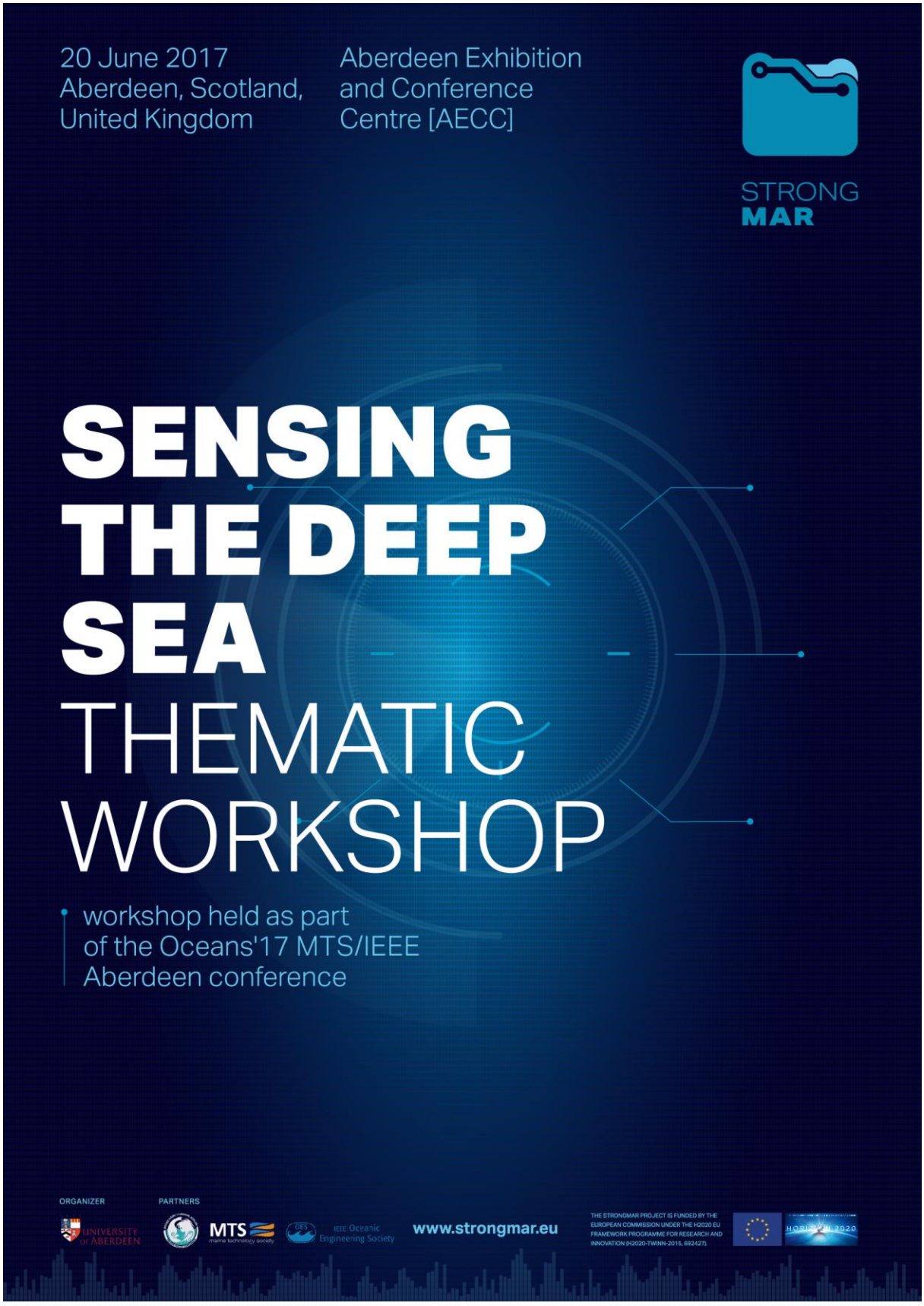
STRONG
MAR

Strengthening Maritime Technology
Research Center

Thematic Workshop on Sensing the Deep Sea

Programme

The STRONGMAR project is funded by the European Commission under the H2020 EU Framework Programme for Research and Innovation (H2020-TWINN-2015, 692427).


