping and imaging tools and sensors systems, and current challenges and limitations from a marine scientist perspective.

Biography

Dr. Marina Carreiro Silva is a marine biologist at the Centre of IMAR of the University of the Azores, studying the biology and ecology of cold-water coral ecosystems. Her current research activities focus on the study of the impacts of climate change on cold-water coral physiology and on reef framework destruction by bioerosion processes. Other research activities included studies on specific aspects of the biology and ecology of key cold-water corals species in the Azores, such as the taxonomy of cold-water corals and associated symbiotic species. She participates in several national and international research projects on cold-water coral ecosystems.

Abstract

Seabed habitat mapping

Sergej Olenin will be talking about seabed habitat mapping, use of underwater video for quantitative identification of benthic habitats (biotopes). He will consider benthic biotopes as functional units of marine coastal ecosystems. He will also talk about biological invasions and their role in changing marine environment, particularly benthic habitats. He will present a biologist's view on how marine robotics can help to solve research questions and environmental problems in the sea.

Biography

Sergej Olenin received his PhD from the A.N. Severtsov Institute of Ecology and Evolution (Moscow, Russia) in 1990 and D. Sc. from the Institute of Oceanology (Sopot, Poland) in 2006. He is Director of the Marine Science and Technology Center and a professor in Biological Oceanography at Klaipeda University (Lithuania), specializes in benthic ecology and aquatic invasion biology. Since 1980s he participated in research cruises in the Baltic and North Seas, Pacific and Atlantic Oceans; he conducted SCUBA diving and underwater video research expeditions in the Black Sea, White Sea and Svalbard. He is a member of the Editorial Board of the international journals Biological Invasions, Oceanologia, Oceanological and Hydrobiological Studies. In 2009-2010 he chaired the Joint Research Center / International Council for the Exploration of the Sea Task Group "Non-indigenous species" developing Good Environmental Status Descriptor for the EU Marine

Strategy Framework Directive. In time spent away from administration, grant hunting/reporting and teaching, he likes to hike, SCUBA dive, read books and listen sea or ethnic music.

Abstract

Quantitative video analysis for benthic study

In the last years, ROV and manned submersibles became easily accessible for the study of marine benthos, hence an increased number of studies have been developed by means of video recording analysis. However, only a limited part of these studies extract quantitative data from the video observations. Here we present the details of a recently developed method for the quantitative video analysis applied to the study of marine megabenthos at several depth ranges and in different areas from the Mediterranean Sea and the northeastern Atlantic Ocean. All the steps of the methodology will be detailed, from the correct data acquisition at sea, to the video and statistical analyses, and the interpretation of the results

Biography

The research conducted by **Andrea Gori** focuses on the study of the ecology and ecophysiology of marine ecosystem engineering species (primarily gorgonians, soft and stony corals) to provide understanding for the sustainable management and conservation of marine ecosystems located from the coastal area to the continental shelf and slope.

His research experience began during the undergraduate studentship with the development of the project to obtain a degree in Biological Sciences at the Università Roma Tre (May 2005, Rome, Italy), it continued during the PhD thesis at the Institut de Ciències del Mar (CSIC) (September 2011, Barcelona, Spain), and it has been enriched by acquiring ecophysiological knowledge during the postdoctoral position at the Centre Scientifique de Monaco (CSM) (Monaco, Principality of Monaco), the Heriot-Watt University (Edinburgh, Scotland), and the Universitat de Barcelona (Barcelona, Spain). Overall, this work was developed in a wide international context that allowed Andrea Gori to work in a total of 9 research centers in 5 different countries. Currently, Andrea Gori has published a total of 19 research articles in SCI journals (9 as first author). These results have also been presented at 18 international and 2 national conferences as 18 oral and 12 poster presentations. As a consequence of a wide field experience during the research career of Andrea Gori, a technical know-how has been also integrated into his academic knowledge.

