BREAKING THE SURFACE 2015 – List of lectures

Lecturer	Institution	Title
:Marine Robotics Session (MAROB):		
Asgeir J. Sørensen and Martin Ludvigsen	Norwegian University of Science and Technology - NTNU (Norway)	Towards Integrated Autonomous Underwater Operations
Thor I. Fossen	Norwegian University of Science and Technology - NTNU (Norway)	Unmanned Aerial Vehicles in Marine Operations
Kristin Y. Pettersen	Norwegian University of Science and Technology - NTNU (Norway)	Swimming manipulators – a bio-inspired solution for subsea inspection and intervention
Marco Bibuli	The Institute of Intelligent Systems for Automation (ISSIA), National Research Council of Italy (CNR) (Italy)	Guidance, interaction and understanding of the diver - A new challenge in marine robotics
Jeff Neasham	Newcastle University (UK)	Future directions in underwater communication networks for subsea robotics
Andreas Birk	Jacobs University Bremen (Germany)	3D Mapping in Marine Environments
Gianluca Antonelli	University of Cassino and Southern Lazio (Italy)	Underwater manipulation
António M. Pascoal	Instituto Superior Técnico (IST) (Portugal)	From Single to Cooperative Marine Robots: Planning, Navigation, and Control
Mirko Kovač	Imperial College London (UK)	From diving birds and flying fish to aerial-aquatic robots
Thomas Glotzbach	Ilmenau Technical University (Germany)	EU Research project MORPH: Results achieved and lessons learnt after the final sea trials in September 2015
:Marine Biology Session (MARBIO):		
Geir Johnsen and Jørgen Berge	Norwegian University of Science and Technology - NTNU (Norway)	The use of Underwater Hyperspectral Imaging to identify, map and monitor marine life on the seafloor
Ingunn Nilssen	Norwegian University of Science and Technology - NTNU (Norway)	Integrated Environmental Mapping and Monitoring
Jasmine Nahrgang	UiT The Arctic University of Norway (Norway)	Sensitivity of a key arctic species to climate and petroleum activities
Blaženka Gašparović	Ruđer Bošković Institute (Croatia)	Marine organic matter, minor contribution but major role
:Marine Archeology Session (MARCH):		
Stockton Rush	OceanGate (US)	OceanGate's Cyclops manned submersible capabilities
Bridget Buxton and Jacob Sharvit	University of Rhode Island (US) and Israel Antiquities Authority (Israel)	Digital Tools for Biblical Shores
Øyvind Ødegård	Norwegian University of Science and Technology - NTNU (Norway)	Towards Autonomy in Marine Archaeology

Giulia Boetto, Pierre Poveda	Aix Marseille University (France)	From shipwrecks to sailing ships
:Maritime security, naval and coast guard operations (MARSEC):		
Robin R. Murphy	Texas A&M University (US)	Unmanned Marine Vehicles at Disasters
Vladimir Djapic	Space and Naval Warfare Systems Command - SPAWAR (US)	Heterogeneous Autonomous Marine Mobile Expeditionary Robots
Stefano Fioravanti and Marin Stipanov	NATO - Centre for Maritime Research and Experimentation (CMRE), (Italy)	ICARUS – Maritime Unmanned Search and Rescue
Gregory Scott	Naval Research Laboratory (US)	
:Maritime oceanography (GRAPH):		
Finlo Cottier	Scottish Association for Marine Science (UK)	Marine Robotics to Support Research

Abstract

Title: Towards Integrated Autonomous Underwater Operations

The Centre for Autonomous Marine Operations and Systems (AMOS) at NTNU (Norway) is as a ten-year research program, 2013-2022, addressing research challenges related to autonomous marine operations and systems applied in e.g. maritime transportation, oil and gas exploration and exploitation, fisheries and aquaculture, oceans science, offshore renewable energy and marine mining. Fundamental knowledge is created through multidisciplinary theoretical, numerical and experimental research within the knowledge fields of hydrodynamics, structural mechanics, guidance, navigation and control. This paper gives an overview of the research challenges, achievements and experience at AMOS from selected field trials related to integrated autonomous underwater operations for mapping and monitoring purposes in coastal waters in Norway and Arctic operations outside Svalbard. Cutting-edge inter-disciplinary research involving technology and marine science fields such as marine biology and archaeology will provide the needed bridge to make high levels of autonomy a reality towards autonomous underwater operations. Integrating different sensors and sensors platforms such as Autonomous Underwater Vehicles (AUV), Remotely Operated Vehicles, moorings/landers and ship-based systems will be shown.

Biography

Asgeir J. Sørensen

Profesor **Asgeir J. Sørensen** obtained MSc degree in Marine Technology in 1988 at NTNU, and PhD degree in Engineering Cybernetics at NTNU in 1993. In 1989-1992 Sørensen was employed at MARINTEK as Research Scientist. In 1993 Sørensen was employed as Research Scientist at ABB Corporate Research Norway. In 1994 he became R&D Coordinator/Project Manager at ABB Industri. In 1996 he was appointed to Manager of Positioning Systems in ABB Industri. From 1998 to 2001 Sørensen was Technical Manager in the Business Area Automation Marine and Turbochargers, ABB Automation. In December 2002 Sørensen and 5 partners founded the company, Marine Cybernetics AS, where he was acting as President and Chief Executive Officer (CEO) until June 2010. In 2014 DNV GL acquired Marine Cybernetics AS. In 2012 Sørensen became a co-founder of the NTNU spin-off company Ecotone AS. Since 1999 Sørensen has held the position of Professor of Marine Control Systems at the Department of Marine Technology, NTNU.

He is currently acting as the Director of the Centre for Autonomous Marine Operations and Systems (AMOS) at the Departments of Marine Technology and Engineering Cybernetics, NTNU. Sørensen has authored more than 170 scientific articles and book chapters on ride control of SES, dynamic positioning of ships and semi-submersibles, guidance and control of underwater vehicles, control of marine structures, modelling and control of propulsion systems, power and energy management systems, and HIL testing and verification of control systems. Sørensen has graduated more than 90 MSc and 15 PhD candidates. He has also together with colleges established the Marine Cybernetics Laboratory (MC-Lab) and the Applied Underwater Robotics Laboratory (AUR-Lab), both at NTNU.

