Intelligence Provides Autonomy:
The Era of Unmanned Vessels

Organised by the University of Portsmouth and Satellite Applications Catapult

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Satellite Applications Catapult, Harwell, Didcot OX11 OQR

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Welcome

We are delighted to extend to you a very warm welcome to the Workshop on Intelligence Provides Autonomy: The Era of Unmanned Vessels. As you participate in the event today we hope you will gain a sense that we are a community of academics and industrials who wish to advance research into Autonomous Vessels.

Autonomous vessels will become common on our oceans within the near future. They are seen as a key element for a competitive and sustainable European shipping industry. The next generation of commercial automated ships will have advanced embedded decision support systems, making extensive use of satellite communication and data. These technologies will combine to provide an operational system that will work without the intervention of an on-board human operator.

This workshop will highlight the importance and place in the market for autonomous vessels; the need for continued research and the expected technology growth in the future. There uses know no bounds; marine surveillance vessels, large cargo ships, offshore support boats and leisure shipping will be explored.

The workshop brings together leading academic scientists, researchers and industrials to exchange and share their experiences of autonomous unmanned craft and will provide a forum for researchers and practitioners to present and discuss their most recent innovations, the technology advances and the practical challenges to be encountered in this awe-inspiring field.

We would like to express our sincere thanks to the speakers and the organising Committee who have made this Workshop a success. Without their commitment and enthusiasm this would not have been possible.

We wish all of you a successful Workshop!

Organising Committee

University of Portsmouth
Prof David Brown (Chair), Centre of Intelligent Data Solutions (CIDS)
Dr Djamila Ouelhadj (Co-Chair), Centre of Operational Research and Logistics (CORL)

Satellite Applications Catapult
Sean McCarthy
Lorraine Fry
Izzy Taylor
Nick Lambert, Marine Expert

A master mariner and a committed proponent of the maritime users’ perspective, Rear Admiral Nick Lambert concluded a long naval operational career as the UK National Hydrographer in December 2012. He advises on a wide range of maritime issues including the growing potential of the blue economy concept, the importance of spatial data infrastructures and hydrography for maritime economies, the evolution of eNavigation and GNSS vulnerability, near or real time situational awareness (especially that derived from space based assets and applications), human factors, and training and education in the maritime sector.

The Rise of Maritime Autonomous Systems
Richard Daltry, Autonomous Surface Vehicles (ASV), Porchester

Abstract

Autonomous systems offer expanding capabilities to provide maritime services in a time where saving costs, creating efficiencies and improved safety are vital.

This presentation will explore Unmanned Surface Vehicles (USV’s) over time from early concept designs to vehicles that are fully operational in applications across the globe.

Vehicles designed and built by ASV serve international defence, oil and gas and science and survey industries.

Unmanned boats find a popular role in the provision of targets for military weapons testing and training. Taking the form of a potential threat craft, ASV’s remote operators assist with training operations on UK MOD firing ranges and several foreign customers’ sites. The crafts range in size from 3-13m long and are able to operate at speeds of up to 50 knots and ranges in excess of 45km.

The prominence of USV’s in the science domain has been strengthened by government funding including an SBRI entered into by ASV to build the C-Enduro, a long endurance research USV. To enable the vehicle to collect data over extended periods, C-Enduro has a three pillar power system comprising solar panels, a wind turbine and a lightweight diesel generator.
Maritime autonomous systems can offer benefits to the oil and gas industry as proven by ASV with the development of the C-Worker, a multi-purpose work class USV. Collaborating closely with a major offshore construction company, ASV were able to establish functional requirements for the offshore, work class USV.

Biography
Richard Daltry has responsibility for the design and continuing development of all ASV products. He is a qualified Naval Architect with extensive experience of commercial small craft design and testing, unmanned control systems and unmanned surface vehicle operations. Richard and his team design bespoke and production systems for a variety of applications with a consistent focus on rugged, reliable and safe unmanned operation.

A Potential Application of a Thermal Camera on Board an Autonomous Surface Vessel
Dr Edward Smart, University of Portsmouth

Abstract
The world’s seas and oceans can be very dangerous places so when a person falls overboard, his or her life could be in immediate danger from rough weather, cold conditions or even sharks. Time to rescue is of critical importance and it can take up to 20 minutes to launch a manned rescue vessel. In that time, the man overboard (MOB) can easily disappear from view, especially at night.

Autonomous Surface Vehicles Ltd, in collaboration with the University of Portsmouth, has undertaken research into an autonomous rescue vessel, equipped with a thermal camera. The research shows that by using image processing techniques and artificial intelligence, it is possible to detect and track a MOB using a thermal camera.

This work was financially supported by Autonomous Surface Vehicles Ltd and Innovate UK.

Biography
Dr Edward Smart is a Research Fellow at the Centre for Intelligent Data Solutions at the University of Portsmouth. After receiving the MMath degree from the University of Reading in 2005, he worked as a software engineer at Clearswift Ltd to develop an autonomous detection system for offensive images. In 2011, he received his PhD in data analysis from the University of Portsmouth. His research interests include the application of artificial intelligence and data analysis to detect anomalies, health scoring (ranking) systems and adaptive learning. He has worked mainly with companies in the aerospace, marine, manufacturing and high performance computing sectors. His research has been supported by grants from Innovate UK, EPSRC and DSTL.
Safe and Secure Ship Autonomy  
Prof Stephen Turnock, University of Southampton

Abstract  
The Southampton Marine and Maritime Institute brings together 300 academics across the University of Southampton along with colleagues in the National Oceanography Centre, Lloyd’s Register and many other industry partners. As such expertise in maritime law, management, operational research, oceanography, psychology, human factors, control systems and maritime engineering amongst many other disciplines can be brought to bear on future challenges. Understanding how increased autonomy, better system diagnostics, ship crew support amongst many other aspects of ship design and operation will be explored in this presentation. The focus will be on the on-going work of the maritime robotics laboratory as it seeks to develop systems that support ship board operations reducing human exposure to risk as well as enhanced navigational capabilities. A recent project to develop an autonomous craft capable of crossing the Atlantic will illustrate some of the complexities.

