July 7, 2022

SOE'22

Space, Ocean and Earth Insights

BIO, GEO and TEK come together to discuss the current frontier of Space Exploration

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SPACE FOR ALL NATIONS

IIAS International Institute for Astronautical Sciences

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PORTUGAL SPACE

Introduction

SOE'22 – Space, Ocean and Earth Insights brings together BIO, GEO and TEK to discuss the current frontier of Space Exploration.

This half-day workshop is a joint collaboration between the UT Austin Portugal Program, INESC TEC, through its Center for Robotics and Autonomous Systems (CRAS), the International Institute for Astronautical Sciences – Space for All Nations (IIAS), the School of Engineering of the Polytechnic Institute of Porto (ISEP), the Faculty of Sciences of the University of Porto (FCUP) and the Portuguese Space Agency, PT Space. The event also counts on the support of the Luso-American Development Foundation (FLAD).

Be prepared for a comprehensive discussion about space exploration with high-calibre panellists from Portugal and the US. They will talk you through the importance of international science and technology cooperation to harness the potential of the space sector. The intersections between biology, geology and technology will be analyzed to cast light on the final frontier of space exploration. Sounds exciting?

Then, take your seats, fasten your seat belts....3, 2, 1.... We are lifting off!

A Constellation of Top-Notch Speakers

Yvette Gonzalez

Yvette is a humanitarian, atmospheric/bioastronautics researcher, space suit technician, and human resilience expert. With over two decades of emergency response experience rebuilding communities in active war, conflict, natural disasters, and epidemiological outbreaks, she focuses on space technologies to solve Earth challenges. She carries out her research with the International Institute for Aeronautical Science where she serves as Head of International Collaborations and Strategic Initiatives. Of Native American and Mexican heritage, she leads efforts providing access to space science and STEM for underrepresented, Indigenous, and marginalized communities.

Ricardo Conde

Ricardo Conde, 55 years old, is the father of two beautiful girls. He holds a degree in Electrical and Computer Engineering from IST – Technical University of Lisbon and a postgraduate degree in Space Technologies. He began his professional career in 1991, having been linked to the Aeronautics and Space sector since 1993 with the participation in several National and International programs, in particular in Space and Ground segments. In 2019 Ricardo joined the Portuguese Space Agency, Portugal Space as a member of the board. About one year later, Ricardo Conde was appointed President of the Portuguese Space Agency.

Miguel Gonçalves

Miguel Gonçalves was born in Porto on May 10, 1978, but spent his childhood and youth in Castelo Branco, returning to his born city in 1996 to enrol in the Physics/Applied Mathematics (Astronomy branch) graduation at the Faculty of Sciences. Science trainer and communicator, he worked as a monitor of the portable planetarium of the Oporto Planetarium and in 1997 he was invited to be National Coordinator of The Planetary Society, the largest non-governmental space agency in the world, a position he held until February 2019. He worked for almost 10 years in the publishing and bookselling industry. He hosts the TV space exploration and astronomy magazine "A Última Fronteira" broadcasted on Portuguese public television and was also an Astronomy and Space Exploration commentator for "Jornal 2" (RTP2) and "24 Horas" (RTP3). He wrote for 2 years a column in "i" newspaper dedicated to Space Exploration and is currently a columnist for the magazine "JN História". He participated in the NASA/Portugal Bilateral Protocol (1999) and in the 53rd IAF World Space Congress, October 9-19, 2002 in Houston, USA (selected by the European Space Agency).

A Constellation of Top-Notch Speakers

Slavka Carvalho Andrejkovičová

Slavka Carvalho Andrejkovičová works, since November 2019, as a Principal Investigator at GeoBioTec – University of Aveiro and as a Special External Scientist for NASA Goddard Space flight Center (USA). From January 2016 to July 2019, she was a Research Scientist on the Mars Science Laboratory (MSL, better known as the Curiosity Rover on Mars) team at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (USA). During this period, she was also Assistant Researcher in the Department of Astronomy at the University of Maryland (USA). Previously, from July 2009 to December 2014 she was an Assistant Researcher in the Department of Geosciences at the University of Aveiro under the program of the Foundation for Science and Technology (FCT) Science 2007, and from 2003 to 2009 she was a PhD Researcher at the Instituto de Inorganic Chemistry at the Slovak Academy of Sciences, Bratislava, (Slovakia). In 2008 he obtained his PhD in Inorganic Technology and Materials. Dr. Slavka Carvalho Andrejkovičová also has a Bachelor's Degree in Chemistry obtained in 2001 and a Master's Degree in Chemistry (specialization in Nuclear Chemistry and Radioecology) obtained in 2003 at Comenius University in Bratislava, Slovakia.

Ricardo Oliveira

Ricardo has a Bachelor's Degree in Geology and currently, he is a Master's finalist in Geological Engineering at the University of Aveiro, with a thesis on the "Cabeço de Vide serpentines and their implications for Mars". Ultramafic rocks from Cabeço de Vide (Portugal) are used as a unique analogue for understanding serpentinization on Mars, linking biological and geological processes on Earth and Mars through a detailed petrographic description and a multidisciplinary approach to the search and study of possible past/present life on the Red Planet.