Biography

Martin Ludvigsen

Professor **Martin Ludvigsen** obtained MSc degree in Marine Technology in 2001 at NTNU, and PhD degree at NTNU in 2010. He started out at the Danish AUV provider Maridan AS before he started his PhD work. His research focus became the application of underwater robotics, cameras and acoustical instruments that provide quantitative scientific information. Back in the industry, he worked with Sperre AS, which provides ROVs to the industry inshore and offshore. He became involved in the field of Inspection Maintenance and Repair (IMR) and from 2012 to 2014 he led the development and delivery of an IMR module handling system for the Åsgård field for AXTech AS. In 2012 Ludvigsen was guest investigator at Woods Hole Oceanographic Institution on a Fulbright scholarship. Since 2014 Ludvigsen has held the position of Professor in Underwater Technology at the Department of Marine Technology, NTNU

Parallelly to his industry activities, Ludvigsen participated in the start-up of the Applied Underwater Laboratory (AUR-Lab) at NTNU in 2009. The AUR-Lab provides possibilities for testing during engineering trails and for scientific observations and collections of samples using underwater vehicles. Running a common pool of advanced underwater equipment and maintaining an interdisciplinary, the research group has proven useful for both engineers and scientists. Today, the AUR-Lab is considered an essential asset for multidisciplinary marine research at NTNU, facilitating a large body of research. Ludvigsen has been the manager for the AUR-Lab since its initiation.

Abstract

Unmanned Aerial Vehicles in Marine Operations

Many countries have vast coasts and economic zones that go far into the Atlantic and Arctic oceans and these are challenging to monitor and manage. The need to protect and manage the vulnerable natural environment and marine resources is becoming more and more important. This is seen by the the drive towards autonomous operations in more remote locations and harsher environment, which demands new approaches and technologies. A key enabling technology is the increased use of autonomous unmanned aerial vehicles (UAVs) instead of manned aircraft and satellite-based remote sensing, oftentimes exploiting strong collaborative links with buoys, ships and autonomous marine vehicles for in-situ observations.

The focus of the presentation is on UAV systems for marine and offshore applications. This includes sophisticated systems for automatic net-landing onboard ships and floaters, deployment and recovery of sensor nodes offshore and operation in Arctic conditions. Recent results on fault-tolerant inertial navigations systems aided by global positioning and camera systems are presented using low-cost MEMS and embedded system technologies.

Biography

Thor I. Fossen

Fossen is a naval architect and a cyberneticist. He received an MSc degree in Marine Technology in 1987 and a PhD degree in Engineering Cybernetics in 1991 both from the Norwegian University of Science and Technology (NTNU), Trondheim. He has been a Fulbright scholar in flight control at the Department of Aeronautics and Astronautics of the University of Washington, Seattle in 1989/1990. He was appointed professor of guidance, navigation and control at NTNU at age 30. He has been visiting professor at University of California, San Diego (UCSD), University of California, Santa Barbara (UCSB) and the Technical University of Denmark (DTU). In 1998, Fossen was elected to the Norwegian Academy of Technological Sciences. He is teaching, mathematical modeling of aircraft, marine craft, unmanned vehicles and control theory. Fossen has authored more approximately 300 scientific papers and 5 textbooks. He is one of the co-founders of the DNV GL company Marine Cybernetics where he was Vice President R&D in the period 2002-2008. He is currently the co-director of the Centre for Autonomous Marine Operations and Systems (AMOS) at NTNU. Fossen's expertise covers guidance, navigation, nonlinear control theory, unmanned vehicles (UAV, AUV, USV), autonomous and intelligent systems, hydrodynamics, ship control systems and nonlinear observers for strapdown inertial navigation systems. He received the Automatica Prize Paper Award in 2002 and Arch T. Colwell Merit Award in 2008 at the SAE World Congress.

Abstract

Title: Swimming manipulators – a bio-inspired solution for subsea inspection and intervention

Swimming manipulators are motivated by the long, slender and flexible body of biological snakes, which allows them to move in virtually any environment on land and in water. The swimming manipulator is a highly flexible and dexterous manipulator arm that can move underwater by itself like a snake. This highly flexible snake-like mechanism have excellent accessibility properties; it can for instance access virtually any location on a subsea oil & gas installation, move into the confined areas of ship wrecks, or be used for observation of biological systems. Furthermore, not only can the swimming manipulator access narrow openings and confined areas, but it can also carry out highly complex manipulation tasks at this location since manipulation is an inherent capability of the system. By incorporating the propulsion system and the manipulation capabilities in the same mechanical structure, this vehicle becomes highly compact and is able to bring inspection and intervention capabilities to locations where ROVs today cannot operate. In the longer term, this may enable reduced size and cost of subsea production systems.

In this talk, I will present swimming manipulators as a new solution for subsea inspection and intervention, and I will present recent research results on swimming manipulators, including both theoretical and experimental results.

Biography

Kristin Y. Pettersen

Kristin Y. Pettersen is a Professor in the Department of Engineering Cybernetics, NTNU where she has been a faculty member since 1996. She was Head of Department 2011-2013, Vice-Head of Department 2009-2011, and Director of the NTNU ICT Programme of Robotics 2010-2013. In the period 2013 – 2022 she is also Key Scientist at the CoE Centre for Autonomous Marine Operations and Systems (AMOS).

She received the MSc and PhD degrees in Engineering Cybernetics at NTNU, Trondheim, Norway, in 1992 and 1996. She has published 200 international papers for conferences and journals, and her research interests focus on nonlinear control of mechanical systems with applications to robotics, with a special emphasis on marine robotics and snake robotics. She has edited a Springer Verlag book on Group Coordination and Cooperative control, and is co-author of one Springer Verlag book on Snake Robots, and another on Modeling and Control of Vehicle-Manipulator Systems. In 2008, she was a Visiting Professor at the Section for Automation and Control, University of Aalborg, Denmark, and in 1999 she was a Visiting Fellow at the Department of Mechanical and Aerospace Engineering, Princeton University. In 2006, she and her co-authors were awarded the IEEE Transactions on Control Systems Technology Outstanding Paper Award for: *Global Uniform Asymptotic Stabilization of an Underactuated Surface Vessel: Experimental Results* (K.Y. Pettersen, F. Mazenc and H. Nijmeijer). She has served as Associate Editor for several conferences, including, the IEEE Conference on Decision and Control, the IEEE Conference on Robotics and Automation, and the IEEE/RSJ International Conference on Intelligent Robots and Systems. She has served as a member of the Editorial Board of Simulation Modeling Practice and Theory, and is an Associate Editor of the IEEE Transactions on Control Systems Technology and the IEEE Control Systems Magazine.

Webpage: http://www.itk.ntnu.no/ansatte/Pettersen_Kristin

Abstract

Title: Guidance, interaction and understanding of the diver - A new challenge in marine robotics

The lecture proposes the analysis of three focal aspect related to the development of a robotic system devoted to the diver operations support, with respect to the EU FP7 CADDY Project.

The three technical aspects are firstly highlighted and explained in an independent way, focusing on the practical challenges and solutions: i) compliant robotic platforms motion control, focusing on the ability of guiding the diver within the underwater environment; ii) diver/robot interaction achieved through the recognition of static and dynamic gestures; iii) language development for the interpretation of the diver behavior and related commands.