20 June 2017
Aberdeen, Scotland,
United Kingdom
Aberdeen Exhibition
and Conference
Centre [AECC]
STRONG
MAR
SENSING
THE DEEP
SEA
THEMATIC
WORKSHOP
workshop held as part
of the Oceans'17 MTS/IEEE
Aberdeen conference
ORGANIZER
PARTNERS
UNIVERSITY OF ABERDEEN
MTS
IEEE Oceanic Engineering Society
www.strongmar.eu
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1 – INTRODUCTION

Dear all participants, welcome to the Thematic Workshop series in the STRONG**MAR** project.

The aim of STRONG**MAR** is to create solid and productive links in the global field of marine science and technology between INESC TEC and established leading research institutions in Europe, that are capable of enhancing the scientific and technological capacity of INESC TEC and linked institutions, thereby helping raising research profile of its and its recognition as a European maritime research center of excellence.

Thematic workshops are designed to provide faster scientific exchange mechanisms, by bringing together small to medium groups of researchers around specific topics. The anticipated outcomes of the workshops are exchange of ideas, research collaborations, and submission of joint research proposals.

This Thematic Workshop (Sensing the Deep Sea) will bring together some experts in the field of ocean sensing. They will cover current technologies, challenges, and their vision for the future. Delegates attending the workshop will be able to have an informal discussion with the presenters and put across their own thoughts. The aim of the workshop is to share ideas and create partnerships towards further research collaborations.

The STRONG**MAR** team.

2 – VENUE

The Thematic Workshop (Sensing the Deep Sea) will be held on 20th June 2017 at Aberdeen Exhibition & Conference Centre (AECC) within the IEEE/MTS Ocean conference. The Oceans conference is one of the premier scientific events in ocean science and therefore will attract some prominent scientists to the workshop.

AECC Venue

A VISION FOR OUR MARINE FUTURES

OCEANS '17 MTS/IEEE ABERDEEN
19th to 22nd JUNE 2017

Address: AECC, Exhibition Avenue, Bridge of Don, Aberdeen AB23 8BL, UK
Maps: AECC | Google Maps
Website: www.aecc.co.uk

AECC ABERDEEN EXHIBITION & CONFERENCE CENTRE

3 – PROGRAMME

Day: 20th June 2017

Venue: Conference Room 10 – AECC

Time: 1300 - 1800

Session 1 (1330 – 1530)

Emerging technologies for sensing the biogeochemistry of the deep sea
Prof. Matthew Mowlem, National Oceanography Centre, UK

Laser-based sensors and systems for next generation robotic undersea exploration
Dr. Fraser Dalgleish, Harbor Branch Oceanographic Institute, USA

Deep sea mineral exploration
Dr. Blair Thornton, University of Southampton & University of Tokyo

Session 2 (1600 – 1800)

Acoustic and optical sensing of coastal and open ocean habitats: Recent experiments
Prof. Jean-Pierre Hermand, University of Brussels

Sensing the opportunity
Dr. Gordon Drummond, National Subsea Research Institute, UK

Perception technologies for underwater mining
Prof. Eduardo Silva, ISEP / INESC TEC, Porto

