

2 July 2020
Online Workshop

TECUSEA um laboratório
no oceano
atlântico

 RawMaterials
Connecting matters

IN THE BLACK

THE SAFETY OF PEOPLE
AND THE PLANET THROUGH
THE APPLICATION
OF TECHNOLOGY

Chairman **Stef Kapusniak**

 INESCTEC

www.inesctec.pt

 EIT RawMaterials is supported by the EIT,
a body of the European Union

www.eitrawmaterials.eu

Robotics Laboratory



(Photos by Communication Service, INESC TEC)

INSTITUTO SUPERIOR DE ENGENHARIA DO PORTO

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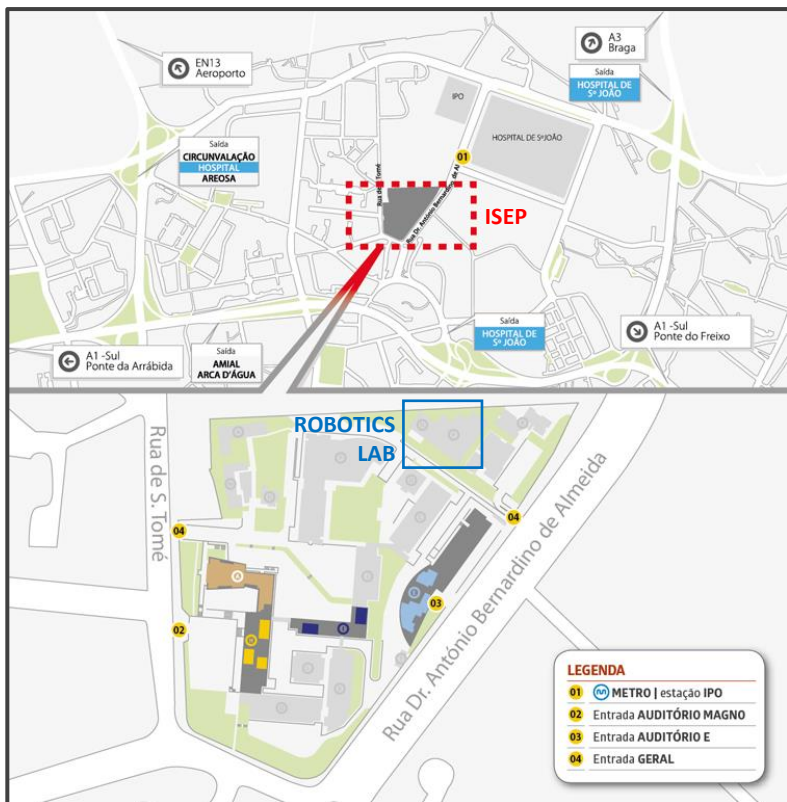
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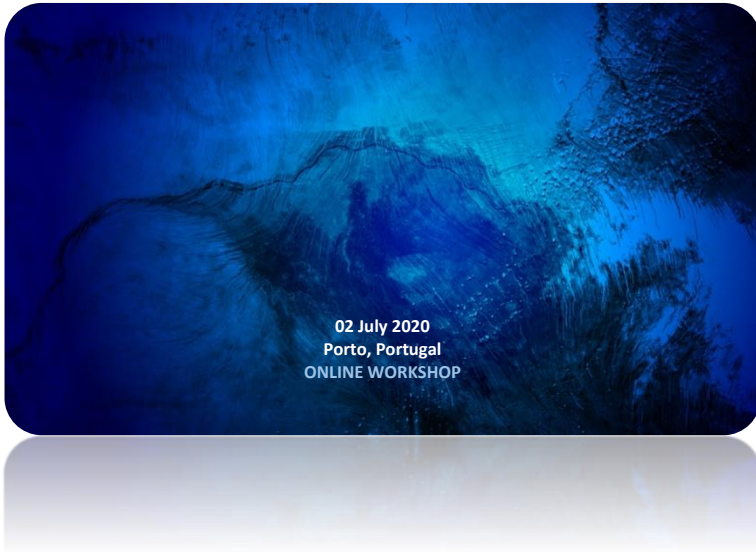
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📍 41.1787° N, 8.6077° W



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Please click on:

Events

↳ Thematic Workshop

↳ In the Black 2020

Welcome Messages

I'd like to thank each of you for attending this workshop and bringing your expertise to our gathering.