The three aspects are then melt together to reach the target of an integrated system for diver operation support in real case scenarios. The lecture proposes different simulative and experimental results at the current stage of the CADDY Project development.

Biography

Marco Bibuli

Marco Bibuli received his Master degree in Information Technology Engineering in 2005, with a thesis focused on the design and implementation of distributed control systems for modular robotic manipulators.
Since the same year, he joined the National Research Council of Italy, focusing his research activity on the design and development of navigation, guidance and control algorithms for unmanned marine vehicles and software architectures for supervision and mission control.
In 2010 he received the PhD Degree in Electronic and Computer Engineering, Robotics and telecommunications with a thesis focused on these mentioned research topics.
The research activity carried out by Marco Bibuli has the goal of enhancing the development and exploitation of robotic techniques and technologies in the field of marine and maritime applications. Regulation techniques are developed and implemented for linear and angular velocity control, while advanced guidance algorithms are developed to drive robotic platforms along desired geo-referenced trajectories. In particular, the problem of generic path-following has led to an important number of both theoretical and experimental results.
The development of mission control architectures is another key topic that leads to the autonomy capability improvement of marine robots; such frameworks allow to exploit robotic vehicles in real applications acting as effective tools for human operators.
Following the leading trends in the robotics' community, the research activity is currently focused on the extension of the mentioned topics towards the framework of heterogeneous multi-vehicle systems, where a set of surface and/or underwater robotic agents cooperate to achieve common mission goals.

Abstract

Title: Future directions in underwater communication networks for subsea robotics

The operation of subsea robotic and autonomous systems places ever increasing demands on wireless data communication in an environment that simply can't support the radio networking technology we take for granted above water. This talk will discuss how far we have progressed towards the goal of reliable communication and tracking for subsea robots, illustrated by recent work carried out at Newcastle University during the FP7 CADDY project, and future directions of research towards the goal of large scale subsea communication network infrastructure. For the benefit of a multi-disciplinary audience, the talk will begin with a (mathematically light) description of the properties of the underwater communication channel, why it proves so challenging and the techniques we employ to overcome this channel.

Biography

Jeff Neasham

Jeff Neasham is a Senior Lecturer in the School of Electrical and Electronic Engineering at Newcastle University UK. His main research interests are in underwater acoustic communication/positioning, sonar, wireless sensor networks and biomedical instrumentation. He has over 20 years of experience working on UK research council, MoD, EU and industry funded projects, publishing numerous papers in the field of underwater communication, and his team are currently members of the EU FP7 CADDY project consortium working on diver-robot cooperation. Several of his developments in underwater communication and positioning technology are commercially available through products marketed by Tritech International and Blueprint Subsea.

Abstract

Title: 3D Mapping in Marine Environments

Marine robots are increasingly used in complex applications taking place in complex environmental settings under descreasing human supervision, i.e. with increasing autonomy. Good internal representations of the environment, i.e., maps, are in these cases not only interesting as mission deliverables but they are also essential for the vehicle's operation. The talk gives an overview of recent advances in the field of robotic 3D mapping with a particular focus on underwater applications. Bathymetric maps are sometimes denoted as 3D - but they can only represent elevation of terrain, i.e., a 2D manifold in 3D space which is also known as 2.5D. Techniques for full 3D representation and processing are in contrast needed for mapping complex natural environments like cliffs or reefs as well as man-made structures. The presentation includes a coverage of the core elements in 3D mapping, i.e., an overview of the state of the art with respect to underwater sensors, 3D representations, 6 degrees of freedom (6-dof) registration methods, and 6-dof Simultaneous Localization and Mapping (SLAM). The

talk is completed by a hands-on tutorial where software for 3D mapping from the Jacobs Robotics group is used to demonstrate the different components and steps needed to generate 3D underwater maps.

Biography

Andreas Birk

Andreas Birk is since November 2011 a full professor in Electrical Engineering and Computer Science at Jacobs University Bremen where he leads the robotics group. He started at Jacobs University in fall 2001 as associate professor while rejecting an offer for a professorship (C3) at the University of Rostock. Before he joined Jacobs University, he held a research-mandate of the Flemish Society for Applied Research, IWT. He was in addition from October 1997 on appointed as visiting professor (docent) at the Vrije Universiteit Brussel (VUB). He also worked as a visiting professor (C3) at the Universitat Koblenz-Landau in the winter-semester of 1999/2000. During the almost six years at the VUB, Andreas Birk was a member of the Artificial Intelligence Lab, which he joined as Postdoc in April 1996. In 1995 he received his doctorate from the Universitat des Saarlandes, Saarbrucken, where he previously studied Computer Science from fall 1989 to spring 1993.

Abstract

Title: Underwater manipulation

Underwater intervention is a critical operation to be performed in a number of missions. This talk critically revises the current state of the art in manipulation tasks and the current on-going research toward the automatization of several manned operations. The work done by the speaker's research group in the framework of European and Italian projects will be also shown. The talk will have an informative shape in order to be enjoyable by non roboticists too.

Biography

Gianluca Antonelli

Gianluca Antonelli is an Associate Professor at the University of Cassino and Southern Lazio. His research interests include marine and industrial robotics, multi-agent systems, identification. He has published 34 international journal papers and more than 90 conference papers, he is author of the book *Underwater Robots* (Springer-Verlag, 2003, 2006, 2014) and co-authored the chapter "Underwater Robotics" for the *Springer Handbook of Robotics* (Springer-Verlag, 2008, 2015). He has been involved in various roles in research projects funded under FP7 and H2020 schemes: Co3AUVs, ECHORD, ARCAS, EUROC, AEROARMS, DexROV and WiMUST. He served both as independent expert and reviewer for the European FP calls several times since 2006. He is secretary of the IEEE-Italy section, he has been chair of the IEEE Robotics and Automation Society (RAS) Italian Chapter, and he has been Chair of the IEEE RAS Technical Committee in Marine Robotics. He served in the Editorial Board of the IEEE Transactions on Robotics, IEEE Transactions on Control Systems Technology, Springer Journal of Intelligent Service Robotics, and he is the Editor for the RAS Conference Editorial Board. He is chief editor of the open access journal *Frontiers in Robotics & AI* specialty "Robotic Control Systems".

