INESCTEC

ANNUAL REPORT 2023

WELCOME
TO THE HOME OF SCIENCE, TECHNOLOGY AND INNOVATION


CREATING A FULFILLING AND SUSTAINABLE FUTURE THROUGH IMPACTFUL SCIENCE, TECHNOLOGY AND INNOVATION.
I'M CREATING A FULFILLING AND SUSTAINABLE FUTURE THROUGH IMPACTFUL SCIENCE, TECHNOLOGY AND INNOVATION.

00. TABLE OF CONTENTS

01. MESSAGE FROM THE BOARD

TO THE INESC TEC COMMUNITY AND OUR VALUED PARTNERS

In presenting our 2023 report at INESC TEC, we take the opportunity to leave you with a brief reflection on our journey through yet another year that has seen both challenges and achievements. We do so through the prism of our strategic commitments. Following up on them is not only guiding us through times of significant change but is also inspiring growth and innovation in many aspects of the life of our institute.

Academic Excellence and Innovation
In 2023, we have furthered our commitment to excel and innovate across the missions of academia. We had another year of remarkable engagement in our educational initiatives, involving in our activities more than 300 PhD and 600 Master's students carrying out their thesis projects, as a reflection of our dedication to preparing the new generations for the future and paving the way for emerging leaders in science and innovation. Our successful recruitment and support for researchers in strategic domains has reinforced our role as an inspiring and empowering community, underpinned by the merit of our research teams and support staff.

Tackling the Toughest Challenges
Facing the toughest challenges head-on, INESC TEC has been consolidating as a force for transformative science and technology. Our 380 R&D projects active in 2023, aligned with many of the United Nations Sustainable Development Goals, underscore our dedication to making a tangible impact on science and society. Through initiatives in digital transformation, sustainability, energy transition, and many others, we have put into play our capacity for bold creativity in pursuit of excellence and impact in science and innovation.

Integrating Across Disciplines and Ecosystems
Our efforts to increase the relevance of our work through multidisciplinarity and integration have fostered impactful advances in science, technology and innovation. The strength of our international collaborations and our role in the technology transfer landscape remain deeply linked to our commitment to integrating across disciplines and across science and innovation. This integrated approach to our projects and initiatives has also enabled us to keep enhancing the capabilities of the ecosystems that we are part of.

Fostering a Talented Community
Attracting and nurturing world-class talent remains at the heart of our endeavours. In 2023, we have kept a strong focus on cultivating an inclusive and freethinking environment, where diversity is celebrated, and personal and professional growth are strongly supported. Our initiatives to promote a good working environment have been key to strengthening team spirit and engagement.

Pursuing Operational Excellence
In our pursuit of a sound and sustainable operational model, we have kept laying the groundwork towards an increasingly resilient and innovative institution. Our engagement in prestigious funding programmes and our dedication to sustainability are aiming at providing our community with the best conditions to thrive and deliver scientific and societal impact. We remain ever more committed to providing excellent facilities and fostering a discovery and learning environment.

As we look to the future, we do so with optimism and determination, ready to continue our journey with innovation, adaptability, and collaboration at the forefront. The achievements of 2023 are not just milestones but stepping stones to greater success and impact.

We extend our heartfelt thanks to every member of our community and our partners for your continued support, dedication, and trust in our mission. Together, we stand ready to inspire, empower, and contribute to a more fulfilling and sustainable future.

MARIA DA GRAÇA BARBOSA, RUI OLIVEIRA, JOSÉ MANUEL MENDONÇA, LUÍS CARNEIRO, JOSÉ CARLOS CALDEIRA (top)
LUÍS SECA, GABRIEL DAVID, JOÃO CLARO, ANÍBAL MATOS (bottom)

Our Board of Directors is chaired by **José Manuel Mendonça**.

João Claro is the vice-chairman of the Board of Directors and the Chief Executive Officer.

The Executive Board is composed also by **Gabriel David, Luís Carneiro, Luís Seca** and **Maria da Graça Barbosa**.