Due to lock-downs and travel limitations this year the workshop will be remotely controlled from Porto.

IN THE BLACK'20, focusing this year on "The safety of people and the planet through the application of technology", is expected to generate renewed momentum to the EIT Raw Materials Community. In addition to strengthening the connections between KIC Partners, we aim to redefine future enabling strategies.

Today's technology is opening up new frontiers for sustainable access to vital raw materials. Tomorrow's technology will undoubtedly open up further exciting opportunities.

I thank INESCTEC and TEC4SEA for providing once again this opportunity, funded by the European Institute of Innovation and Technology's Raw Materials sector.


Hope to see you next year, this time in person!

Stef Kapusniak - Chairman of the Thematic Workshop



Independent Consultant
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stefkapusniak@icloud.com

Dr Kapusniak is an Independent Consultant focussed on sustainable mining. Previously he has managed conventional mines in Australia, and he has also led a number of key underwater mining projects. Previous roles include Technical Management of the EU's VAMOS underwater mining prototype project and Project Director of SMD's contract with Nautilus Minerals to build three production scale sub-sea mining machines.



IN THE BLACK, will provide the opportunity to increase understanding of innovations and new trends in Deep Sea Mining and highlight opportunities for synergy.

The Geology, Biology, Environmental, Digital, Mining, Robotics and other Technological communities will meet "in the middle" of Raw Materials to discuss the next frontier for Deep Sea Mining.

Immerse yourself *IN THE BLACK* and together we can cross the next frontier for mineral exploration and exploitation!

Eduardo Silva - Coordinator of TEC4SEA | INESC TEC



Coordinator of TEC4SEA and Professor
INESC TEC and ISEP
Porto
Portugal
eduardo.silva@inesctec.pt

Eduardo Silva is the Coordinator of the TEC4SEA platform at INESC TEC. Previously he was the Coordinator of the Centre for Robotics and Autonomous Systems (CRAS) at INESC TEC until 2019. He is also a 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 20 research projects, including iVAMOS! and UNEXMIN EU projects, as well as UNEXUP and INSite Upscaling projects funded by EIT Raw Materials. He has more than 60 publications in the area of the Field Robotics.

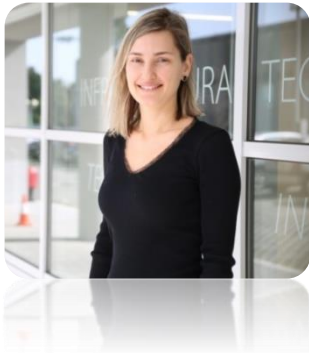
The Deep Sea Mining (DSM) challenges that are ahead of us need more and more events like this Thematic Workshop hosted by the Centre for Robotics and Autonomous Systems from INESC TEC.

As researchers in INESC TEC, we believe that an integrative cooperation between all partners working in DSM is always beneficial. However, the real challenge for us is to find common ground between all the fields involved in DSM. Therefore, we strongly believe that your participation will guarantee the success of the Online Workshop as it is a unique opportunity to share knowledge, science, and technology.

Deep Sea Mining cannot be in the bottom line of Portugal/Europe priorities.

Enjoy the Workshop! Until the next time, hopefully in person and here in Porto!