4 – SUMMARY OF PRESENTATIONS

Emerging Technologies for Sensing the biogeochemistry of the deep sea

Prof. Matthew Mowlem, National Oceanography Centre, UK

Measurement of deep sea biology and chemistry can be used to improve our understanding of natural biogeochemical processes and to enable better management of human activity and impacts in the deep. For example measurement of chemical fluxes from the sea floor have utility in energy exploration, methane hydrate stability assessment, environmental impact assessment, and baselining and assurance of seal integrity in offshore carbon capture and storage reservoirs. These measurements are traditionally made from remotely acquired samples that are subsequently analysed with laboratory equipment. However, whilst technically challenging, there are a number of advantages for making these measurements with submerged sensor systems, especially if these are mounted on remotely deployed or autonomous observing systems such as robotic submarines. The technical challenges include the restrictions imposed by: the observing systems (the sensors must be small, low power, small net buoyancy or buoyancy change); the environment (tolerance to high pressure, wide range of temperature, dilute samples requiring low limits of detection / integration of large samples); and the economics of observing operations (for many applications this means low cost of operation and low capital and integration costs). This talk provides examples of emerging sensing technologies for measurement of chemical and biological parameters in the deep sea and focuses on microfluidic or "lab on chip" based sensing systems which enable high metrology performance by using assays that employ reagents and optical or electrical detection of the analytical response. The wide range of available reagent based assays enables this technology to measure a wide range of parameters include nutrients, trace metals, the aquatic carbonate (CO2) system, particulates, pathogens, parasites, bacteria, viruses, phytoplankton and eDNA. Application examples and proof of concept deployments will be presented.

Laser-based Sensors and Systems for Next Generation Robotic Undersea Exploration

Dr. Fraser Dalgleish, Harbor Branch Oceanographic Institute, USA

The oceans cover more than 70% of Earth’s surface, support much of the biodiversity and provide incalculable living and nonliving resources. Despite their importance, the oceans remain largely unexplored: as much as 95% of the oceans and 99% of the ocean floor remain to be explored. With so much to be known, discoveries in this context tend to be transformative, underscoring the value and importance of developing new technologies to more effectively conduct undersea exploration. This talk will discuss some recent developments in the area of *in situ* laser-based sensors designed to be operable from unmanned robotic platforms that will advance our capability in characterizing important ocean phenomenon and provide quality imagery and data that will allow scientists to discover new environments, organisms and understand phenomena at scales ranging from sub-micron to mesoscale.

Deep sea mineral exploration
Dr. Blair Thornton, University of Southampton & University of Tokyo

The limited availability of time and high costs associated with operating scientific research vessels is a major bottleneck in our ability to study seafloor environments. Mineral exploration is no exception, and involves first locating prospective deposits, assessing their grade and tonnage, and then their economic value. This tasks of gathering information is constrained by not only by the physical limitations of the platforms and instruments that access these remote environments, but also by factors such as weather, scheduling and logistics that are beyond the control of the scientists and engineers involved in their use. In order to optimise the return from our efforts, surveys should ideally be planned in a hierarchical way, with each effort informing subsequent efforts to build up a model of the environment that is increasingly refined in regions that are most relevant. However, technologies available today tend to have large gaps in the resolutions and extents at which they make observations, which limits how effectively information from one sensor can be used to inform strategies for data collection, or conversely be used to interpret data collected, by another. This talk will look at some recent developments in platform and sensor technology and consider how these can be combined with relevant scientific expertise to fill in some of the gaps in our current capabilities.

Sensing the Opportunity
Dr. Gordon Drummond, National Subsea Research Institute, UK

NSRI, The National Subsea Research Initiative operates in all industrial sectors specifically; oil and gas, offshore wind, wave and tidal, subsea mining, defence and ocean science. It is therefore well placed to understand the technological challenges regarding sensors and interpretation of sensory data for these industrial sectors.

The presentation will focus on communicating these sensory challenges. It will draw upon a particular event held by NSRI earlier in the year where through a workshop held in conjunction with CENSIS and DATALAB (2 of Scotland's innovation centres) which examined strategies for condition monitoring and predictive maintenance and failure of oil and gas architecture. This event highlighted opportunities for the developer community to focus upon.

The presentation will additionally identify sensing opportunities that are required in the other industrial sectors previously outlined.

Perception technologies for underwater mining
Prof. Eduardo Silva, ISEP / INESC TEC, Porto

Emerging applications in underwater mining, both at sea and in inland flooded mines pose additional requirements in terms of operational support needs and environment restrictions.