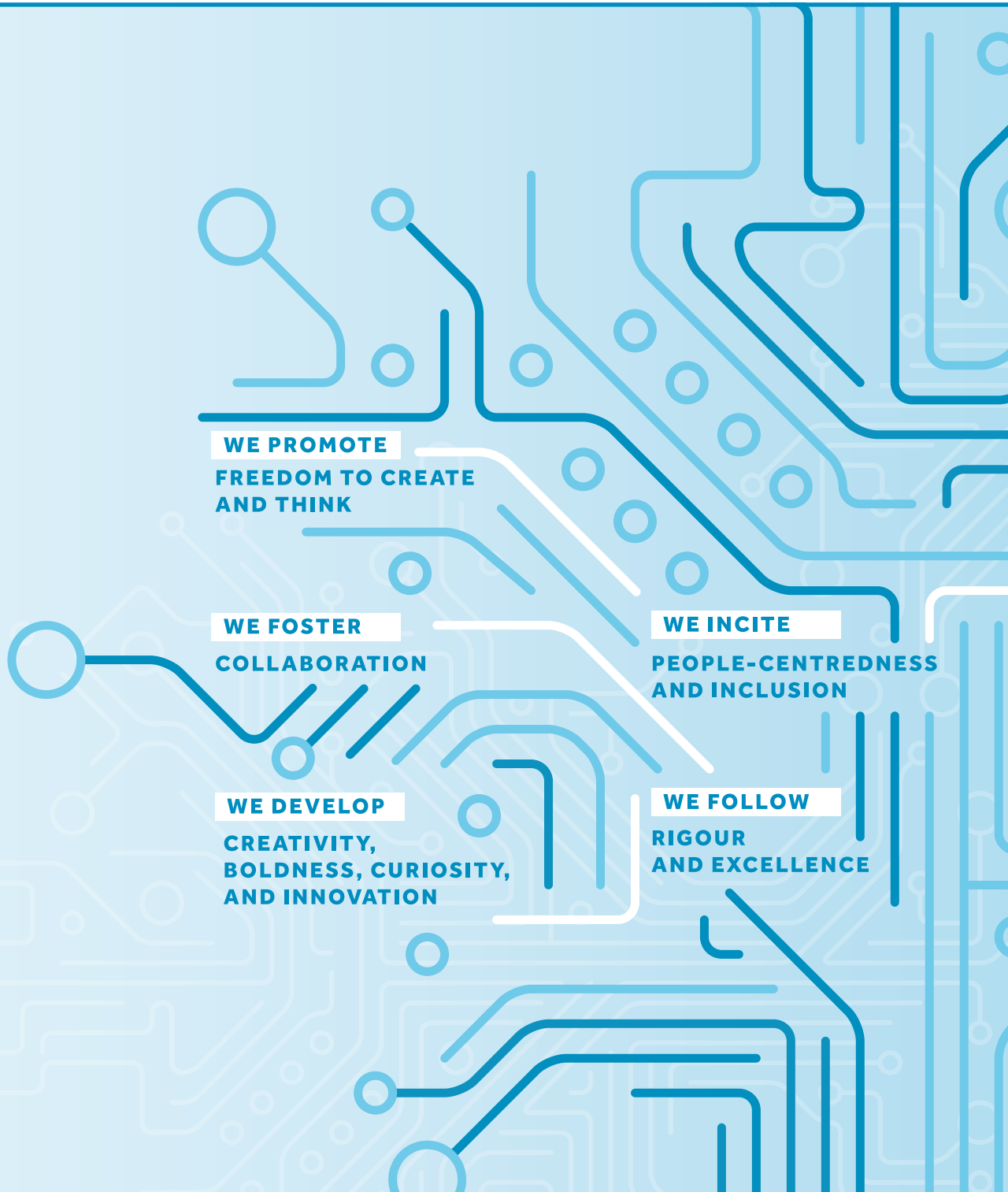
Aníbal Matos, José Carlos Caldeira and **Rui Oliveira** are also members of the Board of Directors.

02. OUR VALUES

Rigour and Excellence
We thoroughly embed rigour in all our work, from ideation to realisation to evaluation.

Integrity, transparency and ethics
We are true to our principles and act with transparency and compliance with ethical standards.

Creativity, boldness, curiosity, and innovation
We explore new areas to advance science and innovation, with bold curiosity and accepting the risk of failing as intrinsic to creating new things.



WE STAND
INTEGRITY, TRANSPARENCY, AND ETHICS

Freedom to create and think

We are autonomous to pursue our intellectual agendas, free of unreasonable interference.

Collaboration

We share all our successes and challenges, with each other and our partners, as a cohesive community.

People-centredness and inclusion

We place people at the centre of all we do, as a community in which everyone is welcome and fully supported in their development.