Abstarct

Climate change, sea-level rise and coastal flooding

The presentation starts with an overview of the past global temperature variability – and especially of the temperature rise over the last hundred or so years – based on both observations and modeling. Some temperature projections for the twenty-first century are presented. Moreover, precipitation variability in the past and its expected changes in the future are briefly commented upon. The presentation then turns to three different methods that are used to determine sea-level change: reconstruction based on geological sea-level indicators, measurement with tide gauges of various types and measurement with satellite altimeters. Global sea-level variability over hundreds of thousands of years and sea-level rise during the last century are then described. It is pointed out that the changes depend on the changes of (1) the ocean volume due to the absorption of heat, (2) the ocean mass caused by the melting of glaciers and ice sheets, and (3) the ocean mass related to the varying water storage on land. The modeling of sea level is considered next. It is shown how modeling is used to project sea-level rise for the twenty-first century. These projections are compared with those obtained with an independent method, which utilizes various empirical relationships between global temperature and global sea level. It is found that the two methods give somewhat different results and the reasons for the discrepancy are addressed. Extreme flooding events in various places around the world are also considered, in particular those related to the hurricanes Katrina (2005), Nargis (2008), Sandy (2012), and Haiyan (2013). The projection of storm-surge events is briefly mentioned. The presentation then focuses on the Mediterranean and Adriatic area. It is shown that during the second half of the twentieth century the sea-level trends were close to zero in the area and that therefore they considerably departed from the global trends. A recent shift in the Mediterranean dynamics and the projections available for the sea are considered. Extreme flooding events in the Adriatic are described as well; it is pointed out that the Bakar tide gauge – the oldest one in Croatia – recorded four highest sea levels after the year 2008. The presentation concludes with a projection of the Adriatic storm surges.

Biography

Mirko Orlić, geophysicist, physical oceanographer (Zagreb, Croatia, 26 May 1955). Obtained Ph. D. in physics – physical oceanography at the University of Zagreb (1988). Visited several oceanographic institutes in Europe, spent a year as visiting scholar at the Scripps Institution of Oceanography in La Jolla, Ca, USA (1993). Researcher at the Center for Marine Research of the Rudjer Bošković Institute in Zagreb (1979–1983); subsequently employed at the Andrija Mohorovičić Geophysical Institute, Faculty of Science, University of Zagreb, most recently as professor (2000–). Teaches introductory courses on physical oceanography at the undergraduate and graduate levels, and a course on wind-induced coastal dynamics at the graduate level. Supervised preparation of about thirty B. Sc. theses, six M. Sc. theses, and six Ph. D. theses. Initiated and led a series of physical oceanographic experiments in the Adriatic; since 1983 supervises tide-gauge station at Bakar. Participated in a number of projects, led five national projects and eight international projects. Editor of Geofizika journal (1990–1992), of three conference proceedings (1999, 2001, 2008) and of a book (2011), guest editor of Journal of Geophysical Research (2004–2007) and of Journal of Marine Systems (2007–2009). Member of the American Geophysical Union and The Oceanography Society, president of the Croatian Committee for Geodesy and Geophysics. Major research interests include physical processes in coastal seas and atmosphere-sea interaction, particularly in the Adriatic area. Authored and co-authored more than 70 refereed publications, about 100 conference communications, a number of professional and popular papers, and a book on the weather and climate of the Adriatic area; the publications have up to now received more than 1000 citations. Obtained the Fulbright Award, the Croatian State Science Award, and the Croatian Academy Science Award.

Abstract

It's not what you do it's the way that you do it: A comparison between high-resolution geophysical wreck survey techniques.

The presentation will cover recent developments in high-resolution 3-D multibeam surveying and will include comparisons between results from different sonar systems, different deployment methodologies, and different approaches to data visualisation. An innovative robotic survey platform will be described that allows cost-effective multibeam sonar surveys of wrecks in deeper water compared to surveys using conventional work-class ROVs. The potential of mobile underwater laser scanning will also be discussed together with the most appropriate way to present multibeam and laser survey data to engineers, naval architects, accountants and, equally important, the public.

Biography

Martin Dean, Special Projects Consultant at AdusDeepOcean Ltd and Senior Research Fellow at School of History, University of St Andrews, Scotland.

Martin Dean was a keen diver with a passion for archaeology before he studied at the Institute of Archaeology, University of London. He worked on terrestrial archaeological sites before being appointed in 1981 as the Underwater Archaeologist at the National Maritime Museum in Greenwich, London. In 1986 he set up the Archaeological Diving Unit at the University of St Andrews working under contract to the UK Government to investigate historic shipwrecks. For the next 20 years he exploited a full range of geophysical survey techniques to support diving operations and this research led to interest from other government agencies and commercial companies.

In 2008 with colleagues, his university, and the nearby University of Dundee, he founded Advanced Underwater Surveys Ltd, now AdusDeepOcean Ltd, to exploit geophysical techniques developed for heritage management to survey and investigate modern wrecks and other man-made structures. Recent surveys include *Deepwater Horizon* at a depth of 1500m in the Gulf of Mexico, and the *Costa Concordia* in Italy.