Two main tasks are to be addressed by assisting robots in these underwater mining operations: providing adequate environment awareness for human operators and obtaining precise real-time 3D environment modelling. We will present innovative systems developed for operations support in inland underwater mining operations. These systems are being developed in the context of the VAMOS (http://vamos-project.eu) and the UNEXMIN (http://www.unexmin.eu/) European H2020 research projects. These projects aim to develop robotic systems for the exploitation of flooded open pit and underground mines.

In both projects, the perception system is equipped with a laser based multiple structured light system for precise modelling when the water turbidity conditions allow and multibeam sonars. In the VAMOS project, an additional AUV is used for two tasks: to provide increased awareness, with sensing (visual and acoustical) from another point of view (different from the Minning Vehicle) to the cutting operations and for precise 3D environment modelling. Validation tests in tank and in relevant operational scenarios are also presented and discussed.

5 – SPEAKERS

Matthew Mowlem

Prof. Mowlem is the head of the Ocean Technology and Engineering Group at National Oceanography Centre, Southampton, UK. He leads over forty engineers, technologists, and scientists in the development and provision of technology for support of marine, aquatic and environmental science and related industrial and regulatory applications.
His research interests include the development of environmental measurement systems including the development of new chemical sensors and sensors for microbiology. He has a particular interest in the development of microsensors using either or both microfabrication and microfluidics. This has led to the development of a suite of sensors for nutrients, carbonate system parameters, trace metals, organic nutrients, pathogens, phytoplankton, hydrocarbons, pollutants and toxins.

Fraser Dalgleish

Dr. Fraser Dalgleish is an Associate Research Professor with Harbor Branch Oceanographic Institute at FAU where he founded and currently directs the Ocean Visibility and Optics Laboratory. Over the last fifteen years, his experimental, systems development and modeling activities have focused on the application of laser sensors and unmanned marine vehicles to develop new undersea robotic imaging, detection and networking capabilities. He is an author on more than 60 papers and patents and is currently the PI or co-PI for multiple federal grants, mainly in the area of undersea LiDAR detection, imaging and classification systems development. He has recently conducted research in subsea environmental LiDAR at the NATO Centre of Maritime Research and Experimentation as a Visiting Scientist, has been the Underwater Imaging committee chair for the Marine Technology Society since 2009, and is currently the Program Evaluator at NSF LASER-TEC ATE at Indian River State College in Florida.

Blair Thornton

Blair Thornton is an Associate Professor of Oceanic Engineering Science at the University of Southampton, England with an adjunct position at the Institute of Industrial Science (IIS), The University of Tokyo, Japan. He specialises in Marine Robotics and Sensing technology, in particular the application of spectroscopy, computer vision and probabilistic modelling to build more descriptive maps of seafloor environments. After graduating the University of Southampton in 2002 (B. Eng, Naval Architecture), he went on to do a Ph.D. in underwater robotics at Southampton, spending 2 years at the IIS funded by the Japanese Ministry of Education. After completing his Ph.D. in 2006, he continued to work at the IIS, developing autonomous underwater vehicles and in-situ instrumentation for visual, chemical and biological surveys. Blair has participated in over 45 ocean research expeditions, 25 of which as principal investigator, with a total of more than 350 days spent at sea. He became a member of the faculty of the University of Southampton in 2016, and is an Associate Editor of the IEEE Journal of Oceanic Engineering.