02. OUR VALUES

We support distinct initiatives, that make us a unique research institution.

DIVERSITY AND INCLUSION

We embrace Diversity and Inclusion (D&I), and, for that reason, we've created a Commission in 2021. In 2023, INESC TEC's Diversity and Inclusion Commission focused on raising awareness, developing skills, monitoring the D&I landscape, and promoting events in the three priority areas: 1) Gender equality; 2) Interculturality and 3) Accessibility.

2023 HIGHLIGHTS

Monitoring
- The 2nd edition of the D&I survey to assess the status of our community concerning these issues.

Training
- 2 editions of the Portuguese Sign Language Workshop.
- Workshop of Self-defence for ALL.

Events
- World Braille Day.
- Eid al-Fitr - which marks the end of the Ramadan period.
- Mobility for Blind People.

Communication
- International Mother Language Day.
- PWIT Women's Mentorship Program.
- D&I Summer Reading List.
- White Can Safety Day.
- D&I highlights at INESC TEC season party.

Award
- The D&IC applied for the award "Selo da Diversidade", promoted by Associação Portuguesa para a Diversidade e Inclusão (APPDI), under the scope of "Promoting interculturality", with the initiative "Sharing Celebrations for Building Community".

SOCIAL RESPONSIBILITY

We believe in the integration of social and environmental concerns in our processes. For that reason, in 2019, we created INESC TEC Technical Committee for Social Responsibility that works on INESC TEC's philanthropic dimension both from an internal point of view, i.e., issues related to the institution itself and its employees; and from an external point of view, i.e., how INESC TEC can support the local community.

2023 HIGHLIGHTS

External dimension

- Protocol with the European Recycling Platform for electronic waste collection.
- Enrolment in the "Healthy Workplaces Campaign 2023-2025 - Safe and healthy work", promoted by the European Agency for Safety & Health at Work in the digital age.
- Preparation of the initiative "INESC TEC takes Science to IPO Porto".
- Support of six institutions in the Northen Region of Portugal on the International Volunteer Day.
- Blood donation campaign with the Portuguese Institute of Blood and Transplantation.
- Celebration of the "World Children's Day" with a collection of goods that were delivered to AMU Portugal.
- Campaign that collected over 170 products for pregnant women and babies at risk, supported by Associação Vida Norte.

Internal dimension

- Participation in Wellbeing Games Edition of 2023.
- Celebration of the "World Health and Safety at Work Day" with a training session, given by the Aguda Volunteer Fire Brigade, to the INESC TEC community.
- Laboral gymnastics workshop.
- Organisation of a talk session "How to embrace well being & performance" targeted to INESC TEC managers.
- Participation in the appreciation of the internal code of conduct.
- Internal collection of Nespresso capsules to be recycled, thus contributing to the donation of rice that Nespresso makes to the Food Bank, as part of the "Recycling is Feeding" project.

ETHICS

We consider ethics as a fundamental value in our scientific path. So, in 2022, we created an Ethics Committee (EC) that ensures the monitoring and promotion of standards of integrity, transparency and accountability in the different areas of INESC TEC research.

2023 HIGHLIGHTS

- The IT supporting tools for project leaders to submit their ethics questionnaires, online, have come to a regular and intense use.
- The experience with the use of these tools led to several changes, to improve the system.
- A dialog was established with the principal investigators, to clarify possible doubts or to improve accompanying documents.
- The EC kept track with the national and international practices concerning ethical issues in research, especially the particular attention raised by the use of Artificial Intelligence.
- We have hosted the 2nd ERCIM Forum Beyond Compliance: Digital Ethics in Research.
- No projects were refused on ethical grounds.

03.**2023 IN A REVIEW** JAN - AUG

JANUARY

We started leading a European project for the development of 6G mobile communication solutions – **TERRAMETA** – supporting the digital transition process of the European business ecosystem.

FEBRUARY

We celebrated the **International Day of Women and Girls in Science** with the Bold initiative. Four conversations between Women in Science. Eight women talking about education, leadership, work-life balance, and future.

8

<BOLD> WOMEN

MARCH

We launched our cutting-edge infrastructure to explore the Blue Economy – **TEC4SEA** –, supporting the research, development and testing of robotics, telecommunications, and sensors equipment for operations in maritime environments.