He was the senior editor and a major contributor to *Archaeology Underwater: the NAS guide to principals and practice*, first published in 1992, and co-author in 1997 of the UK government's *Approved Code of Practice for Scientific and Archaeological Diving.*

Abstract

Marine Technology, Archaeology, and Dangerous Landscapes

Shipwrecks occur in particularly dangerous environments. In North America, the most dangerous places for ships have been its maritime frontier zones. Part of the Euro-American westward expansion, North America's maritime frontiers begin on the edges of Newfoundland and extend to the Bering Sea. They include coastal areas and major inland waterways. Alaska is the latest of these maritime frontier zones. The more than 3000 reported shipwrecks-- most from the late 19th Century to the present—reveal the power of frontier as a physical place and as an associated pattern of behaviors. This talk looks at shipwrecking and archaeological investigations from technological and frontier perspectives. Drawing on the experiences of multiple projects in Alaska and elsewhere, the lectures examines critical interplays between technology and environment in "Dangerous Landscapes" and suggests lesson learned in applying new marine technologies to archaeology in frontier marine environments.

Biography

Dr. John Odin Jensen is Associate Professor of Maritime Studies and Public Policy with the Sea Education Association in Woods Hole, Massachusetts (www.sea.edu) and Associate Research Professor of History at the University of Rhode Island. A historian, archaeologist, and policy practitioner, Jensen began his working career as a commercial fisherman in Alaska at the age of 10 in 1971 and brings extensive historical and practical knowledge of coastal seafaring. Jensen's teaching and policy work integrate cultural and environmental issues of coastal and inland maritime communities. He has participated in underwater archaeological and historical investigations in several North American maritime regions and has particular expertise in the Great Lakes, Mississippi River basin Alaska, and New England. He has published numerous articles and technical reports on Great Lakes and Alaska maritime archaeology, cultural heritage management, fisheries, and public health.

Abstract

A Platypus, a Typhoon, and 10,000 years of Civilization: field-testing the first generation of autonomous vehicles built for underwater archaeology

Since the early years of the modern discipline, nothing in the technology and methodology of underwater excavation has evolved as dramatically as site and landscape recording. Photogrammetry, digital photo-modelling, SLAM systems, and various high-resolution acoustic imaging technologies have all been touted as the 'next big thing' in site recording. Yet as much as archaeologists are eager to trade the laborious work of tape measures and datum spikes for the promises of the latest gadgets, we have yet to find a site-mapping technology with enough clear advantages for it to be widely adopted. Issues of cost, accuracy, and post-processing time are usually paramount. The capability to translate points and images into archaeologically useful data and diagrams is also a concern. In this paper I will discuss from an archaeologist's perspective the experience of using two prototype tools for archaeology that are attempting to meet some of these challenges: the Platypus autonomous robot (small-scale sites and harbors) and the Typhoon AUV system (maritime landscapes). The fieldwork will take place in Israel under the auspices of the Israel Antiquities Authority Maritime unit, and includes site, harbor, and submerged cultural landscape exploration and mapping in a variety of marine environments.

Biography

Dr. Bridget Buxton is an assistant professor of History at the University of Rhode Island and a member of URI's Archaeology Group. She obtained her Ph.D. in Ancient History and Mediterranean Archaeology from the University of California, Berkeley on a Fulbright, and her MA in Classical Studies (with distinction) from Victoria University, Wellington, New Zealand. Her archaeological field experience includes both land and underwater projects in Greece, Israel, Turkey, the Black Sea, and in her homeland of New Zealand. Since 2006 she has been involved in deep water projects under the direction of Prof. Robert Ballard of the University of Rhode Island and Prof. Shelley Wachsmann of Texas A&M Nautical Archaeology Program, and more recently joined a collaboration with the Israel Maritime Antiquities Unit. She obtained certification as an AAUS scientific diver and NAUI assistant instructor qualifications through Berkeley's scientific diving program in 2000. Her main areas of interest in addition to underwater archaeology include Roman and Hellenistic history and archaeology, and archaeological ethics. She held the McCann-Taggart lectureship in underwater archaeology for 2009-2010, and is currently beginning a third national lecture tour for the Archaeological Institute of America, speaking on underwater archaeology and the Roman emperor Augustus, which is under contract with Cambridge University Press.