The Organising Team of the Thematic Workshop



Ana Paula Lima

Project Manager, PhD

Research Fields: Biology, Natural Resources and Ecosystems

INESC TEC | CRAS [Centre for Robotics and Autonomous Systems]

aplima@inesctec.pt



Ana Cristina Pires

Researcher, PhD, MEng

Research Fields: Geosciences, Geotechnics and Mineral Resources

INESC TEC | CRAS [Centre for Robotics and Autonomous Systems]

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Programme

Schedule

| Start | End | Session | Speaker | Title |
|---------------------------------------|-------|--------------|-----------------|---|
| 2nd July / Thursday | | | | |
| 10:00 | 10:25 | OS | Opening Session | Chairman: Stef Kapusniak |
| 10:25 | 11:30 | S1 | Session 1 | Bramley Murton National Oceanography Centre <i>Deep-Sea mineral exploration and the future role of autonomy and robotics</i> |
| | | | | Gary Van Eck Diamond FutureSmart Studies De Beers Group <i>SAFE MINING: Is Technology the silver bullet?</i> |
| | | | | Marc Lincoln Project Management Technology De Beers Group <i>De Beers and Diamond FutureSmart™</i> |
| 11:30 | 11:45 | Coffee break | | |
| 11:45 | 12:15 | S2 | Session 2 | Norbert Zajzon University of Miskolc <i>The UNEXUP project – Further tuning the UNEXMIN technology</i> |
| | | | | Pedro Jorge Applied Photonics (CAP) INESC TEC <i>INSite – In situ ore grading system using LIBS in harsh environments</i> |
| 12:15 | 12:30 | CS | Closing Session | Chairman Intervention (Final Words) |
| | | | | Michel Vanavermaete [Innovation Hub Director CLC West, EIT Raw Materials] |
| | | | | Eduardo Silva [TEC4SEA, INESC TEC ISEP] |

Sessions

OS| Opening Session

S1| Application of Technology

S2| “Raw” Projects in Sustainable Discovery and Innovation

CS| Closing Session



Introduction to "In The Black '20" - Having the Technical Capability to Mine Underwater is Not Enough

Stef Kapusniak [Independent Consultant]

This opening presentation puts the 2020 edition of In the Black into context with previous editions. Previously the majority of presentations were focussed on technical solutions to enable underwater mining. A brief look back at last year's edition is followed by historic examples of socio-political, safety and environmental barriers that have stopped the introduction of technology in mining. Sometimes these barriers have closed down "state of the art" major mining projects.

Examples of why some of the EU's underwater mining projects have an advantage over conventional mining in terms of addressing these barriers are also given. The presentation also takes a look at what big mining houses are focussed on. Developing and applying technology that improves the safety of people and the planet is becoming essential. The presentation is aimed at encouraging, researchers, scientists, innovators, engineers and technicians to consider the wider socio-political, safety and environmental aspects at every stage of the raw materials chain.



Deep-Sea mineral exploration and the future role of autonomy and robotics

Bramley Murton [National Oceanography Centre]

As the world faces a global climate and ecological emergency and a resources and energy crisis, new frontiers of exploration are needed to help reduce our dependence on carbon-based fuels. The deep-ocean holds vast amounts of metals and elements that are critical to decarbonizing our future society. However, accessing these resources is challenging and requires new approaches. In this presentation I will discuss our current approach to several deep-sea mineral types and how autonomy and robotics have been used in their exploration and deposit assessment. I will discuss how we approached the exploration, mapping and deposit assessment of seafloor massive sulphide deposits in the TAG area of the Mid-Atlantic Ridge, and highlight the limitations of such an approach. I will also describe our approach to mapping ferromanganese crusts on a seamount in the NE Atlantic, and identify new approaches to improve its effectiveness. I will conclude with a view of how to reduce the risks associated with deep-sea mining by using appropriate technology to monitor environmental conditions during operations.



SAFE MINING: Is Technology the silver bullet?

Gary Van Eck [Diamond FutureSmart Studies, De Beers Group]

287 fatalities occurred across International Council on Mining and Minerals (ICMM) company members in 2019. This is an increase from 2018, when there were 50 fatalities. Of the 287 fatalities recorded, 250 occurred as a result of the Brumadinho dam collapse in Brazil.

When we talk mining, several points come to mind. High amongst these are safety considerations. Is mining an inherently risky undertaking? Do people need to die in order for the world to recover the minerals it needs? How do we ensure the safety of people when conducting mining operations? In addition, how do we mitigate the safety risks of offshore mining operations, requiring both marine and safety considerations to ensure operations that do not cause harm.