Rui Moura

Rui Moura is from Portugal, a professor and researcher at the Faculty of Sciences of the University of Porto. He graduated from the University of Aveiro in Geological Engineering and later completed a PhD from the University of Aveiro in Geophysics. Currently a researcher at the INESCTEC - CRAS (Porto) and also the vice-director of the Geophysical Institute of the University of Porto. One of his research interests, at the moment, is in the geophysical properties of Lunar Regolith having also conducted microgravity experiments on that topic. His field of research has given him more than 25 years of geophysical exploration field work, thus plenty of experience in performing scientific measurements in some harsh wild environments. He also researches and lectures on topics related to natural hazards and risk assessment and was responsible for setting up current Earthquake Risk Assessment guidelines for Kyrgyzstan's government. Rui, joined IIAS (International Institute of Astronautical Sciences), in 2016, graduating from Scientist-Astronaut class 1601. Recently he has also made efforts in Portugal to promote human space flight using authentic artefact exhibitions and has also been invited to numerous public talks, media interviews and conference events. At IIAS, he was also the former chair for Space for All Nations (SFAN).

A Constellation of Top-Notch Speakers

Jason Reimuller

Jason Reimuller is the Executive Director of IIAS. Since its founding in 2012, he has led the development of over 60 credits of upper-division and graduate curriculum, providing immersive educational services to over 350 professional scientists, engineers, and educators from 53 different countries.
He serves as Co-Principal Investigator of NASA's PMC-Turbo experiment as well as Co-I of various IVA space suit test and evaluation programs including microgravity, post-landing, and high-altitude evaluations to evaluate human performance, CO2 washout, the suit-seat interface, and functionality of the test pressurization system and biometric monitoring system. He also serves as Co-Principal Investigator of an EVA space suit test and evaluation program including gravity offset and neutral buoyancy evaluations of an EVA space suit.
Jason holds a PhD in Aerospace Engineering Sciences from the University of Colorado in Boulder, an M.S. degree in Physics from San Francisco State University, an M.S. degree in Aviation Systems from the University of Tennessee, an M.S. Degree in Aerospace Engineering from the University of Colorado, and a B.S. degree in Aerospace Engineering from the Florida Institute of Technology.

Aaron Person

Aaron H. Persad is a research scientist at the Massachusetts Institute of Technology and his primary research investigates the size-separation of molecules using novel filters made of graphene with Angstrom-sized features for applications in healthcare, energy, and water purification. He is also the Director of Bioastronautics at the International Institute of Astronautical Sciences and is leading efforts there to prepare the next generation of scientists and engineers for careers in human spaceflight. Dr Persad is Co-Founder and CTO of Mission: Space Food, the first commercial company addressing questions of nutrition in space. Dr Persad's other research activities include advancements in space sciences and technology. Between 2007 and 2016, Dr Persad represented Canada as a science team member in the European Space Agency's Microgravity Application Program (MAP) on research payloads related to evaporation, condensation, and boiling. He helped to design and develop over 25 payloads that have flown aboard parabolic aircraft, stratospheric balloons, and the International Space Station. Dr Persad has published several papers related to thermodynamics, space sciences, and spacesuits. In 2017, he ranked in the Top 60 candidates in the Canadian Space Agency's Astronaut Recruitment Campaign.

Andreia Magalhães Oliveira

Andreia Magalhães Oliveira is a PhD Student in Biomedical Engineer at the Faculty of Engineering of the University of Porto, and part of the Neuroengineering and Computational Neuroscience Lab at i3S - Instituto de Investigação e Inovação em Saúde, Porto. She graduated in Medicine from the Faculty of Medicine of the University of Porto in 2020, with a thesis project on the access to surgical care in low and low-middle income settings. Currently, she is a researcher in the field of Deep Brain Stimulation, where she is studying adaptive mechanisms in the context of Parkinson's Disease.

A Constellation of Top-Notch Speakers

Lori Magruder

Lori Magruder is an Associate Professor in the Aerospace Engineering Department and the Associate Director of the Center for Space Research at the University of Texas at Austin. She is a subject matter expert in altimetry, remote sensing and 3D geospatial data exploitation for Earth Science applications. Dr Magruder received her bachelor's degree from The University of Southern California in Aerospace Engineering and her master's degree from Princeton University in Mechanical and Aerospace Engineering. Her PhD was earned from The University of Texas at Austin with a focus on ground-based validation studies for NASA's ICESat (Ice, Cloud and Land Elevation Satellite) mission. She has held positions at Jet Propulsion Laboratory and The Johns Hopkins Applied Physics Laboratory prior to returning to UT Austin. Dr Magruder has played a critical role in NASA's ICESat-2 mission via leadership of the science teams since 2014 and innovation of several science applications including nearshore benthic habitat mapping, ecosystem structure determination and coastal change detection. She also has developed a unique method using ground-based optical components for passive validation of the space-based laser geolocation. Dr. Magruder leads many other NASA research efforts in addition to supporting programs through the Department of Defense with her expertise in geospatial topics and the unique link she brings between engineering and science applications through remote sensing for Earth Science.

Alfredo Gonçalves

Alfredo Martins is currently a Professor with the School of Engineering (ISEP), Porto Polytechnic Institute (IPP), and a Research Coordinator with the Robotics and Autonomous Systems Group, INESC TEC, Portugal. He currently participates in various international EU and H2020 (EU-Scores, Atlantis, UNEXUP, Nettag) and national deep sea (Nessie, Hypersea) marine robotics research projects. He has a vast experience in mobile robotics, having worked with autonomous robots, since 1993, in multiple international (NATO, EU FP7, H2020) and national research projects addressing search and rescue, security, environmental monitoring, underwater mining and marine and deep-sea robotics. With an extensive list of publications in both land, aerial, underwater, and surface autonomous robots, his research interests include the perception, navigation, control, and coordination of mobile robots with particular emphasis on marine robots.