Webpage: http://www.eng.docente.unicas.it/gianluca_antonelli

Abstract

Title: From Single to Cooperative Marine Robots: Planning, Navigation, and Control

There is currently widespread interest worldwide in the development of advanced robotic marine systems to drastically improve the methods available for exploring and exploiting the ocean and its frontiers. We are at the dawn of an era where groups of marine robots acting in cooperation will be able to acquire scientific ocean data on an unprecedented scale. Some of these robots will be fully autonomous and will therefore be able to roam the oceans freely (e.g., autonomous underwater vehicles (AUVs), autonomous surface vehicles (ASVs), and underwater gliders). The human dimension has also recently come to the fore, due to the realization that marine robots have the potential to substantially improve the safety conditions of human divers and assist them during the execution of demanding missions at sea. Meeting these goals calls for the development of networked systems that will allow for the establishment of symbiotic links between human divers and a set of companion autonomous underwater and surface robots. In summary, the use of autonomous marine vehicles is expected to have far reaching

implications in a large spectrum of scientific and industrial applications that include, but are not limited to fisheries and aquaculture, offshore wave and wind energy harvesting, underwater archaeology, oil exploration, deep-sea mining, transportation, and security.
A key enabling element for the execution of advanced robotic operations at sea is the availability of single and cooperative motion planning, navigation, and control systems. This talk addresses the latter topics, both from a theoretical and a practical standpoint. The presentation is rooted in practical developments and experiments. Examples of scientific mission scenarios with autonomous surface vehicles (ASVs) and autonomous underwater vehicles (AUVs), acting alone or in cooperation, set the stage for the main contents of the presentation. From a theoretical standpoint, special attention is given to a number of challenging problems that include cooperative motion control and navigation of groups of autonomous vehicles. The efficacy of the systems developed has been shown during real tests at sea. The connections with advanced methods for navigation, including single-beacon and geophysical-based navigation, are also discussed. The results 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

António M. Pascoal

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, from 2008-2014. 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

Title: From diving birds and flying fish to aerial-aquatic robots

Most robots are designed to either move in air or in water. Multi-modal mobility in both air and water and across fluid boundaries would allow for unprecedented mission capabilities that can not be done with only flying or swimming robots. For example, it would enable autonomous water sampling in inaccessible coastal areas, between floating ice in the arctic sea and during urban flooding situations where obstacles in the water inhibit access with single-mode robots. However, the conflicting design requirements for operation in air and water has prevented the demonstration of a fully functional aerial-aquatic robot.

In this talk, I will present how biological inspiration can help in the design of such vehicles and what we can learn from aerial-aquatic animals to build multi-modal robots. I will also present the current state of the Aquatic Micro Aerial Vehicle (AquaMAV) research at Imperial College London where we demonstrated successful transition principles from air to water and back to air enabling aerial-aquatic mobility in robotics.

Bigraphy

Mirko Kovač

Dr. **Mirko Kovač** is director of the Aerial Robotics Laboratory at theAeronautics Department at Imperial College London. His research interest is the conception and implementation of novel morphologies and locomotion methods for mobile robots and their analogy in biological systems. With his group he has developed multi-modal robots that can move in air, on ground and in water using the same propulsion systems and locomotory modules. His research focus is in bio-inspired robot design, fluid-structure interaction and smart materials. Before his appointment in London, he was post-doctoral researcher at at Harvard University in Cambridge, USA. He obtained his PhD at the Swiss Federal Institute of Technology in Lausanne (EPFL). He received his M.S. degree in Mechanical Engineering from the Swiss Federal Institute of Technology in Zurich (ETHZ) in 2005. During his studies he was research associate with the University of California in Berkeley USA, RIETER Automotive Switzerland, the WARTSILA Diesel Technology Division in Switzerland, and CISERV in Singapore. Since 2006, he

has presented his work at numerous international conferences and in journals and has won several best paper and best presentation awards. Also, he is advisor to the UK government on aerial robotics opportunities and he is founding member of the London Robotics Network that acts as the community building hub in the larger London area for robotics in academia and industry. He has also been invited lecturer at more than 35 research institutions world wide and has been representative speaker on education and innovation at the World Knowledge Dialogue Symposium 2008 and the London Innovation Summit 2014.

Webpage: http://www.imperial.ac.uk/aerialrobotics

Twitter: @AerialRobotics, @MKovacRobotics

Abstract

Title: EU Research project MORPH: Results achieved and lessons learnt after the final sea trials in September 2015

The reserach project MORPH (http://www.morph-project.eu/), supported by the EU within the 7th Framework Porgramme, is about to enter into the final phase this year. Coordinated by ATLAS ELEKTRONIK (Dr. Joerg Kalwa), it gathers a consortium of 9 partners (Centre for Maritime Research and Experimentation, Jacobs University, TU Ilmenau, University of Girona, IMAR – Instituto do Mar, Consiglio Nazionalle delle Ricerche, IFREMER, Instituto Superior Tecnico). The project goals are to realize a marine Supra-vehicle our of several autonomous single units, called nodes, to perform challenging underwater application that are beyond current state-of-the-art, like the mapping of vertical underwater structures. Since its beginning, the project has contributed to important progresses in the research in underwater robotics, of which several have been reported in the previous BtS-events. An important milestone, the realization of the mentioned Supra-vehicle over flat terrain, was presented last year. With the final sea trials planned in September 2015, this year's lecture will sum up the efforts executed in the last year in order to reach the final goal, the mapping of a vertical underwater wall, and will report the results achieved in the three sea trials organized by the consortium in 2015. On top of that, some of the lessons learnt when operating a huge number of marine robots from different partners/providers will be discussed.

Biography

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

Title: The use of Underwater Hyperspectral Imaging to identify, map and monitor marine life on the seafloor

Currently a new Underwater Hyperspectral Imager (UHI) have been deployed on ROVs for a more automated identification, mapping and monitoring of bio-geo-chemical objects of interest. Sea floor maps based on UHI can be used to classify different objects of interest (OOI) based on specific optical fingerprints providing spectral upwelling radiance or reflectance with up to 1 nm spectral resolution in the visible range for each image pixel. Different habitats comprising soft bottom, deep and cold water coral reefs, sponge habitats, pipeline monitoring and kelp forest maps are examples for UHI-based mapping. The overall image quality and identification success of OOI can be optimized if movements of the ROV is controlled by a dynamic position system and corresponding speed, altitude, pitch, roll and yaw control. Likewise, illumination control is important to provide proper light intensity, spectral composition and illumination evenness of OOI. The benefits of using UHI for seafloor habitat mapping can be evaluated by four categories of resolution. These are A) spatial resolution (image pixel size), B) spectral resolution (1–

10 nm, 400-800 nm), C) radiometric resolution (dynamic range, bits per pixel), and D) temporal resolution. These categories of resolution are discussed with respect to OOI identification and mapping.

Biography

Geir Johnsen

Geir Johnsen is a professor in marine biology at Dept of biology Norwegian University of Technology and Science (NTNU), Prof II at University Centre on Svalbard (UNIS), and is one of the founding partners in a NTNU spin-off company Ecotone using new optical techniques for mapping and monitoring the marine environment. He has been at 1 years research stay at University of California at Santa Barbara (1992-93) and at Curtin University, Perth, Australia (2010-11). Adviser for 34 MSc and 12 PhD students graduated. Currently he advises 10 MSc and 5 PhD students, published >100 papers in international scientific journals and been a co-editor for the books "Ecosystem Barents Sea" (Tapir Academic Press) and Phytoplankton pigments: Updates on Characterization, Chemotaxonomy and Applications in Oceanography (Cambridge University Press, 2011). Research areas: Marine ecology and biodiversity, bio-optics, photosynthesis, pigment chemotaxonomy, underwater robotics and sensor development for *in situ* identification, mapping and monitoring of bio-geo-chemical objects of interest in the marine environment.