Many technologies exist that enhance mining safety – some of these are hardware focussed, some personnel focussed, and some critical control focussed. However, technology alone does not ensure that mining operations can go beyond the well-known mantra of Zero Harm. Should we measure the effectiveness of a safety program by metrics alone?

A combined approach that couples the culture of the organisation, the competence of people, and the correct tools and techniques, supplemented by the use of technology is the only means of ensuring safe mining operations.

De Beers and Diamond FutureSmart™

Marc Lincoln [Project Management Technology, De Beers Group]

De Beers wants to embrace the ever-changing future of diamond mining, and has initiated Diamond FutureSmart, which is project to change the mining paradigm. De Beers is adapting to the fact that diamond pipes are getting smaller, the customer is getting more discerning, and environmental issues (climate change, water, etc.) are even more challenging. In order to adequately address the new paradigm De Beers has put forward guiding principles to steer the new mining paradigm and these include 100% renewable, remote autonomous digital control, Small footprint - Modular, Movable, Repeatable, Scalable, Zero people exposed at the workplace (maximum safety), Zero permanent structures (no concrete), Zero new water, and Transparent & tangible community benefits.

Diamond FutureSmart is working to address the guiding principles and this presentation will show where we are on the journey to addressing the future.

The UNEXUP project – Further tuning the UNEXMIN technology

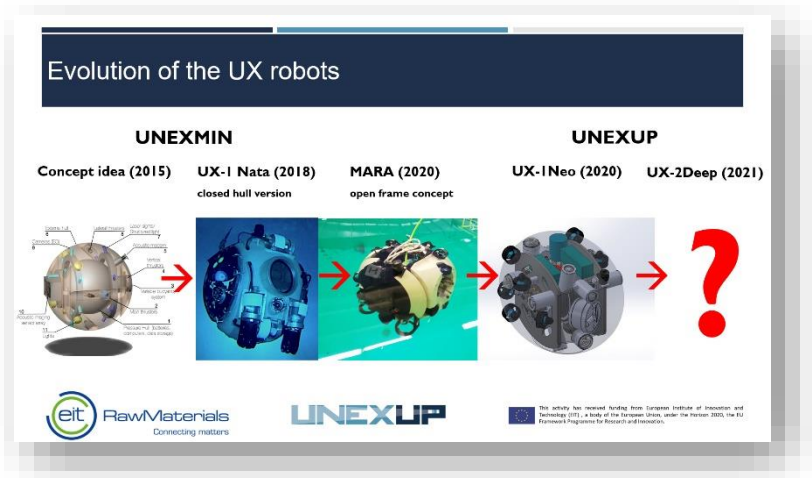
Norbert Zajzon [University of Miskolc]

UNEXUP (UNEXMIN "UP"scaling) is an EIT RawMaterials upscaling project (unexup.eu), which is developing further the UNEXMIN technology. UNEXMIN (2016–2019) proved the concept of robotic mapping of flooded underground mines (e.g. reopening for raw materials exploitation) by developing the UX-1 robots' series. During UNEXUP (2020–2022), more development and stabilization of the technology are the main targets, to bring it closer to commercialization as an exploration service.

UNEXUP is upgrading the UX-1 robots with the "UX-1Neo" and developing the "UX-2Deep", with improved hardware and software capabilities. The core focus is to strengthen development of scientific instrumentation and tools, extend exploration capabilities and improve operation support systems. The new robots will be more modular, with open frame and easily transported thanks to the lower weight in a similar dimension. With the increased functionalities - easily swappable batteries, quick data retrieval, additional cameras and new instruments (e.g. rock sampling unit) - the hardware will be more versatile and effective during the field operations. The operation support system development, like autonomous calibration modules, improvement in localization initialization procedures and mission control tools reduces the crew on the field, which makes the operations more productive and cost-effective.

The above improvements will be validated in field trials during the next three years. The commercial sites will be chosen from a continuously growing list.