APRIL

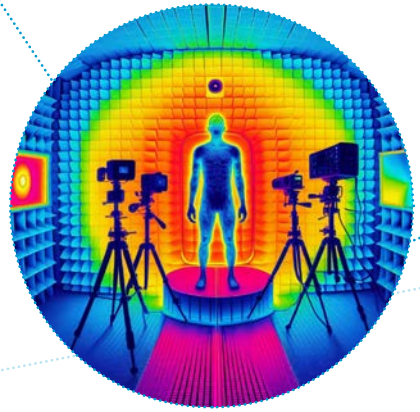
We addressed IPMA's (and Portugal's) request to inspect **Vulnerable Marine Ecosystem (VME) 13**. Not only did we made significant advances and developed a technological solution in record time (less than 2 months), but for the first time, we carried out an **underwater inspection of a VME in deep waters (> 600m) with a robotic system developed entirely in Portugal**.

MAY

We were the first Portuguese R&D institution to take part in the **four-day workweek** pilot project.

4

TERRAMETA



We initiated the coordination of the **CONVERGE project**, a European consortium that is developing a set of **innovative tools to support research infrastructures**, combining radio communications with computer vision towards 6G.

6G

JUNE

We launched the second edition of the **International Visiting Researcher Programme** – with more than 50 applications from over 30 foreign institutions.

We organised an **advanced training course** involving multiple competences for **REN's top managers**.

We were recognised by the French authorities as **a suitable organisation to allow the purchase of science and technology services** with a benefit in terms of credit.

We participated and presented technological solutions at **HIMSS23** (European Health Conference & Exhibition), one of the major **international events in digital health**.

The MIT-Pt flagship project **Transformer4.0** (TRF4.0), aimed at developing a novel concept for the digital twin of a complex energy grid device, closed and we contributed with a set of tools for **managing the lifecycle of the power transformer**.

We were involved in the financial closure of **45 projects financed by Portugal 2020**, while supporting other 29 PRR's projects (22 mobilising agendas, 3 bioeconomy, 3 agriculture and 1 hub).

45

PROJECTS

NORTE2020

50

APPLICATIONS

30

FOREIGN INSTITUTIONS

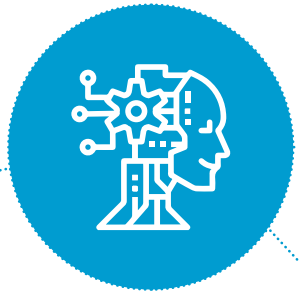
JULY

We launched the public tender for the construction of the **Leixões Blue Hub (HAL)** – a scientific, technological and innovation infrastructure, aimed at the sustainable development of the **Blue Economy**.

We launched the sixth edition of our **INESC TEC Science & Society Magazine** about the empowerment of the blue economy through innovation and technology.

AUGUST

We organised a **tutorial about Explainability in Predictive Maintenance** at KDD 2023, an A* conference.



03.**2023 IN A REVIEW** SEP-DEC

SEPTEMBER

We featured the installation of the Deucalion. **"A step forward for Portugal"** - this was how the Portuguese Prime Minister described the inclusion of the **Deucalion supercomputer** in the Portuguese scientific panorama. A machine with 1900 metres of optical fibre and 2359 high-speed interconnect cables, capable of completing 10 million billion calculations per second.

10 MILLION BILLION CALCULATIONS PER SECOND

We were part of the path of future mobility by participating in the project **"THEIA – Automated Perception Driving"**, a partnership between Bosch and the University of Porto, dedicated to the development of efficient algorithms for safer self-driving cars.

We pioneered the installation of a **5G infrastructure** at our Industry and Innovation lab to develop and test new digital technology products for industry in a relevant environment.

We organised **EMS LIBS 2023** – the 12th Euro-Mediterranean Symposium on Laser-induced Breakdown Spectroscopy, an international recognition of our research competencies in this area.

We established a partnership with **Amazon AW** in cloud robotics and AI, promoting the use of cloud-based services both in the development lifecycle of robotic applications and in the support of robotic systems in operation.

Our DPO and our **Data Protection Group** supported the capacity building of the University of Porto for data protection, with training in data protection, within the scope of the CAPIES project.

We launched a new science podcast in Portugal. The first season of our **INESC TEC Science and Society podcast and videocast** was dedicated to Artificial Intelligence and Health.

OCTOBER

Our technology – **MyNPK** – was on the podium of European Innovation Awards. We were the only Portuguese entity among the winners of the 2023 edition of the EARTO Innovation Awards, with a precision fertilisation sensing technology.