Biography

Jørgen Berge

TBA!

Abstract

Title: Integrated Environmental Mapping and Monitoring

The talk will present a conceptual approach to integrated environmental mapping and monitoring (IEMM). The different steps from purpose of mission to selection of parameters, sensors, sensor platforms, data collection, data storage, analysis and to data interpretation for reliable decision making will be described. To operationalise the content of the concept, case studies from the marine environment will be presented.

Biography

Ingunn Nilssen

Ingunn Nilssen holds a MSc in Marine Biology from the University of Oslo, Norway from 1996. After completing her studies she worked for the Norwegian Pollution Control Authority with petroleum related issues for 7 years. The areas of responsibility covered discharge permits, audits, regulations, produced water related issues, environmental monitoring and foreign aid programmes. Since 2004, Ingunn has been working for the Norwegian oil company Statoil. In Statoil she has mainly been working with research related to environmental monitoring and environmental technology. She has coordinated the Research & Development activities related to environmental monitoring and led the environmental group within the Norwegian Deep Water programme. Through a position in the HSE staff for Production and Development Norway (2009-2011) she gained more operational experiences. Currently Ingunn is conducting her Industrial PhD on Integrated Environmental Monitoring through Statoil and NTNU. The main areas are focusing on: visualising the advantages of flexible environmental monitoring, optimised selection and interpretation of data, and to provide processes ensuring that decision makers get appropriate data in due time.

Abstract

Title: Sensitivity of a key arctic species to climate and petroleum activities

The Arctic is becoming a centre of attention with increasing human activities and warming of the climate, affecting marine ecosystems. With the reduction of sea ice, shipping has increased along Arctic shelf seas, and boreal species have extended their distributions further north. At the same time, the oil and gas industry is pushing the boundaries of resource exploration northward towards the Arctic Ocean. In this context of increasing anthropogenic pressure in an ecosystem often considered fragile and pristine, there is a need to fill important gaps in knowledge regarding the basic biology of Arctic species and their sensitivity to a combination of human and environmental stress factors. As an example, polar cod (Boreogadus saida), a key species in the Arctic ecosystem may be particularly sensitive to oil pollution during its early life stages. Polar cod has positively buoyant eggs, aggregating under the ice where spilled oil may also accumulate. An exposure study on embryos to very low levels of water soluble fractions of crude oil showed significant increases in the occurrence and severity of malformations with treatment, in addition to reduced cardiac activity in hatched larvae. The long development, and thus

exposure time are thought to increase the susceptibility of the embryos to extremely low levels of contaminants compared to other species. Although adult specimens may be more robust, significant deleterious effects such as delay in egg maturation and reduced sperm mobility (under analysis) may occur during reproductive development. The ecologic importance of such effects may be enhanced by co-occurring population effects from climate warming. Based upon a large-scale field study, adult polar cod showed signs of an impaired breeding stock and reproductive success in regions of strong warming. The combined effects of climate warming and exposure to toxic oil compounds may have significant effects on growth and life history characteristics of polar cod that will lead to alteration of its role as an Arctic keystone species. This may in turn affect community dynamics and energy transfer in the entire Arctic food chain.

Biography

Jasmine Nahrgang

Dr Jasmine Nahrgang is an Associate Professor at the Department of Arctic and Marine Biology of UiT The Arctic University of Norway and holds an adjunct position at the University Centre In Svalbard. She is leading the educational work packages of the Research Centre for Arctic Petroleum Exploration (ARCEx) and the Environmental Waste management project (EWMA), and responsible for a bachelor programme in Environmental management at UiT.
During the last 10 years she has developed a strong research background within marine ecotoxicology, and specifically biological effects of petroleum related pollution in species (mainly fish and bivalves) from both the southern and northern Barents Sea. She took her PhD degree in 2010 at Akvaplan-niva, and was then employed as a researcher in the same company, working on projects in collaboration with the industry. In 2012, she started a post-doctoral fellowship at UiT on the EWMA project and got two international research projects funded by the Norwegian research council that she has been leading since.
Dr Nahrgang investigates the effects of oil contaminants on Arctic species, especially focusing on the keystone fish polar cod. Dr Nahrgang´s research interest also includes ecological studies of Arctic organisms and their response to combined natural and anthropogenic stressors. She combined basic ecological understanding with toxicological questions and methods (e.g. in vitro cultures), using both experimental studies (toxicokinetics and mechanistics) and field-based work to understand risks and sensitivity of Arctic species to climate and expanding activities in the Arctic.

Abstract

Marine organic matter, minor contribution but major role

Marine organic matter (OM) is a minor component, in a comparison to the inorganic salts, but has a great influence on the biological, chemical, geological and physical processes taking place in the seawater. It is a very complex mixture of substances possessing different physico-chemical properties and originating from different sources, mainly from in-situ production and in less extent from the atmosphere and the land. The general roles of OM are: forming tissues and structural support for marine organisms, physiological adaptation, food source for heterotrophs (bacteria), communication and defense. Investigation of some organics can serve as early warning system for environmental changes. The talk will present results on the plankton accommodation to stressful environmental condition by changing organic matter production (lipids, surface-active substances).

Biography

Blaženka Gašparović

Blaženka Gašparović is senior scientist at Ruđer Bošković Institute, Zagreb. She received PhD in Oceanology in 1996. Her work includes: direction of 5 research projects, associate on 10 projects, two submitted project as PI to EU FETOPEN call and to Coastal and Marine Research in Lower Saxony, Germany, published 37 publications in international journals, 62% as main author, 20 invited presentations and over 50 communications and workshops, supervision of 2 PhD students and 3 engineers, lecturer of 2 courses, organization of 3 international conferences, member and/or reviewer of 4 PhD defense committees in Croatia, external reviewer for numerous international journals. Research area: lipid biogeochemistry, marine carbon cycling, characterization and cycling of surface active substances in seawater and sea-surface microlayer, marine sensors.

Abstract

Title: OceanGate's Cyclops manned submersible capabilities

Since 2010, OceanGate Inc. has used a number of manned submersibles to assist with the development and testing of new sonar, guidance and imaging systems. By allowing untethered and easily controlled motion, manned subs offer a unique platform to test many new autonomous vehicle systems. Some systems that are too large or too power intensive to be tested on existing AUVs can limit testing options and may force a program to wait for the full vehicle to be completed before they can gain real world data. However, by placing sonar, guidance or camera systems on a manned submersible, where an engineer can be inside the vehicle and adjust test profiles and even rewrite software on the fly, a program can rapidly advance system development and reduce costs. This development paradigm is similar to that used in aviation where engines and avionics are often tested on a vehicle completely different from the ultimate intended aircraft.