Biography  
Stephen Turnock has been working in the area of autonomous vehicle development for 15 years based on his expertise in understanding the fluid dynamic interaction required to provide effective control and complete complex missions. He is head of the Fluid Structure Interactions group, a team of 18 academics within the Faculty of Engineering and the Environment dedicated to understanding the many complex aspects of designing and operating maritime engineering systems within the ever changing ocean environment. He is one of the seven academics within the group who along with colleagues in Electronics and the National Oceanography centre form the Maritime Robotics Lab which currently has a fleet of 5 vehicles of varying capabilities. He also directs the performance sports engineering lab awarded a Queen’s Anniversary award for Higher education in 2011 for its innovative support of UKSport.
Pathway to Autonomous Large Vessels
Prof David Brown and Dr Djamila Ouelhadj, University of Portsmouth

Abstract
Intelligent autonomous systems are emerging as a key enabler for the creation of a new paradigm of services in our future society. Decision making will be a fundamental tenet of autonomy to give these systems the intelligence to autonomously act and accomplish their tasks on the ground, air and water.

The aim of this presentation is to survey a variety of reasoning, optimisation and decision making methodologies for creating highly autonomous systems and decision support aids. The focus is on principles, algorithms, and their application, taken from the disciplines of Artificial Intelligence and Operational Research.

Sensors and data collection are essential to autonomous systems; they are the antennas to the real world, high sampling rates are needed to achieve good signal representation but cause problems by providing large volumes of data. AI algorithms can be made to drastically reduce data content by only using its important features for system monitoring.

With the fusion of mathematics, computer science and engineering all systems have the potential of being made autonomous - thinking and acting for themselves with the minimum of human intervention.

Biography
Professor David Brown joined the University of Portsmouth in 1998, having previously worked in industry as the Managing Director of an automation and diagnostics company, Technical Director within Cambridge Electronic Industries and a lecturer at the University of Southampton. David set up and is now Director of the Institute of Industrial Research at the University of Portsmouth, undertaking a number of concurrent Research and Knowledge Transfer (RKT) projects. Over the past two years the Institute team has attracted nearly £2,000,000 in funding from commercial research partners.

Dr Djamila is a Principal Lecturer in Operational Research (OR) in the Department of Mathematics and a member of the Centre of Operational Research and Logistics Group (CORL). She is the Director of Innovation of CORL and the Director of MSc Logistics and Supply Chain Management. Djamila has more than 18 years of experience in OR and the development of novel mathematical optimisation models, advanced meta-heuristic methods, cooperative agent-based optimisation, and intelligent decision support systems for automatically producing high quality solutions to a wide range of real world optimisation, scheduling and logistics problems. Real world challenges include: manufacturing, healthcare, personal scheduling, vehicle routing and transportation, supply chain and production management, sustainability and renewable energy, etc. Successful research involved in the
EU FP7 SEABILLA project which entailed applying Operational Research methodologies to sea-border security. She is a co-investigator on the 2OM and LEANWIND FP7 EU research projects that involve the application of Operational Research methodologies to optimise the operations and maintenance procedures of offshore wind farms. She is a co-investigator on several InnovateUK grants: OR methods for energy efficient computing with Xyratex (2013), real-time cost effective maintenance in future food industry with Stork (2013-2015), Vessel efficiency with STS Defence (2014-2016) and co-supervisors on several KTP projects.

Fostering Collaboration with Industry to Stimulate the Next Generation of Marine Autonomous Systems
Kevin Forshaw, National Oceanographic Centre, Southampton

Abstract
The Marine Autonomy and Robotic Systems Innovation Centre at the NOC will provide the creative space and supporting research infrastructure to enable next generation developments of Marine Autonomous Systems. Building on our success engaging with companies for Innovate UK and Horizon 2020, the centre will further create linkages with the defence, oil & gas and offshore renewable end users of tomorrow.

Biography
Kevin Forshaw has been engaged with support for the Marine and Maritime sector for over 15 years, acting as the interface between University’s and Research Organisations and Industry. He established a Marine Thematic Group whilst working for the EC’s Innovation Relay Centre, and has since worked for 3 Universities before joining the NOC. During this period he has established numerous collaborative research projects focussed on vessel efficiency that have leveraged many £millions of supporting EC and UK public funding. Kevin also sits on various national and regional committees including the Marine Industries Leadership Council, Marine Industries Leadership Group and the Solent LEP’s Solent Marine and Maritime Working Group.
Maritime Autonomous Systems – A View from Innovate UK
David Elson, InnovateUK, Swindon

Abstract
In this presentation David will provide a brief overview of the activities of Innovate UK in supporting business-led innovation in the UK before explaining in more detail the specific interest in Maritime Autonomy. This will include a discussion of the recent investment in collaborative R&D projects through the Maritime Autonomous Systems competition and a wider review of the foreseen opportunities in this area.

Biography
Lead Technologist – Marine and Maritime Industry, Innovate UK
David is a Chartered Naval Architect and joined Innovate UK in June 2013 as Lead Technologist for the Marine and Maritime Industry where he is responsible for developing and delivering Innovate UK’s activities in the sector. He has held senior design, engineering and strategic positions with large and small organisations both in the UK and overseas, in the defence, leisure and commercial maritime sectors.