A Constellation of Top-Notch Speakers

Luísa Bastos

With a degree in Surveying Engineering, Luísa Bastos had her Ph.D. in Surveying Engineering from the Faculty of Sciences of the University of Porto, where she was currently a Retired Guest Principal Investigator. Working in Satellite Positioning and Navigation for more than 30 years, she is, since 2018, Head of the Ocean Dynamics, Coastal and Water Systems group at the Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), where she had been a member of the Board from 2013 to 2015.

Since 2021 she is a member of the Satellite Navigation and Remote Sensing group of the Institute of Space Sciences of the University of Shandong, China. Since 2021 she acts as consultant of the company Weihai Wuzhou Satellite Navigation Technology Co., Ltd., China.
In 2021 she was awarded the professional qualification level of “Counselor Engineer” by the Order of Engineers. In 2021 the city of Weihai, China awarded her the title of Honorary Citizenship.
From 1977 to 2020, she was the Director of Prof. Manuel de Barros Astronomical Observatory, where she led the recovery of the largest telescope in Portugal.
From 2010 to 2015, Luísa Bastos was nominated for the “Mission Evolution Advisory Group”, an EU group of experts to advise the European Commission on the European Satellite Navigation System.
Between 2003 and 2015 she acted as a member of the Board of the UP Institute for Common Resources (IRIC) and the Marine Research and Innovation Center (OCEANUS), and also as Vice-President of the Department of Geosciences, Environment and Spatial Planning (DGAOT) of the FCUP.
She was elected as President of the IAG Special Commission 6 (Project WEGENER -Working Group of European Geoscientists for the Establishment of Networks for Earth-science Research) from 2000 to 2004.

Agenda

Opening Session

2:00 p.m. – 2:10 p.m

Maria João Viamonte
President of the School of Engineering of the Polytechnic Institute of Porto (ISEP|IPP)

Session I:
The Space Ecosystem, Communication and Outreach

2:10 p.m. – 2:20 p.m

Yvette Gonzalez
Head of International Collaborations and Strategic Initiative at the International Institute for Astronautical Sciences (IIAS)

2:20 p.m. – 2:30 p.m

Ricardo Conde
President, Portugal Space (PT Space)

Agenda

Session II:
The Cosmos, the Moon, Mars, and Beyond

2:30 p.m. – 2:50 p.m

Miguel Gonçalves
Host of “A ÚltimaFronteira”, RTP magazine about Astronomy & Space Exploration

2:50 p.m. – 3.10 p.m

Slavka Carvalho Andrejkovičová
Principal Investigator at the University of Aveiro and Special Expert Collaborator for SAM team at NASA Goddard Space Flight Center

Ricardo Oliveira
Master's finalist in Geological Engineering at the University of Aveiro

3:10 p.m. – 3:30 p.m

Rui Moura
Professor at the Faculty of Sciences of the University of Porto and Researcher at INESC TEC’s Centre for Robotics and Autonomous Systems

10-min Q&A

Agenda

Session III:
Space Medicine, Microgravity Research, and Astronautical Sciences

4:00 p.m. – 4:20 p.m
Jason Reimuller
Executive Director at IIAS

4:20 p.m. – 4:40 p.m
Aaron Persad
Research Scientist at the Massachusetts Institute of Technology (MIT) and the International Institute for Astronautical Sciences (IIAS)

4:40 p.m. – 4:50 p.m
Andreia Magalhães Oliveira
Medical Doctor and PhD Student at the Faculty of Engineering of the University of Porto | Neuroengineering and Computational Neuroscience Lab at i3S

10-min Q&A

Session IV: Technological Developments from Deep-Sea, to Earth Observation and Outer Space

5:00 p.m. – 5:20 p.m

Lori Magruder
Associate Professor at The University of Texas at Austin's Aerospace Engineering and Engineering Mechanics Department

5:20 p.m. – 5:40 p.m

Alfredo Martins
Associate Professor at the School of Engineering of the Polytechnic Institute of Porto (ISEP|IPP) and Research Coordinator at the INESC TEC's Center for Robotics and Autonomous Systems

10-min Q&A

Agenda

Session V:
The Current Frontier of Space Exploration

5:50 p.m. – 6:40 p.m

Luísa Bastos (Moderator)
Head of the Ocean Dynamics, Coastal and Water Systems group at the Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), Area Director for Space-Earth Interactions, UT Austin Portugal Program

Discussants: Yvette Gonzalez; Ricardo Conde; Aaron Persad and Miguel Gonçalves

Closing Session

6.40 p.m. – 6.50 p.m.

José Manuel Mendonça
Chairman of the Board of INESC TEC and National Director of the UT Austin Portugal Program

Space Robotics Sunset (and Technological Exhibition)

7:00 p.m.

(Venue: Laboratory for Robotics and Autonomous Systems – ISEP)

Welcome and Opening Session

Maria João Viamonte

Maria João Viamonte, President of the School of Engineering of the Polytechnic Institute of Porto (ISEP|IPP), will officially open the SOE'22 Space Workshop.

ISEP is one of the SOE'22 supporters.