Jean-Pierre Hermand

Professor Hermand is currently the research director at U.L.B. where he founded the Environmental hydro-acoustics lab in 2001, which became part of Laboratories of Image, Signal Processing and Acoustics (LISA) in 2012. Since 2001, he has been providing leadership for cross-disciplinary research on ocean acoustic observatories in the framework of European and international projects. Between 1985 and 2000, he has held several positions at the SACLANT Undersea Research Centre, La Spezia, Italy, conducting experimental and theoretical research in ocean acoustics with emphasis on inverse problems. In 1991, he became the PI of a grant from the U.S. Office of Naval Research to develop environmentally adaptive sonar processing at the Naval Underwater Systems Centre, New London, CT. In 1993, he was appointed Principal Scientist to the SACLANTCEN Environmental Research Division to lead the research and development of acoustic sensing techniques and inversion methods for the characterization of shallow-water marine sediments. He has been a Scientist-in-Charge of international interdisciplinary experiments at sea. He has had adjunct appointments at the AILUN Free University of Nuoro, Sardegna, and at the Ca' Foscari University of Venice, Italy, and a consultant to industry and government on applied ocean acoustics and environmental measurements.

Gordon Drummond

Dr. Gordon Drummond has been involved in the Subsea sector since 1994 initially offshore on Diving vessels and latterly in an engineering capacity. Gordon has a first class degree in Mechanical Engineering, PhD and MBA from the Robert Gordon University.

After returning from offshore roles, he has spent 10 years with IMES group and thereafter 10 years with Subsea 7 leading and executing research initiatives and implementing them into the businesses as new capability. Presently he is the Project Director of the National Subsea Research Initiative (NSRI).

Eduardo Silva

Dr. Eduardo Silva is the Coordinator of the Centre for Robotics and Autonomous Systems (CRAS) at INESC TEC and Professor at the School of Engineering (ISEP) of the Porto Polytechnic Institute (IPP). He has a PhD in Electrical and Computer Engineering from the University of Porto. His main research areas are marine robotics, control architectures, perception and navigation for autonomous robots. He has participated in more than 14 research projects and has more than 60 publications in the area of the Field Robotics.

6 – PARTICIPANTS

6.1 – Speakers

Nº	Name	Institution	E-mail
1	Matthew Mowlem	National Oceanography Centre	matm@noc.ac.uk
2	Jean-Pierre Hermand	University of Brussels	Jean-Pierre.Hermand@ulb.ac.be
3	Blair Thornton	University of Southampton/ University of Tokyo	blair@iis.u-tokyo.ac.jp
4	Fraser Dalgleish	Harbor Branch Oceanographic Institute	fdalglei@fau.edu
5	Eduardo Silva	INESC TEC Porto	eduardo.silva@inesctec.pt
6	Gordon Drummond	National Subsea Research Institute	Gordon.Drummond@nsri.co.uk

6.2 – Strongmar Participants

Nº	Name	Institution	E-mail
1	John Watson	University of Aberdeen	j.watson@abdn.ac.uk
2	Thanga Thevar	University of Aberdeen	t.thevar@abdn.ac.uk
3	Eduardo Silva	INESC TEC Porto	eduardo.silva@inesctec.pt
4	Alfredo Martins	INESC TEC Porto	alfredo.martins@inesctec.pt
5	Ana Paula Lima	INESC TEC Porto	aplima@inesctec.pt
6	André Dias	INESC TEC Porto	andre.dias@inesctec.pt
7	Aníbal Matos	INESC TEC Porto	anibal.matos@inesctec.pt
8	Carlos Almeida	INESC TEC Porto	carlos.almeida@inesctec.pt
9	Filipe Teixeira	INESC TEC Porto	fbt@inesctec.pt
10	Francisco Gonçalves	INESC TEC Porto	francisco.r.goncalves@inesctec.pt
11	Guilherme Amaral	INESC TEC Porto	gasilva@inesctec.pt
12	Hugo Ferreira	INESC TEC Porto	hugo.a.ferreira@inesctec.pt
13	José Miguel Almeida	INESC TEC Porto	jose.m.almeida@inesctec.pt
14	José Melo	INESC TEC Porto	jose.l.melo@inesctec.pt
15	Luis Coelho	INESC TEC Porto	lcoelho@inesctec.pt
16	Oluyomi Aboderin	INESC TEC Porto	oluyomi.aboderin@inesctec.pt
17	Pedro Jorge	INESC TEC Porto	pjorge@inesctec.pt