Our CEO – **João Claro** – was a speaker at the largest European event dedicated to policy cohesion, the **European Week of Regions and Cities**, in Brussels.

We initiated the coordination of the European project **AI4REALNET**, where Artificial Intelligence and humans will collaborate to increase safety of critical infrastructures.

The European Commission approved another European project – **AI4Lungs** – coordinated by our research team. Using Artificial Intelligence, AI4Lungs focuses on personalised care, while optimising human resources, and reducing costs and time needed to diagnose lung-related diseases.

Our researcher **Aurélio Campilho** was honoured as Portuguese Pattern Recognition Association (APRP) Fellow.

We organised the first edition of **"The Synergy Day: Robotics and IoT for Vineyards"** where we demonstrated IoT solutions for vineyard monitoring tasks on Douro terraces, using three robots that promise to revolutionise the wine sector.

NOVEMBER

The eight edition of the **Autumn Forum** explored the role of innovation ecosystems.

The InterConnect project – the largest consortium ever managed by a Portuguese institution (us) - launched the **Wattchr App** in 10 European countries.

Wattchr

interconnect

10 **EUROPEAN COUNTRIES**

Our **Science Bits podcast** was among the five nominees in the "Science, Technology and Education" category of the PODES awards – a national initiative that aims to acknowledge podcasts in different areas.

We promoted, together with Associação Os Montanheiros, the first analog mission in Portugal – **CAMões** (Caving Analog Mission for Ocean, Earth and Space Exploration), in the Azores.

DECEMBER

INESC TEC signs a protocol and inaugurates a **new lab at University of Trás-os-Montes e Alto Douro** (UTAD).