Session I: The Space Ecosystem, Communication and Outreach

Yvette Gonzalez

Head of International Collaborations and Strategic Initiatives,
International Institute for Astronautical Sciences (IIAS)

Shaping Access to the Space & Humanity Ecosystem

Over a decade ago, as the space sector turned a critical corner towards rapid expansion and innovation, a group of passionate industry professionals sought to ensure that the most underrepresented and marginalized communities around the world could participate in the evolving ecosystem. The International Institute for Astronautical Sciences (IIAS) was established to offer equitable access to space research and education.

With over 52 countries and multiple disciplines represented, the IIAS has built a community of professional and citizen scientists who conduct space medical, geoscientific, atmospheric, flight test engineering, bioastronautics, aeronomy, and spaceflight operations research. In this session, we learn how the power of science enables a collaborative and productive movement to advance solutions through inclusivity. And how together with international partners they are creating strong relationships for a better future in space and on Earth.

Session I: The Space Ecosystem, Communication and Outreach

Ricardo Conde

President, Portugal Space (PT Space)

Understand the moment in the Space Race 2.0

The scenarios for the space economy and what are the key drivers for the space renaissance era.

The importance of Space governance for a sustainable space economy and space as a collaborative ecosystem to be preserved.

Session II: The Cosmos, the Moon, Mars, and Beyond

Miguel Gonçalves

Host of “A Última Fronteira” RTP magazine about Astronomy & Space Exploration

As for the future, your task is not to foresee it, but to enable it

The last two decades of the history of Space exploration and our knowledge of the Cosmos are marked by remarkable technical, economical and logistical revolutions and developments and an increasingly explicit presence of space technologies in our daily lives.

This presentation will indicate some of the contexts in which Humanity is present, the new challenges and warnings, as well as the importance of an effective scientific culture and communication to prepare the next generations for scenarios and realities increasingly far away from our planet.

Session II: The Cosmos, the Moon, Mars, and Beyond

Slavka Carvalho Andrejkovičová

Principal Investigator at the University of Aveiro and Special Expert Collaborator for SAM team at NASA Goddard Space Flight Center

NH4-smectites – part of nitrogen cycle on Mars?

The presence of nitrates in Martian near-surface samples has been confirmed by evolution of NO during heating of samples by the Sample Analysis at Mars (SAM) instrument suite on the Curiosity rover, indicating that nitrogen fixation processes occurred in early Martian history. However, little is known about other possible nitrogen reservoirs on Mars, including those that may contain reduced forms of N in the sediments.

Thus, understanding whether reduced N compounds such as NH_4^+ are present in Martian regolith is important to assess habitability in the Martian environment. Ammonium may be sequestered and stabilized in surface materials by inclusion of NH_4^+ in certain phyllosilicates. Smectite clay minerals have been detected in most drilled rock samples analyzed by Curiosity (Bristow et al., 2021). Therefore, the presence of reduced N in the form of NH_4^+ on clay mineral exchange sites would have important implications for the development of a nitrogen cycle on Mars, and therefore Mars' past habitability.

Oxychlorine phases, such as perchlorates, have also been detected in several samples analyzed by SAM and when heated they evolve oxygen. The main aim of this study is to determine if reduced N in the form of NH_4^+ sequestered in the interlayer space of the smectites, when heated with perchlorate salts, produce N compounds (NO) during heating comparable to those observed during heating in SAM.

Session II: The Cosmos, the Moon, Mars, and Beyond

Ricardo Oliveira

Master's finalist in Geological Engineering at the University of Aveiro

Cabeço de Vide Serpentines and their implications for Mars

Based on the European Astrobiology Roadmap, sites associated with serpentinization processes, both on Earth and throughout the Solar System, are becoming increasingly compelling for the study of habitability and astrobiology, centrepieces in the study of the origin of life. Serpentinization is common on Earth in locations where olivine-enriched bedrock is in contact with liquid water, typically in tectonically active margins, but continental occurrences of active serpentinization on Earth are rare. Environments prone to serpentinization are of particular interest because they imply the presence of several of the “key elements” for life as we know it: liquid water, ametabolic energy source (H2), and an abiotic means of forming organics like CH4. These reactions are also often discussed and considered relevant for origin-of-life hypotheses for life on Earth. Also, for this reason, Jezero Crater has been selected as the landing site for a recent rover in NASA's Mars Exploration Program, the Perseverance.

The knowledge of the detailed mineralogy of terrestrial Mars analog samples is crucial for the interpretation of the data acquired by rovers on Mars. Mars analogs are environments on Earth providing similar geological formations and mineralogy as those on Mars.

Because of its accessibility and active serpentinization, the hydrothermally altered mafic–ultramafic complex from Cabeço de Vide (CdV), Portugal, provides a unique opportunity for the investigation of continental serpentinized rocks on Earth, emphasizing the fact, that CdV ultramafics are not ophiolites, but associated with the intrusion of mafic/ultramafic pluton. In this context, CdV is proposed as an excellent mineralogical environment to study as a Mars analog, as serpentine detections have been reported at the Mars 2020/Perseverance rover landing site, Jezero Crater. These findings will provide greater context on the serpentine bodies on Earth as an important approach to understanding the geochemical processes on Mars.