The presentation will cover OceanGate's Cyclops manned submersible capabilities and discuss specific examples where an OceanGate submersible was able to be both a target and a testing platform as well as examples of other scenarios where a manned submersible can reduce development times and costs.

Biography

Stockton Rush

Stockton Rush is Chief Executive Officer and Co-Founder of OceanGate Inc. As CEO, Rush is responsible for OceanGate's financial and engineering leadership, shaping the company's strategic direction with a clear vision focused on developing manned submersible solutions for commercial, scientific and exploration opportunities.

Rush began his career early, becoming the youngest jet transport rated pilot in the world when he obtained his DC-8 Type/Captain's rating at the United Airlines Jet Training Institute in 1981 at the age of 19. He proceeded to serve as a DC-8 first officer during college summers, flying out of Jeddah, Saudi Arabia for Overseas National Airways under a subcontract from Saudi Arabian Airlines. In 1984, Rush joined the McDonnell Douglas Corporation as a Flight Test Engineer on the F-15 program.

Over the past 20 years, Rush has overseen the development of multiple successful IP ventures. He most recently served on the Board of Directors for Seattle's BlueView Technologies, a manufacturer of small, high-frequency sonar systems. He continues to lend his comprehensive business expertise to several Seattle companies, currently serving on the Board of Directors of Entomo, an enterprise software developer focused on post-sale channel management and financial reporting. Rush also serves as Chairman of Remote Control Technology, Inc. (RCT), a manufacturer of wireless remote control devices for several Fortune 500 industrial clients.

He obtained his BSE in Aerospace Engineering from Princeton University in 1984, and his MBA from the U.C. Berkeley Haas School of Business in 1989.

Abstract

Title: Digital Tools for Biblical Shores

Submerged along the shallow Mediterranean coasts are thousands of archaeological sites: more than 4000 documented harbors and anchorages, many of which are over 2000 years old. We provide a brief overview of the historical evolution of ancient harbor engineering, describing the most interesting and innovative technological aspects, and the new appreciation for these structures brought about by archaeology. Ancient harbors are important cultural and economic resources for tourism, but traditionally the management, monitoring, and protection of Mediterranean coastlines has focused on the natural environment. Inshore coastal heritage is also neglected in the archaeological world, where the focus on developing new technology has almost exclusively been directed towards deepwater sites, especially shipwrecks. In recent times, however, evolving environmental, economic, and security concerns have brought coastal sites back into focus, creating new technological needs and opportunities. Every year, winter storms transform the underwater coastal landscape of Israel, often exposing ancient ruins and shipwrecks. Unfortunately the resources to document, monitor, and protect those sites are limited. In February 2015, amateur divers discovered a 1000-year-old Fatimid gold coins and reported to the IAA. Later underwater excavation reviled treasure of over 3000 gold coins and the remains of a medieval shipwreck inside the ancient Caesarea harbor(the excavation is still in action). The University of Zagreb Pladypos ASV is one of the new technologies being utilized to investigate this important discovery, as well as mapping Caesarea's ancient harbor. We reflect on this experience of deploying new robotic technologies in coastal underwater archaeology. In addition, we consider the needs and economic opportunities associated with the application of new marine technologies for coastal underwater sites.

Biography

Bridget Buxton

Dr. Bridget Buxton is an associate 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 is currently working on a Croatian aviation archaeology project under the direction of Megan Lickliter-Mundon, Texas A&M. Since 2010 she has been collaborating with Jacob Sharvit and the Israel Maritime Antiquities Unit at the Hellenistic port of Akko and other underwater sites along the Israeli Coast. She is a regular educational speaker on archaeological themes for the Archaeological Institute of America and the cruise ship industry, and publishes on topics in underwater archaeology and the Roman emperor Augustus.

Jacob Sharvit

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

Title: Towards Autonomy in Marine Archaeology

This talk will present the application of underwater robotics to marine archaeology in research cruises conducted by AUR-Lab. Using Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) as platforms, several novel sensors have been applied to selected underwater cultural heritage sites. This paper will present some examples of data acquired by an Underwater Hyperspectral Imager (UHI), Synthetic Aperture Sonar (SAS) and stereo camera photogrammetry. The talk will suggest possibilities for integrating autonomy into marine archaeological praxis, and highlight some impacts this will have on archaeological knowledge production.

Biography

Øyvind Ødegård

Øyvind Ødegård received his Master degree in Archaeology in 2002 with a thesis on symbolic aspects in Viking age and medieval ship building in Northern Europe. Since 2003 he has held a position as marine archaeologist at NTNU University Museum, working with underwater cultural heritage management in Norwegian territorial waters. He has led numerous marine archaeological projects, both diver and robot based. From 2007 to 2013 he was GIS manager at the same institution, working with the transition from analog to digital data recording in archaeological field projects. Since 2011 he has been a board member of NTNU's Applied Underwater Robotics laboratory (AUR-Lab), and has been principal scientist for archaeology at many of AUR-Lab's multidisciplinary research cruises. Since 2013 he has been a PhD-student at the Centre for Autonomous Marine Operations and Systems (AMOS), working in an interdisciplinary project bringing archaeological end-user perspectives into the marine cybernetics domain.

Abstract

Title: From shipwrecks to sailing ships

Through case studies both from both terrestrial and underwater archaeological excavations, we will present the methodology used by the Nautical Archaeologists of the Centre Camille Jullian (UMR 7299, Aix Marseille University, CNRS) to record, study and finally reconstruct the original shapes of Ancient ships though an extensive, and reasoned, use of informatics.

We will see:

- the different steps used to gather the data from the shipwrecks during fieldwork (excavation, labelling, photogrammetric survey and sampling);
- the process of analysis and interpretation of the data through the creation of virtual models of the preserved remains of the ships, permitting the fine detailed study of the hull's' deformations ;
- the process used to define one or more valid hypotheses of rigorously based rigorously on the archaeological preserved remains and on various elements of comparison (iconographic etand ethnographic parallels, literary sources, comparable remains) to reconstruct the original shapes of the ships);
- the production of additional information on the nautical qualities and sailing capabilities of the hypothetical reconstructed ships based on the analyseis of virtual models.