Abstract:

Recent Development of the Gnalić Shipwreck Project

The shipwreck of Gnalić was officially registered in 1967. After several rescue campaigns, realized between 1967 and 1973, the project restarted in 2012, comprising the accurate study of the preserved historical sources. The ship proved to be a round merchantman with an extremely rich and exciting history. It was built in Venice in 1569, captured by the Ottomans in 1571, sold in Pera (Constantinople) to Odardo da Galiano in 1581, and sunk near Biograd na Moru in 1583. Systematic excavation led to the new interpretation of the hull remains and its original position on the seabed. The talk emphasizes the importance of accurate mapping of the shipwreck site, and discusses the possibility of its automation.

Biography:

Irena Radić Rossi graduated in archaeology from the University of Zagreb in 1988. After a long working experience in the cultural heritage protection service (today's Ministry of Culture of the Republic of Croatia) in the field of protection of coastal and underwater cultural heritage sites, she moved to the Department of Archaeology of the University of Zadar in 2009. Her main fields of interest are maritime and nautical archaeology, museology and virtual reality for archaeological purposes. Having gathered rich fieldwork experience on the sites from all the periods of human past, she currently directs a couple of international interdisciplinary projects focused on shipwrecks and coastal archaeological sites. She is associated researcher of CNRS – Centre Camille Jullian (UMR 7299, Aix-en-Provence, France) and the adjunct professor at Nautical Archaeology Program of the Texas A&M University (College Station, USA).

Abstract

The challenge of documenting and recovering artifacts from shallow underwater ancient sites situated along the Israeli Mediterranean coastline

The Mediterranean coasts have been a nursery for Maritime civilizations since Prehistoric times. During historical periods, the coasts functioned as crossroads and busy trading routes. Thousands of years of commerce, fishing, seafaring and naval warfare left an abundance of archaeological sites and remains on the shallow and deep seafloor. During five decades of underwater archaeology along the coasts of Israel, focused mainly in shallow waters, hundreds of archaeological assemblages of shipwrecks, artifacts and prehistoric sites were found. Most of the sites were exposed and found after strong sea storms removed the thick layer of sediments that protected and preserved them for thousands of years. From the moment of discovery underwater archaeologists are in a race to document and rescue finds and sites before they are destroyed or covered again by sediments. The basic tools and methods utilized by underwater archaeologists today have not changed in the last decades. This is done by divers with deployment of markers, poles, grids, etc. over the sea-bottom. Surveys with the traditional techniques require a considerable effort limiting the possibilities of multiple inspection surveys by the responsible agencies. For years archaeologists used the technology and tools of oceanographers to search the deep water archaeological sites and did not use or develop new technological tools for fast documentation of shallow water sites. For example the Caesarea harbors breakwaters and the prehistoric sites along the Haifa coasts.

The objective is to develop technologies and methods that are quick accessible and easy-to-use, to obtain 2D or 3D maps of underwater archaeological sites that will help reveal the processes that occurred in the site and aid in monitoring, management and development of the site for tourism.

Biography

Jacob Sharvit received his bachelor degree on biology in Hebrew University. His bachelor and master degree on archaeology and underwater archaeology he received in Haifa university. He is working as archaeologist and underwater archaeologist since 1988 . He is director of the Underwater Archaeology Unit of the IAA , including tens underwater archaeology excavations and surveys , management of the underwater and coastal archaeological of Israel . Published tens scientific articles , report and popular articles. He is commercial diver, technical diver all stages including TriMix and CCR (rebrithers) for more than 30 years.

Abstract

ICARUS Project: Sensor Suite Integration and Implementation of Autonomous Behaviors on Unmanned Surface Vehicles for Search and Rescue Operations at Sea

ICARUS is an EU-FP7 project in the field of unmanned Search And Rescue (SAR) operations. Project objectives are:

- Development of a light sensor capable of detecting human beings
- Cooperative Unmanned Aerial System (UAS) tools development for unmanned SAR
- Cooperative Unmanned Ground Vehicle (UGV) tools development for unmanned SAR
- Cooperative Unmanned Surface Vehicle (USV) tools development for unmanned SAR
- Heterogeneous robot collaboration between Unmanned Search And Rescue devices
- Self-organizing cognitive wireless communication network development, ensuring network interoperability
- Integration of Unmanned Search And Rescue tools in the C4I systems of the Human Search And Rescue forces
- Training and support system development of the developed Unmanned Search And Rescue for the Human Search And Rescue teams

Overall purpose of the ICARUS project is to apply its innovations for improving the management of a crisis and by doing so to reduce the crisis risk and impact on citizens. The use of unmanned search and rescue devices embedded in appropriate information architecture and integrated into existing infrastructures will help crisis personnel by providing detailed, and easy to understand, information about the situation. This system will inform crisis personnel about real dangers present on the ground, and will thus increase their performance in resolving the situation.