Session II: The Cosmos, the Moon, Mars, and Beyond

Rui Moura

Professor at the Faculty of Sciences of the University of Porto and Researcher at INESC TEC's Centre for Robotics and Autonomous Systems

The Role of Planetary Geology: From short microgravity opportunities to lunar science exploration

An overview of the history of planetary geology and geophysics carried out throughout history will be addressed. Particular emphasis will be placed on experiments carried out on the lunar surface during the Apollo program. The insight provided by these missions was essential to comprehend not only the geological history, age and origin of the Moon but also the Earth and Solar System. However many geological phenomena we tend to interpret are all based on a relatively strong gravity field environment that conditions, for example, the atmosphere, sedimentation or fluid flow.

Today we aim to understand geological processes involved in planetary geology in low gravity field bodies such as primordial solar dust clouds, asteroids and comets. To explain these environments microgravity studies using either parabolic aircraft flights, suborbital or orbital space flights can be of great use.

Session III: Space Medicine, Microgravity Research, and Astronautical Sciences

Jason Reimuller

Executive Director at the International Institute for Astronautical Sciences (IIAS)

IIAS Research Facilities and Educational Offerings

IIAS provides a high-value, immersive education within culturally-diverse operational environments that enables research that promotes multi-national space exploration, science literacy, and the equitable and peaceful uses of outer space. Licensed by the State of Connecticut, we offer certificates in space flight operations, space suit evaluation, aeronomy, and flight test engineering. IIAS is in the process of accrediting a Master's degree in astronautical sciences and bioastronautics. IIAS's research activities concentrate on 1) the dynamics of the mesosphere and lower thermosphere (Project PoSSUM), 2) the test and evaluation of space suit and biomonitoring technologies including human performance and human factors research, 3) microgravity research, and 4) space medicine research.

IIAS maintains various laboratories and research facilities through contract including a parabolic flight lab, a spacecraft egress and neutral buoyancy lab, a two-axis gravity offset laboratory, five IVA spacesuits and one prototype EVA space suit system, a hypobaric and hyperbaric altitude chamber, several aircraft, and various simulators and boilerplates including Virgin Galactic's Spaceship Two, NASA's Orion vehicle, and the Quest Airlock on the ISS. IIAS currently has students from 53 different countries and sponsors projects and programs serving emerging space nations as well as under-represented communities in STEM.

Session III: Space Medicine, Microgravity Research, and Astronautical Sciences

Aaron Persad

Research Scientist at the Massachusetts Institute of Technology (MIT) and the International Institute for Astronautical Sciences (IIAS)

Bioastronautics Reduced Gravity Research with Human-in-the-Loop Experiments: A Shift from Autonomous toward Human-Tended Payloads

As more commercial spaceflight opportunities arise, there is increasing opportunity for researchers to access new reduced gravity platforms with the added benefit that payloads can be human-tended and recovered.

The International Astronautical Institute for Aeronautical Sciences (IIAS) has been developing methods, test procedures, and programs to equip spaceflight participants with the knowledge, skillset, and experience needed to enable them to maximize the scientific return of spaceflight missions. This includes providing them with hands-on experience in payload development, integration and certification, in addition to tending payloads in hypo and hypergravity environments. Through our various collaborations, we pursue unique research that helps build our intuition of how life and physical systems behave in reduced gravity. In this talk, we will explore various ground-based and spaceflight IIAS bioastronautics projects, including the near weightless testing of intra-vehicular activity (IVA) spacesuits and developing novel propellant management technologies.

We will also present ways in which reduced gravity research can be performed locally (e.g. at home or in schools) and provide examples of the rich physics that can be uncovered with just 1 second of freefall time.

Session III: Space Medicine, Microgravity Research, and Astronautical Sciences

Andreia Magalhães Oliveira

Medical Doctor and PhD Student at the Faculty of Engineering of the University of Porto | Neuroengineering and Computational Neuroscience Lab at i3S

An Insight into Space Medicine

In this session, the aim is to provide a brief overview of the field of Space Medicine. We will start by understanding what such a field entails, and how can its findings be important both to space exploration, but also to bedside practices. We will move to its main applications: research, careers and certifications.

Moreover, it is important to acknowledge some of the most pressing challenges in Space Medicine, but more broadly in the potential that its methods can reach. Lastly, we will present some of the work in progress in Portugal.

Session IV: Technological Developments from Deep-Sea, to Earth Observation and Outer Space

Lori Magruder

Associate Professor at The University of Texas at Austin's Aerospace Engineering and Engineering Mechanics Department

Earth observing laser altimetry for global remote sensing applications

NASA's Ice, Cloud, and land Elevation Satellite (ICESat-2) carries the Advanced Topographic Laser Altimeter system (ATLAS) lidar to measure the changing height of the Earth's surface. After nearly 4 years of data collection, ATLAS has emitted well over a trillion laser pulses.

The satellite continues to operate nominally and provides global elevation measurements to a broad range of science disciplines. On-orbit discoveries with the data have facilitated advancements in cryospheric science, terrestrial ecology, hydrology, bathymetry, and oceanography.

Although space-based laser altimetry has been acquired by other missions/instruments in the past, ICESat-2 hosts state-of-the-art technology to accommodate high spatial and temporal resolution measurements not previously achievable. This cross-discipline mission not only supports innovative science but is an example of critical advancement in engineering and mission implementation.

Session IV: Technological Developments from Deep-Sea, to Earth Observation and Outer Space

Alfredo Martins

Associate Professor at the School of Engineering of Porto and Research Coordinator at the INESC TEC's Center for Robotics and Autonomous Systems

From Deep Sea to Outer Space: the Current Challenges of Underwater Technologies

Underwater robotic and autonomous systems are key tools in exploration and in establishing human presence or action in extreme environments such as the deep sea or underground flooded mines. These tools are also emerging as relevant in the mineral and raw materials application areas such as in the emerging focus on deep sea mining and the possible exploitation of untapped land mineral resources in a sustainable way.