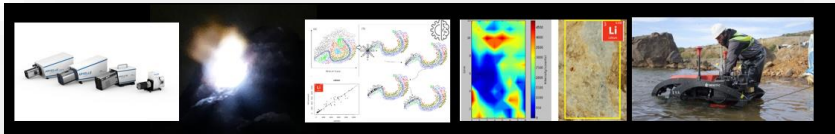
The project has a strong focus to bring the service to the market, where UNEXMIN GeoRobotics Ltd. is the spin-off company making the technology commercially available.



INSite – In situ ore grading system using LIBS in harsh environments

Pedro Jorge [Applied Photonics (CAP), INESCTEC]

INSite brings together a multidisciplinary research team with a renowned spectroscopy company (Lasertechnik Berlin) to take to the market a new smart LIBS (Laser Induced Breakdown Spectroscopy) technology. LIBS is a powerful spectroscopy technique for element analysis with very promising features for real time assessment of composition. However, in spite of many systems already probing the market, its performance is only acceptable with simple samples and in controlled conditions. Its identification and quantification abilities rapidly decline with sample complexity and environmental roughness (e.g. underwater). To date no satisfactory system presents acceptable performance when facing complex mineral samples in harsh mining conditions. Solution on the market are plagued by inconsistent results and poor quantification performance. INSite introduces a new solution where innovative hardware is combined with the concept of information transfer coupled with advanced AI algorithms and a knowledge database of mineral spectra enabling true in-situ ore grading with a new generation of smart LIBS technology.



An abstract, textured background in various shades of blue, ranging from deep navy to bright cyan. The texture is reminiscent of a rough surface or a close-up of a material like stone or wood. A faint, dark profile of a human face is visible, facing right, with the text overlaid on it.

Speakers *(by alphabetical order)*



Bramley Murton



National Oceanography Centre
Associate Head of Marine Geoscience
UK

bramley.murton@noc.ac.uk

Academic Qualifications:

PhD (Open University, 1987) in Geology, Petrology and Geochemistry

BSc (Edinburgh University, 1982)

Posts Held:

Present: NERC Grade 3, Associate Head, Marine Geosciences, National Oceanography Centre, UK

1992-95 Senior Scientific Officer, Institute of Oceanography, Deacon Lab.

1990- Research scientist, Institute of Oceanography, Deacon Lab.

1989-90 Senior Research Fellow, University of Durham.

1988-89 Royal Society Research Fellow.

1987-88 Research Fellow, Open University.

Appointments and Honours:

2019 Coke Medallist, Geological Society, London.

2018 Honorary Professor Research, University of Southampton

2014-18 Executive Board member, Blue Mining Project

2010-13 Chairman of InterRidge

2004-13 Member of IODP, Environment Protection and Safety Panel

2004-13 Member of UK-IODP Science Advisory Panel

2002-12 Editorial Board: Marine Geophysical Researches (Elsevier)

1996-98 Chairman, Society for Underwater Technology (Southern Branch)

1995-96 Member of ODP Lithosphere Panel

Principle Investigator on Major Research Programmes (since 2010):

2019- Project ULTRA (NERC large strategic grant).

2015-19 MarineE-tech (NERC large strategic grant).

2014-18 Blue Mining (EC FP7 consortium project).

2011-15 Cayman Trough Sulphide Mineralisation.

2011 45°N Mid-Atlantic Ridge Sulphide Mineralisation (inc. Marine Institute Ireland ship-time).

2010 V-shaped Ridges, Plume-Ridge Interaction: a multi-channel seismic study.

2010 Cayman Trough Hydrothermal vents.



Gary Van Eck



B.Sc (Mech) Eng; M.Sc (Naval Arch); PMP
Diamond FutureSmart Studies
De Beers Group
South Africa
Gary.VanEck@debeersgroup.com

Gary started off his professional life as a graduate mechanical engineer in the Defence industry. He subsequently obtained a Master's degree in Naval Architecture, and various project management qualifications, including the PMP®. Gary joined De Beers Marine as a project manager in 1999. He has successfully managed several mining projects, including the conversion, establishment and initial operation of the world's largest marine mining ship, the PEACE IN AFRICA. He was seconded as the Engineering & Portfolio Manager to AuruMar when it was created in 2010, and was later appointed General Manager. Under his leadership, AuruMar conducted exploration campaigns for offshore placer gold in various locations across the globe. Gary has worked on a number of marine / wet mining projects within the De Beers Group. He is currently De Beers Diamond FutureSmart Lead : Energy and (Acting) Group Safety Lead. He resides in Cape Town, South Africa.