CMRE is involved in the project with the goal to design and build a sensor suite to be installed in the U-RANGER USV for enhanced autonomy. The U-RANGER USV should be an unmanned crisis response boat capable of delivering roving spot-coverage situation awareness, system communications, and life-rescue capability through deployable Unmanned Capsules.

In 2013 CMRE has developed a first prototype of sensor suite and autonomy behaviors and has collected a large amount of data during experiments at sea.

The selected sensors (multilayers laser scanner, combined Thermal/Visible camera with gyro-stabilization, high resolution Radar, loud-hailer, directional microphone) provide the USV obstacle avoidance capabilities, the ability to detect victims in water at 200m distance, and spot coverage situation awareness.

All the sensors processors are merged together to guarantee full autonomy within the framework provided by the MOOS-IvP architecture.

Experimental data collected during sea trials in 2013 and 2014 will be shown.

Biography

Dr. Stefano Fioravanti graduated from the University of Genova in 1990 where he also received his Ph.D. in image and signal processing in 1993, working within the Dept. of Biophysics and Electronic Engineering.

In 1995 he joined the Centre as a scientist, working on sonar signal processing, image analysis and sonar design for buried object detection and classification, with a particular emphasis on Synthetic Aperture Sonar. In 2000 he moved to the Engineering Department where he is currently Head of the Portable Sensors Section (PSB). Among other projects, he has worked on the system design, autonomy and design/integration/processing of advanced sensor suites for Unmanned Surface Vessels, Autonomous Underwater Vehicles, and on the design of various underwater data acquisition/processing systems. In addition, he has been also professor of Applied Oceanography for Military Operations at the Naval Academy School of Livorno during the period 2001-03

Keywords for expertise: Autonomous Vehicles, Digital signal processing, sensor integration, data acquisition, image processing

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Abstract:

Techniques and Results for Munitions Assessments

Since 2007 the University of Hawaii (UH), Woods Hole Oceanographic Institution and the environmental consulting firm Environet, Incorporated have assessed munitions and the surrounding environs at a deep-water munitions disposal site (HI-05) south of Oahu, Hawaii for the U.S. Department of Defense. Platforms used during this field program included research vessels, towed sonar systems, human occupied vehicles (HOVs), remotely operated vehicles, a towed, high-resolution, downward-looking camera, and autonomous time-lapse camera systems. Attached to these platforms were various sensors including

sonars, a deep-ocean mass spectrometer, a miniature autonomous plume recorder (MAPR), video cameras, environmental sensors and equipment to collect sediment, water and faunal samples within meters of suspected chemical and conventional munitions as well as at control sites. Physical samples collected by the HOVs included sediment and samples, shrimp and sea stars. Continuous mass spectrometer surveys were completed on three HOV dives. Both high- and standard-definition video data were acquired throughout each HOV deployment. During night-time towed camera transects of the field area, one picture was acquired every eight seconds from altitudes of 4-5 meters above the seabed, yielding a total of 30,000 high-resolution downward-looking images along 130 kilometers of track. The MAPR, attached to the towed camera system, collected pressure, temperature and turbidity measurements every 5 seconds throughout each of 17 tows. The time-lapse cameras were deployed for 1- and 3-day periods, documenting the interactions of macrofauna with two different munitions at 1 and 3.5 minute intervals. Some of these technologies were also deployed, informally, at shallow water sites including Ordnance Reef, located on the western side of the island of Oahu. I will present a general overview and comparison of the capabilities of various systems for assessing sea-disposed munitions, highlighting some of the scientific findings from the Hawaii Undersea Military Munitions Assessment.

Biography:

Margo Edwards is currently director at Department of Homeland Security National Center of Excellence for Island, Maritime and Extreme Environment Security,Univ. of Hawaii and a Senior Research Scientist at Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, University of Hawaii at Manoa. She got her PhD in Marine Geology and Geophysics at Lamont-Doherty Geological Observatory of Columbia University Her main research interests are marine geology and geophysics, remote sensing of the seafloor, mid-ocean ridges and Arctic Basin. Currently her scientific research is focusing on two projects, mapping the Arctic Basin using a swath bathymetry and sidescan system mounted on the hull of a US Navy nuclear-powered submarine, and using photographic and acoustic data from a variety of platforms to map the East Pacific Rise at very high resolution.