Space Exploration and Space Resources are also fields of interest where these kind of technologies could contribute, in a first stage on Earth and Underwater as test-beds, to achieve Space applications in the Moon, on Mars or in asteroids.

This presentation will provide a glimpse of the current state of underwater autonomous systems with particular attention with their relationship with raw materials application area. It will briefly address some of the INESCTEC current work in this topic and will also perspective the future trends that are emerging, such as the potential of our Geo-robotic systems in Space Exploration.

Session V: The Current Frontier of Space Exploration

Moderator: Luísa Bastos

Head of the Ocean Dynamics, Coastal and Water Systems group at the Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), Area Director for Space-Earth Interactions, UT Austin Portugal Program

Discussants

Yvette Gonzalez

Ricardo Conde

Aaron Persad

Miguel Gonçalves

Wrap-up and Closing Remarks

José Manuel Mendonça

Chairman of the Board of INESC TEC and National Director of the UT Austin Portugal Program.

Scientific Coordinators

Ana Pires
Researcher, Centre for Robotics and Autonomous Systems (CRAS), INESC TEC

Rui Moura
Researcher, Centre for Robotics and Autonomous Systems (CRAS), INESC TEC

Paula Lima
Industry-Research Liaison Officer (TEC4SEA) & Project Manager, Centre for Robotics and Autonomous Systems (CRAS), INESC TEC

Other Experts Involved in the Organization of SOE'22

José Almeida (INESC TEC); Slávka Andrejkovičová Carvalho (University of Aveiro); Andreia Passos (UT Austin Portugal); António Gaspar (INESC TEC)

Supporting Team:

Adriana Costa (UT Austin Portugal); Catarina Carvalho (INESC TEC); Sheila Habib (UT Austin Portugal); Sofia Maciel (UT Austin Portugal); Rita Costa (UT Austin Portugal); Vera Pinto (UT Austin Portugal)

Event Supporters

INESC TEC - Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência is a private non-profit research institution dedicated to scientific research and technological development technology transfer, advanced consulting and training, and pre-incubation of new technology-based companies.
As part of its mission to develop science-based knowledge with societal impact, INESC TEC relies on interdisciplinary research teams organised to address societal challenges or application markets with global relevance. This internal arrangement with market orientation is designated as TEC4. INESC TEC's TEC4SEA develops technological solutions to overcome the deep-sea challenges and empower the Sea Economy through sustainable approaches to explore and exploit living and non-living ocean resources. By ensuring an advanced platform for tests, research development, and interdisciplinary collaboration around sea-related topics through its TEC4Sea, INESC TEC has become a key stakeholder in designing and implementing national strategic infrastructure roadmaps for the Sea Economy.
INESC TEC's Centre for Robotics and Autonomous Systems (CRAS) contributes to this mission. CRAS shows an excellent scientific track record and vast experience in underwater technologies, geo-robotics for complex environments, research projects, advanced technology development for the sea, its operation and technology transfer. CRAS works in 6 main areas of research: (i) autonomous navigation; (ii) long-term deployments; (iii)sensing, mapping, and intervention; (iv) multiple platform operations; (v) space-earth and space-water interaction and validation using innovative robotic technologies; (vi) exploration of underwater geological resources.
Website: https://www.inesctec.pt/en
Chairman of the Board: José Manuel Mendonça

INESCTEC

FLAD, the Luso-American Development Foundation, works daily to promote Portugal's development in cooperation with the United States of America. And by assuming this mission, FLAD constitutes itself as a bridge between the two countries, a resource of excellence among those who seek and offer opportunities in the USA in different areas Focusing on four major areas – Science and Technology, Education, Art and Culture and Transatlantic Relations – FLAD wants to pave the way for the Portuguese scientific, academic and artistic potential, strengthen Portuguese-American communities and bring people and institutions from the two sides of the Atlantic closer together.

Member of the main national and international networks of foundations (The Portuguese Foundation Center – CPF; The European Foundation Center – EFC), FLAD is recognised as one of the most important Portuguese foundations. It has opened doors to the United States for almost 35 years, developing Portugal, the Portuguese and Portuguese descendants, in partnership with leading institutions, while supporting projects of recognised value.
Website: https://www.flad.pt/en/
President: Rita Faden

FLAD LUSO-AMERICAN DEVELOPMENT FOUNDATION

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IInSITE - Insitu ore grading system using LIBS in harsh environments, is an upscaling project funded by EIT Raw Materials. It brings together a multidisciplinary research team with a renowned spectroscopy company to take a new smart LIBS (Laser Induced Breakdown Spectroscopy) technology to the market.

LIBS is a powerful spectroscopy technique for element analysis with up-and-coming features for the real-time assessment of composition. However, despite many systems already probing the market, its performance is only acceptable with simple samples and 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.

Recently, however, our team has developed novel methods that allow LIBS technology to perform with improved performance even with complex mineral samples, thus enabling real-time ore grading. This was achieved under the Horizon 2020 VAMOS project [http://vamos-project.eu/], where the technology was validated in a relevant mining environment (TRL6). The technology is in a production state and is ready to be improved for the market under the efforts of the inSITE project.