Marc Lincoln



Project Manager
Diamond FutureSmart™
De Beers Group
Canada

Marc.Lincoln@debeersgroup.com

Education:

1984-1987 BSc. Mechanical Engineering WITS
1989-1993 Diploma in Computer Science Unisa
1991 Government Certificate of competency
1999 MDP Stellenbosch Business School 1999
2013 Occupational First Aid Level One (BC Work Safe)

KEY SKILLS

Project delivery - Full project life cycle experience – 20 years (Anglo American/De Beers experience 31 years):

| | |
|--------------------------------------|---|
| Project & Study manager | Chidliak Project Canada, Pebble Copper Project - Alaska, Peace River Coal – British Columbia, Skorpion Zinc – Namibia (numerous projects), DeBeers Capital Expansion – Canada, Microwave Project, and Optical Sorter. |
| Project engineer | Sadiola, Columbus Stainless Steel Joint Venture project, Namakwa Sands Project, Gamsberg, Konkola (Zambia), Skorpion Zinc (original project) |
| Engineering manager | DeBeers GK designate, Gamsberg project |
| Project controls | Manager in 2 major projects Pebble and Gamsberg |
| Project construction | 3 years onsite experience for Namakwa Sands, and Skorpion Zinc |
| Procurement management | Particularly the Namakwa Sands project where procured all the equipment and other contracts. Skorpion Project spares procurement. |
| Contract management | All projects, but notably successfully defended a law suit against Anglo American |
| Risk management | Particularly with the due diligence project in Africa like Tenke, Frontier, Komoto, Lumwana and Kansanshi. Also part of all project delivery |
| Commissioning | 2 years onsite experience and accountability for Namakwa Sands (primary and secondary separation plants), Skorpion Zinc (the complete plant) |
| Project due diligence | Various operations (Kamoto, Kansanshi, Lumwana, Frontier, Tenke) |
| Project estimating | Actual preparation of estimates Kabanga Nickel and Boyongan (Philippines). Managed the capital estimates of many project for example Pebble PFS, Debeers Capital Expansion of Snap Lake. |
| Demolition | Working on the demolition of project at Konkola Zambia |
| EPCM project house experience | 5 years (in the offices of Bateman and Murray & Roberts), AMEC (Canada), Fluor (Canada), Hatch (South Africa and Canada) |
| Financial analysis | Boyongan copper project (Philippines) responsible for the preparation financial model. Gamsberg project prepared the investment proposal to reinstate the project. Skorpion Zinc and the Sulphur Project successful |



Norbert Zajzon



Associate Professor
Institute of Mineralogy – Geology
Faculty of Earth Sciences and Engineering
University of Miskolc
Hungary
nzajzon@uni-miskolc.hu

Norbert Zajzon completed his studies about mineralogy, geochemistry and solid mineral resources at the Eötvös Loránd University (MSc 2001, PhD 2006), Budapest, Hungary. His research subject was instrumental mineralogy and geochemistry related to global environmental crises, mass extinctions. Until now he is dedicated to numerous analytical techniques in the geoscience field.