Biography

Giulia Boetto

Dr. Giulia Boetto is first class researcher in Nautical and Maritime Archaeology at the French National Centre for Scientific Rresearch (CNRS). and sShe is based at the Centre Camille Jullian (UMR7299, Aix Marseille University, CNRS) in Aix-en-Provence, France. Dr. Boetto achieved her bachelor degree in Classical Letters in 1993 (University of Turin) and a post graduation Master in Classical Archaeology in 1998 (University of Turin). Parallel to her schooling, Dr. Boetto worked as a free-lance (contractual) land and underwater archaeologist for the Italian Ministry of Culture; and in 1997 she moved toin Ostia (Rome) to be in charge forof the EU funded projects Navis I and Navis II and others research activities of the Museum of the Ships (Fiumicino) and of the Archaeological Superintendence of Ostia. In 2004, she was placed has been in charge of the study of the shipwrecks discovered in the Roman silted harbour of Naples. In 2006, sShe completed her PhD in Letters and Human Sciences at the University of Provence with the dissertation "The Fiumicino ships (Italy): architecture, materials, types and functions. Contribution to the study of the harbour system of Rome under the Empire", in 2006. She accepted the post of From 2007, she is permanent first class researcher at CNRS in 2007.

Dr. Boetto's research focuses on ancient ships (typology and function) through archaeological, written, iconographic, ethnological and archaeometric sources within two main topics: 1. The iInterrelation between ships, in particular service boats, and harbours based on fieldwork in Western Roman Mediterranean harbours, including Ostia-Portus, Naples, Toulon and Antibes; 2. Eastern Adriatic Ancient Shipbuilding in the framework of the Franco-Croatian projects in Pakoštane, Caska bay (University of Zadar) and Istria (Archaeological Museum of Istria). Dr. Boetto is also interested in the development of the photogrammetric techniques in shipwreck survey and ship 3D reconstruction and modelling.

Finally, Dr. Boetto coordinates the Nautical Archaeology Teaching Unit of the new Masters programme on the Maritime and Coastal Archaeology (MoMArch), labeled in the "Excellence Academy" by the A*MIDEX University Foundation (Aix-Marseille University, http://amidex.univ-amu.fr/en/momarch, https://momarch.hypotheses.org/).

Pierre Poveda

Dr. Pierre Poveda is second-class engineer of research in Nautical Archaeology at the French National Centre for Scientific Rresearch (CNRS). and hHe is based at the Centre Camille Jullian (UMR7299, Aix Marseille University, CNRS) in Aix-en-Provence, France. After his Master degree in Archaeology at the University of Provence (2008), Dr. Poveda completed his PhD Thesis at the Aix-Marseille University in 2012, working on displacements and nautical qualities of Ancient Mediterranean ships through the use of 3D numerical methods, computer-aided graphic tools and hydrostatic calculations. In 2013, within the "Prôtis Project: reconstruction of the sailing replica of a Greco-Massaliote boat of the 6th c. BC", he was in charge of the technical coordination of the construction of the Gyptis sailing replica of the Greco-Massaliote Jules Verne 9 fishing boat. As nautical archaeologist of the private French enterprise "Ipso Facto", he participated to the excavation, study and 3D reconstruction of the Gallo-Roman barge Arles-Rhône 3. InFrom 2014, Dr. Poveda becameis permanent second-class engineer of research; in addition to and, besides the study of the sailing performances of the Gyptis replica within a long-term sailing programme, he participates in to the reconstruction studies of the original shapes and structures of the shipwrecks (Antibes, Jules-Verne, Naples, Fiumicino, Isola Sacra, Caska) studied within the Nautical Archaeology research programme of the Centre Camille Jullian.

Abstract

Title: Unmanned Marine Vehicles at Disasters

Between between 2001 and 2013, at least 31 unmanned marine vehicles have been deployed to seven disasters. The growth in the number of UMVs is expected to continue and possibly become more frequently used than unmanned ground and aerial vehicles because flooding is the most common and costly disaster in the world. This talk will review the reported UMV deployments through 2015, robot performance at each incident, and emerging research gaps. The analysis identifies several dichotomies impacting the application of UMVs for disasters, especially deep water or shallow littoral regions, inspection versus manipulation tasks, and debris versus open water environments. Extensive video will be shown.

Biography

Robin Roberson Murphy

Robin Roberson Murphy is the Raytheon Professor of Computer Science and Engineering at Texas A&M, Director of the Center for Robot-Assisted Search and Rescue and the Center for Emergency Informatics. She received a B.M.E. in mechanical engineering, a M.S. and Ph.D in computer science in 1980, 1989, and 1992, respectively, from Georgia Institute of Technology. She has over 150 publications on artificial intelligence, human-robot interaction, and robotics including the Introduction to AI Robotics and Disaster Robotics. Her insertion of tactical ground, air, and marine robots at 18 disasters includes the 9/11 World Trade Center disaster, Hurricane Katrina, Fukushima, and the Washington mudslides. Dr. Murphy is a co-founded the Technical Committee on Safety Security and Rescue Robotics and its annual conference. She serves on several government and professional boards, most recently the Defense Science Board and is the recipient of the 2014 ACM humanitarian award.

Abstract

Title: Heterogeneous Autonomous Marine Mobile Expeditionary Robots

The US Navy aims to create multiple unmanned vehicle systems containing Unmanned Surface Vehicles (USVs), Unmanned Aerial Vehicles (UAVs), and Unmanned Underwater Vehicles (UUVs) for search, identify, and intervention missions at sea. Until recent developments in technology, the combination of USV, UAVs, and UUVs had only been visions for the future. Now, various research groups from around the world are making the connections needed for the success-ful implementation of this idea. The team plans on creating a successful combination of the Unmanned Systems (UxVs) for future missions at sea. We use a Wave Adaptive Modular Vessel (WAM-V) catamaran USV as the central node and main transport mechanism to carry UAVs and UUVs to distances over 100 miles. The system is designed to be modular and can easily be scaled up if needed. Over the next three-to-five years, the Center for Innovative Naval Technologies-Information Dominance (CINT-ID) Heterogeneous Autonomous Mobile Maritime Expeditionary Robots (HAMMER) project, funded by Office of Naval Research (ONR), aims to successfully integrate unmanned surface, aerial, and underwater vehicles. This talk covers current progress involving the USV and UAV. Future developments to the project will include the integration of UUVs. Using preexisting software and prototyping programs, a framework was developed to inte-grate, collaborate, control, and interact with this project. This incorporates a publish-subscribe framework for communications and control, as well as a mission control graphical user interface (GUI) that allows users to report and interact with the HAMMER system. Common controllers for multiple unmanned systems, programs to enable cooperative autonomy and autonomous command and control of UxS, and distributed control of unmanned systems using widgets, among other projects at varying levels of technical maturity, are already initiatives at SSC Pacific.