Acronym: inSITE
Start: 1st January 2020
End: 31st December 2022
Global Budget: € 1.937.146,00
Lead Partner: INESC TEC
Principal Investigator: Pedro Jorge
Project Manager: Ana Pires
Website: https://www.inesctec.pt/en/projects/insite

inSITE LIBS Project Disruptive Innovation

eit RawMaterials Connecting matters

Co-funded by the European Union

The **UT Austin Portugal Program** is a successful Science and Technology joint venture between the Portuguese Foundation of Science and Technology (FCT) and the University of Texas at Austin (UT Austin), supported by the Ministry of Science, Technology, and Higher Education in close collaboration with the Council of Rectors of the Portuguese Universities (CRUP). It has been running for fifteen years, fostering change through human capital development, mission-driven research and entrepreneurial support.

In its third funding phase (2018-2023), the Program elected five critical areas of knowledge to deliver real impact on the ground and in the coming years. Some of these areas are new ventures (Space-Earth Interactions and Medical Physics), while others were already covered in the previous editions of the Program (Advanced Computing, Nanotechnologies and Technology Innovation and Entrepreneurship, through UTEN – University – Enterprise Network).

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Through the several instruments offered by the Program, which ensure a consistent approach to the knowledge-to-value chain, researchers in Portugal and at UT Austin work together to tap into scientific topics with social and economic relevance at a global level, from space and science technology to medical physics and nuclear medicine, nano-science and technologies, high-performance computing (including data analytics, visualisation and artificial intelligence), to list a few.

The area of Space-Earth Interactions is committed to unlocking the full potential of integrating spaceborne, airborne, marine borne, along with underwater data towards a better understanding of the ocean, including deep-sea areas, and its interactions with the earth and the atmosphere, aiming to improve predictive capabilities under climate change scenarios. The envisaged research thrusts are 100% aligned with the Atlantic International Research Center (AIR Center), an international collaborative framework tackling global challenges and local priorities in the Atlantic region through an integrated approach to space, climate, ocean and energy.

Website: https://utaustinportugal.org/

National Director: José Manuel Mendonça | National Co-Director: Rui Oliveira

International Institute for Astronautical Sciences (IIAS) is a DBA for Integrated Spaceflight Services. The IIAS is a United States (US) research and education institute specializing in suborbital operational science capabilities, flight engineering systems, aeronomy, and bioastronautics. Through immersive training, testing, and research within high-fidelity operational environments, IIAS enables professional suborbital flight preparation and deployable scientific research payloads.

IIAS provides essential services to safe and cost-effective microgravity and suborbital qualification program, serving as an unbiased integrator versed in combined human and payload integrations in the process of suborbital research and training. IIAS conducts upper-atmospheric, intravehicular (IVA) and extravehicular activity (EVA) pressurized suit, and space technology research. The program combines microgravity, high-altitude, geoscience, flight test engineering, space medicine, and operational science courses. All training courses are designed and instructed by former NASA astronaut instructors as well as IIAS team scientists.

Website: https://astronauticsinstitute.org/

Executive Director: Jason D. Reimuller

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Space For All Nations|SFAN is one of the initiatives developed under the scope of the International Institute for Astronautical Sciences. SFAN helps emerging space nations work among themselves to participate in pure science ventures of global importance while creating opportunities for these nations to collaborate with established space nations.

Space For All Nations helps its member institutions develop STEM outreach activities within their own nations to inspire the next generation of space professionals.
Website: https://astronauticsinstitute.org/about/sponsored-outreach-programs/
Co-Chairs: Ana Pires and Rodrigo Carvalho Santiago

The School of Engineering of the Polytechnic Institute of Porto (ISEP) is one of the leading schools of engineering in Portugal contributing to the achievement of sustainable development, by creating and transmitting applied knowledge. ISEP offers a wide range of engineering programs with several A3ES and EUR-ACE accreditations.

ISEP a is member of the international consortium Conceive - Design - Implement – Operate (CDIO) and has more than a hundred partnerships within the European Space of Higher Education. ISEP strongly invests in its R&D units to create, develop and share applied scientific knowledge. ISEP houses ten research units, four recognized as National Research Centres by the Portuguese Science and Technology Foundation (FCT).

ISEP contributes to international networks with major R&D consortiums and participation in large-scale international projects, promoting a continual thrive for answers to society's needs, turning its campus into a home for innovation and technology.

The Autonomous Systems Lab (LSA) is an R&D unit of the Engineering School of Porto Polytechnic. It conducts research in autonomous systems and related areas such as navigation, control and coordination of multiple robots to embedded real-time systems design, encompassing advanced sensing and perception. The lab activity is structured around four lines of work: (1) R&D programs; (2) Educational projects (3) Dissemination projects; and (4) Strategic positioning projects for ISEP. LSA's main research areas are field robotics, environmental monitoring, security, and transportation.
Website: https://www.isep.ipp.pt/
President: Maria João Viamonte

isep Instituto Superior de Engenharia do Porto

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The **Faculty of Sciences of the University of Porto (FCUP)** is a Higher Education Institution of excellence in Exact, Natural, and Computer Sciences and technological applications. FCUP provides a multidisciplinary background that allies passion for discovery with academic rigour and technological pragmatism. It pursues Research, Design, & Innovation (RD&I) activities to provide excellence in teaching and in science & technology development, boosted by the diversity of its scientific community and international collaborations.