He is currently an associate professor at the Institute of Mineralogy and Geology, and head of the Mineralogy – Petrology Department, University of Miskolc (Miskolc, Hungary), teaching instrumental mineralogy, ore deposits and astronomy and planetology and head of the microprobe laboratory (<http://www.geology.uni-miskolc.hu/index.php/en/staff/13-munkatarsak/438-dr-norbert-zajzon>), and co-leader of the 3D laboratory. He has experience in numerous H2020 projects, like Robominers, or UNEXMIN (unexmin.eu) where he was the coordinator. UNEXMIN project developed and proved the concept of an autonomous underwater robotic explorer (UX-1) capable to 3D map and deliver geo-scientific information by non-invasive methods from abandoned, flooded underground mines. The UNEXMIN results led to its continuation the EIT Raw Materials financed UNEXUP project (unexup.eu) from 2020 to 2023 where also he is the coordinator. UNEXUP aims to stabilize and develop the technology further bringing the technology closer to the market. He is also the scientific advisor of the UNEXMIN Georobotics Ltd, which was founded by the UNEXMIN consortium. Nearby his university carrier, he also works for the geological society, as Co-president of the Hungarian Geological Society and fellow of the Society of Economic Geologists.



Pedro Jorge



PhD, Senior Researcher and Area Manager
INESC TEC
Invited Assistant Professor, FCUP
Portugal
pedro.jorge@inesctec.pt

Pedro A. S. Jorge was born in Braga, Portugal, in 1973. He graduated in Applied Physics (Optics and Lasers) at University of Minho in 1996, and received a MSc in Optoelectronics and Lasers by the Physics Department of the University of Porto in 2000. In 2006 he concluded his PhD program in Physics at the University of Porto in collaboration with the Department of Physics and Optical Sciences at the University of Charlotte, North Carolina, USA, with work in luminescent quantum dots and its applications in optical fibre sensors for environmental and biomedical applications.

Pedro Jorge is currently working as Senior Researcher at INESC TEC - Institute for Systems and Computer Engineering, Technology and Science, a R&D institute affiliated to the University of Porto. He is the Leader of Biochemical Sensors Area, member of the coordination council of the Centre for Applied Photonics (CAP), and the coordinator for the CAP activities in TEC4Sea Infrastructure.

He is also working at the Physics and Astronomy Department of the Faculty of Sciences of the University of Porto (FCUP) as Assistant Professor.

Since 2007 Pedro Jorge leads the Biochemical Sensor group at INESC TEC, exploring the potential of photonic technologies in the development of new solutions for chemical and biological monitoring in environmental, biomedical and industrial applications. This activity is framed in a diversity of competitive national and International research projects with academia and Industry, where he acts as Principal Investigator (9), workpackage leader (14) or regular team member (9), supervising also the training of advanced human resources at PhD and Msc level. Photonics technologies such as optical fiber sensors, interferometry, fluorescence spectroscopy, optical trapping and Laser Induced Breakdown spectroscopy are being explored in a diversity of applications ranging from systems for real time evaluation of minerals for underwater mining, determination of dCO₂ in Aquaculture, manipulation and diagnostic of single cells, and remote monitoring of water quality.

Since 1998 Pedro Jorge co-authored 82 peer-reviewed papers, 3 book chapters and more than 200 communications in international and national conferences in the field of optical sensors. He is the author of 1 patent, and three Patent pending (EP). In total, these publications have attracted 2531 citations according to Google Scholar (user: P. A. S. Jorge) with h-index of 29; SCOPUS (ID 9740971900), 1888 citations, h-index of 24; on researcherID (user: G-4964-2011), 1704 citations, h-index of 23. Pedro Jorge is a member of SPIE and SPOF.



Michel Vanavermaete



Innovation Hub Director CLC West
EIT Raw Materials
Belgium
michel.vanavermaete@eitrawmaterials.eu

Michel Vanavermaete has been appointed Innovation Hub Director (CLC West) as of May 2018. Michel has extensive experience in financing and public support to innovation and industrial R&D. After graduating with a degree in Information Technology in 1986, he started his career within an IT Start Up company developing Belgian accountancy and tax management systems. He continued his career as IT Director in a large US advertising and Communication company. In 1999, Michel joined the EUREKA Secretariat (mother organization of Joint EU-EUREKA Eurostars Innovative SME support programme), Contributing to its design, he was appointed as Director of the Eurostars Programme. With a long experience in managing public funding for innovation and the development of innovation strategy and innovation hubs in Companies, He also acquired expertise in support and selection of Start Ups.





Organizers

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