Biography

Vladimir Djapic

Vladimir Djapic received the B.S. and M.S. degrees from the University of California at San Diego,in 2000 and 2001, and the Ph.D. degree from the University of California at Riverside, Riverside, in 2009, all in electrical engineering. He returned to the Unmanned Maritime Laboratory in Space and Naval Warfare Systems Center Pacific in San Diego in 2014 where he is a Chief Scientist and a lead Principal Investigator (PI) for projects that utilize Maritime Autonomous Systems (air, surface, and subsurface). Dr. Djapic is also leading numerous international collaborative efforts, for example, Next Generation Autonomous Systems (NGAS) with multiple international partners and Coalition Warfare Program (CWP) with Croatia. From 2008 to 2013 he worked at Center for Maritime Research and Experimentation (CMRE), former NATO Undersea Research Centre (NURC), La Spezia, Italy, and served as a Scientist-in-charge for 5 major NATO sea trial that involved two CMRE ships, as well as shore-lab experiments set-ups with heterogeneous autonomous robots: Autonomous Surface and Unde!
rwater vehicles (ASVs and AUVs). The objective of his research effort at CMRE was to design an inexpensive, but robust and effective autonomous mine neutralization system and perform multiple at-sea experiments. From 2002 to 2007, he worked at Space and Naval Warfare Systems Center Pacific in

San Diego. His ONR funded work focused on utilizing advances in navigation, control, and sonar processing to exploit AUVs for complex missions, for example, ship hull inspection.
Dr. Djapic has served as Technical Director of Student Autonomous Underwater Competition-Europe (SAUC-E, sauc-europe.org) since 2010 and since 2013 as a PI for European Robotics Athlon (euRathlon, www.eurathlon.eu/site) and Robocademy (www.robocademy.eu). He has over 50 publications at prestigious international journals and conferences and has served as an editor and reviewer during his scientific career.

Abstract

Title: ICARUS – Maritime Unmanned Search and Rescue

ICARUS is an FP7 European project introducing autonomous robots to assist Search and Rescue (SAR) operations. Autonomous robots participating in SAR operations need to be able to execute a critical set of autonomous behaviors that ensure mission success and safety. Some of necessary behaviors range from remote control, where pilot involvement is maximal, to more autonomous behaviors like path coverage using obstacle avoidance and victim detection where operator involvement is minimal. This lecture presents ICARUS project concepts under which autonomous robots are to be introduced to assist SAR teams in SAR operations. Focus is on the ICARUS maritime SAR scenario where CMRE takes part in the project with the scope of increasing robot autonomy using a sensor suite and behaviour sets implemented in the U-RANGER Unmanned Surface Vehicle (USV) used for unmanned capsule (U-CAP) delivery. Interoperability is a crucial requirement in the ICARUS project, allowing one operator to control multiple robots at the same time, requiring higher robot autonomy to ensure mission success and safety while allowing the operator more time to focus on victim search. Results obtained during ICARUS project SAR maritime scenario final demo (July 2015, Almada, Portugal) will be presented with a focus on achieved U-RANGER USV autonomous behavior using the CMRE USV autonomy suite.

Biography

Stefano Fioravanti

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

Biography

Marin Stipanov

Marin Stipanov, M.eng graduated automation from the University of Zagreb, Faculty for Electrical Engineering in 2007 and computing where he is currently pursuing a PhD in underwater systems field. In 2007 he joined the Brodarski Institut (Zagreb, Croatia) as a researcher in underwater systems which, among various assignments, involved design, maintenance, underwater instrumentation deployment and data analysis, ROV inspection mission planning and execution. Starting in 2011 participated at STO-CMRE (La Spezia, Italy) as a research fellow working on AUV tracking, guidance and decision making in scope of the autonomous mine countermeasure project. In 2013 joined STO-CMRE as an engineer in the Engineering Department where he works on embedded system development and sensor integration for the CMRE USV autonomy suite for Search And Rescue operations in scope of the ICARUS FP7 project.

Abstract

Title:

In an effort to improve sailor safety during underway replenishment on the open sea, a robotic refueling system has been developed to autonomously refuel unmanned surface vehicles (USVs). The Rapid Autonomous Fuel Transfer (RAFT) project has demonstrated a methodology that could be used on the open water to autonomously refuel Navy vessels at significant sea states. The prototype refueling system is made up of two robotic arms: a rigid and precise industrial robotic manipulator to pinpoint the location of the target fuel tank and a novel soft pneumatic arm (Octarm) to provide compliant and safe contact with the USV. At the end of the Octarm, a magnetic end effector was designed (patent pending) to transfer a refueling "puck" from the robotic system to the target fuel tank. Acting under manual control or autonomously through visual tracking techniques, the robotic refueling system was shown to effectively transfer fuel to the target US Navy Sea Fox vessel under sea state 3.25 conditions at the US Army Aberdeen Test Center. The results demonstrate the feasibility of using a robotic solution to allow autonomous shore-to-ship or ship-to-USV refueling. It also illustrates the benefits and challenges of future robotic ship-to-USV refueling operations. This represents the first demonstrated use of a robotic system for fluid transfer to vessels in active sea states. This paper describes the design, development, and demonstration of the prototype autonomous refueling system.

Biography

Gregory Scott

Dr. Scott is an aerospace engineer and roboticist at the US Naval Research Laboratory where he has spent the past 5 years developing novel technologies to support space and undersea robotic manipulation. Although a "rocket scientist" at heart, Dr. Scott has been primarily focusing on robotic manipulation for the undersea and maritime surface environments. He completed his PhD research in Space Robotics at the University of Surrey, his Master's degree in Space Architecture at the University of Houston, and his Bachelor's degree in Aerospace Engineering at the Pennsylvania State University. Prior to starting at the NRL, Dr. Scott built an strong international research reputation through work on the ESA's Bionics and Space Systems Design Contract and was awarded funding to support the EADS Astrium UK's Reference Soils Characterization Activity for the ExoMars program.

Abstract

Title: Marine Robotics to Support Research

The pace of development of robotic platforms and associated sensors for use in the marine environment continues to increase. The variety, reliability and utility of such systems is such that there appears to be a technical solution to most measurement problems. In this talk I will discuss the application of marine robotics from the perspective of an end-user – a scientist with a research question and the quest for appropriate data. I will present some recent project that have utilised marine robotics and assess some of their limitations and challenges but also the new vision of the marine environment that they present.

Key website:
www.sams.ac.uk
www.sams.ac.uk/scottish-marine-robotics-facility

Twitter: @ScotMRF

Biography

Finlo Cottier

Finlo Cottier is currently a Senior Lecturer at the Scottish Association for Marine Science (SAMS) where he has the responsibility as Head of the Physics and Technology Department. He recently initiated the launch of the Scottish Marine Robotics Facility which provides a range of robotic, autonomous and automatic technologies in support of science projects in Scotland and worldwide. He did his PhD on sea ice physics at the Scott Polar Research Institute before moving to Oban on the west coast of Scotland in 2000 to take up a post-doctoral position in Physical Oceanography at SAMS. Much of his research is cross-disciplinary linked to polar environments; this includes oceanography, glaciology and marine biology.