FCUP is committed to continuing education, dissemination of science & technology, and knowledge exchange and applying science & technology toward the 2030 United Nations Sustainable Development Goals. FCUP hosts six departments with teaching and research staff, providing more than 70 teaching programs at undergraduate and postgraduate levels. Staff are committed to RD&I within 16 high-performing associated Research Units. FCUP intends to further reinforce its contribution to Portuguese excellence in Higher Education and its associated Research Units to affirm its position as a leading RD&I institution.
Website: https://sigarra.up.pt/fcup/pt/web_page.inicial
Director: Ana Cristina Freire

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The **Agência Espacial Portuguesa - Portugal Space (PT Space)** was created by the Portuguese Government in March 2019. The Agency's primary purpose is to promote and strengthen Space in Portugal, its ecosystem and its value chain for the benefit of society and the economy in the country and worldwide. Portugal Space acts as a business and development unit for universities, research entities and companies, as stated in the Portugal Space 2030 Strategy, approved in 2018.

PT Space also coordinates the Portuguese participation in the international space sector. It represents the country in institutions such as the European Space Agency (ESA), the European Southern Observatory (ESO), the European Solar Telescope (EST), Square Kilometre Array Observatory (SKA), participating in the Committee on the Peaceful Uses of Outer Space (COPUOS) amongst other.

PT Space is also the national representative for Portugal to the European Commission for space-related matters, such as European Union Agency for the Space Programme (EUSPA), and the European Union Space Program (Copernicus, Galileo, GOVSATCOM, SSA), and financial instruments related to space.
Website: https://ptspace.pt/
President: Ricardo Conde

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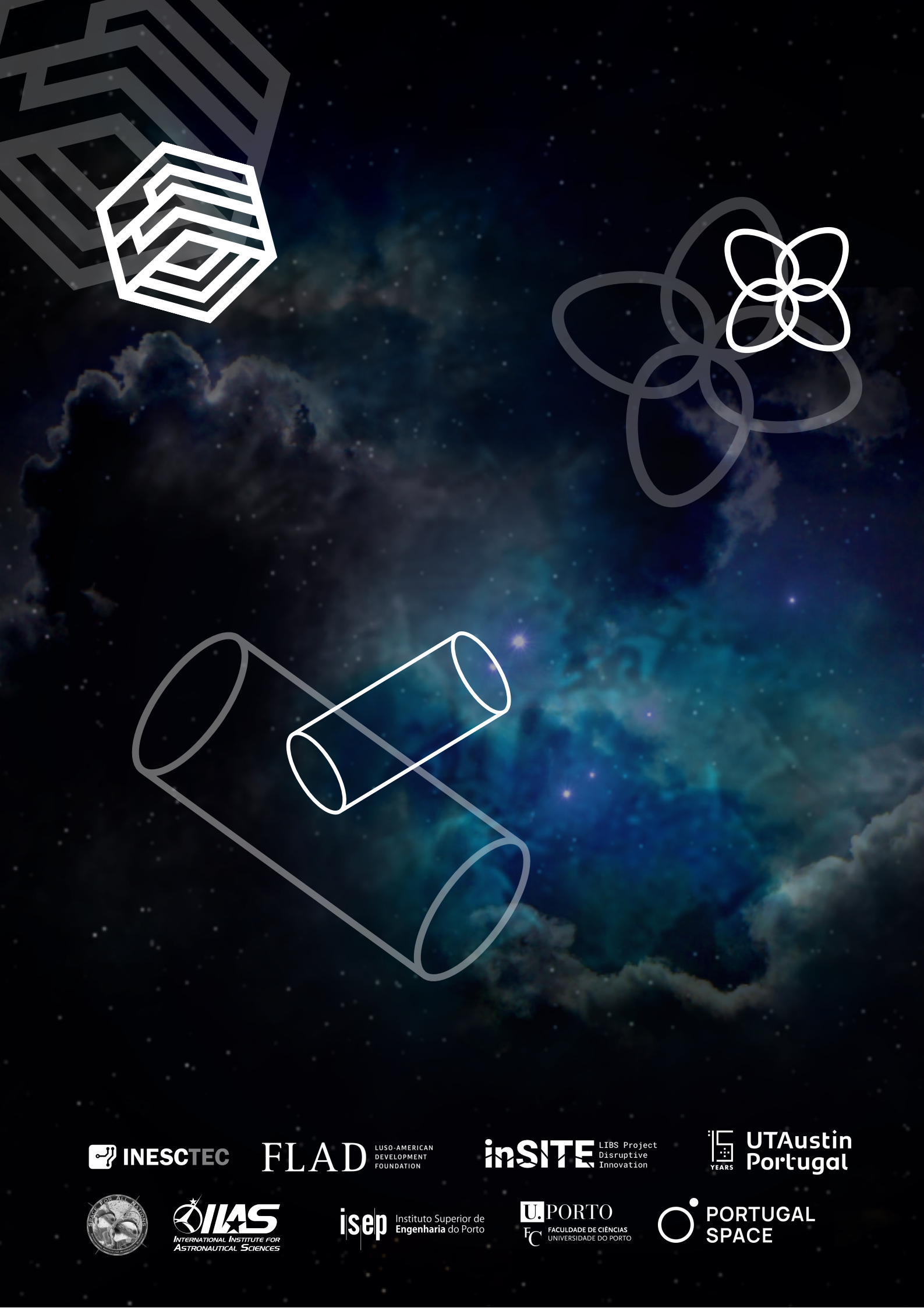
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