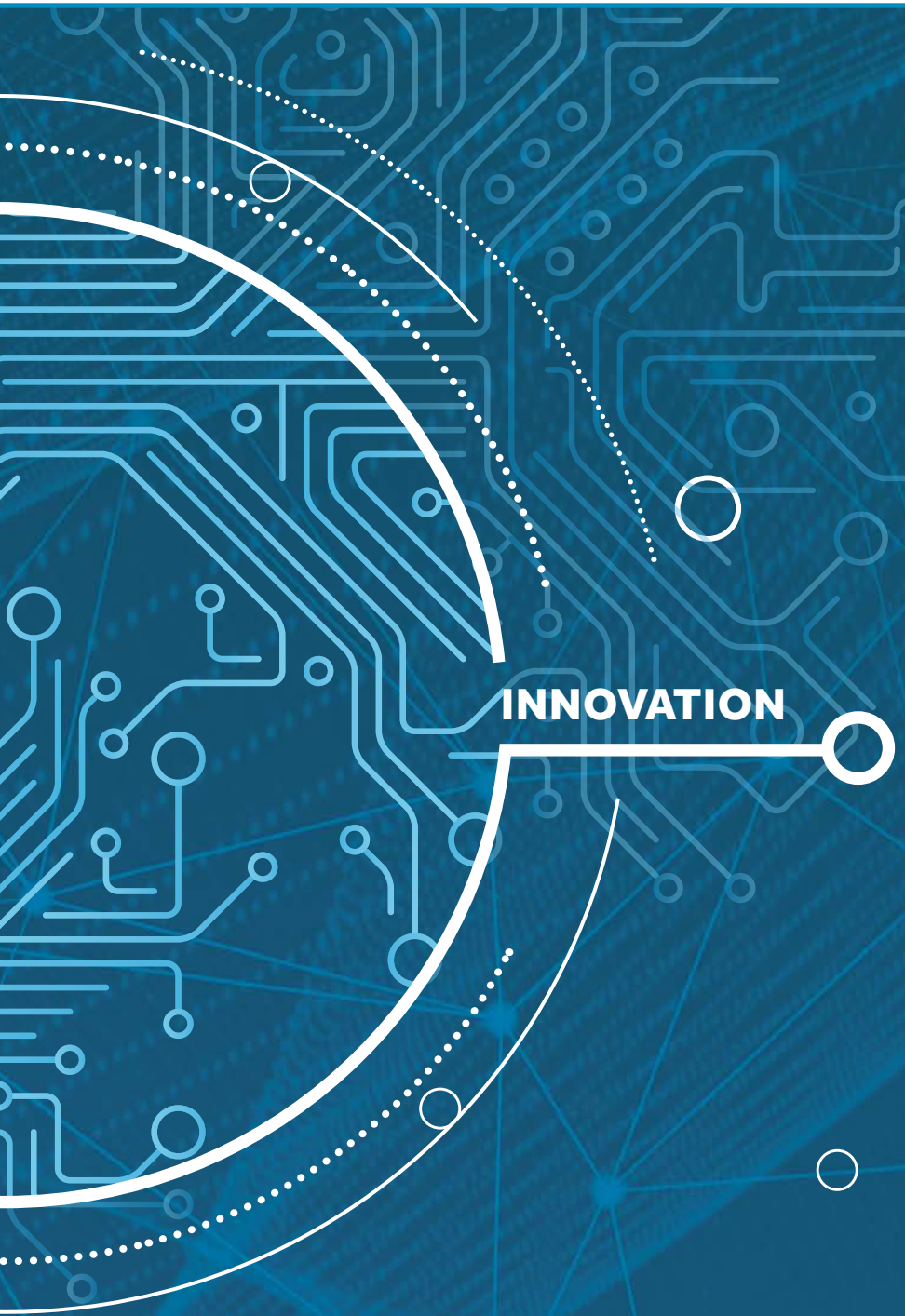
04. OUR MODEL

RESEARCH

Domains Behind Excellence in Science

SCIENTIFIC DOMAINS

ARTIFICIAL INTELLIGENCE
BIOENGINEERING
COMMUNICATIONS
COMPUTER SCIENCE AND ENGINEERING
PHOTONICS
POWER AND ENERGY SYSTEMS
ROBOTICS
SYSTEMS ENGINEERING AND MANAGEMENT



INNOVATION

TEC4 Addressing Market Challenges

INNOVATION AREAS

TEC4 AGRO-FOOD

TEC4 ENERGY

TEC4 HEALTH

TEC4 INDUSTRY

TEC4 SEA

TEC PARTNERSHIPS

05. OUR NUMBERS

OUR PEOPLE

Total Integrated HR
1028

Management, Administrative and Technical Employees
137

Employees
126

58 | 68

Academic Staff
9

Grant Holders and Trainees
2

Research Team
891

Employees
238

183 | 55

Academic Staff
187

152 | 35

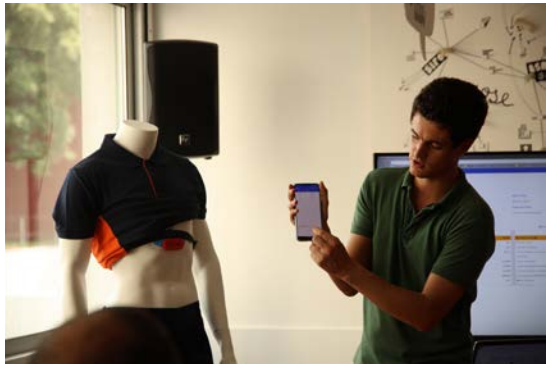
Grant Holders and Trainees
400

187 | 113

Affiliated Researchers
66

60 | 6

Total Core PhD
290



OUR PUBLICATIONS

Indexed Articles in Journals
489

Indexed Articles in Conferences
427

Books (author)
7

Chapter/paper in books
31

PhD theses concluded by members of the Centre
25

Concluded PhD theses supervised by members of the Centre
39

OUR TECHNOLOGY

First Priority Patent Applications
8

First Patents Internationalisation
5

Spin-offs
1 Established
5 In development

OUR DISSEMINATION

Participation as principal editor, editor or associated editor in journals
105

Conferences organised by INESC TEC members (in the organising committee or chairing technical committees)
72

International events in which INESC TEC members participate in the program committees
258

Participation in events such as fairs, exhibitions or similar
92

Conferences, workshops and scientific sessions organised by the R&D Centres
66

Participants in the conferences, workshops and scientific sessions organised by the R&D Centres
3347

Advanced training courses organised by the R&D Centres
11

OUR FUNDING

Total Activity
28.8M€ (+25%)

National Funding (projects)

R&D Programmes – FCT
1.4M€

R&D Programmes - S&T Integrated Projects
103k€

Cooperation Programmes with Industry
7.5M€

R&D Services and Consulting
2.7M€

EU Funding (projects)

Framework Programmes
9.2M€

Cooperation Programmes – Other
590k€

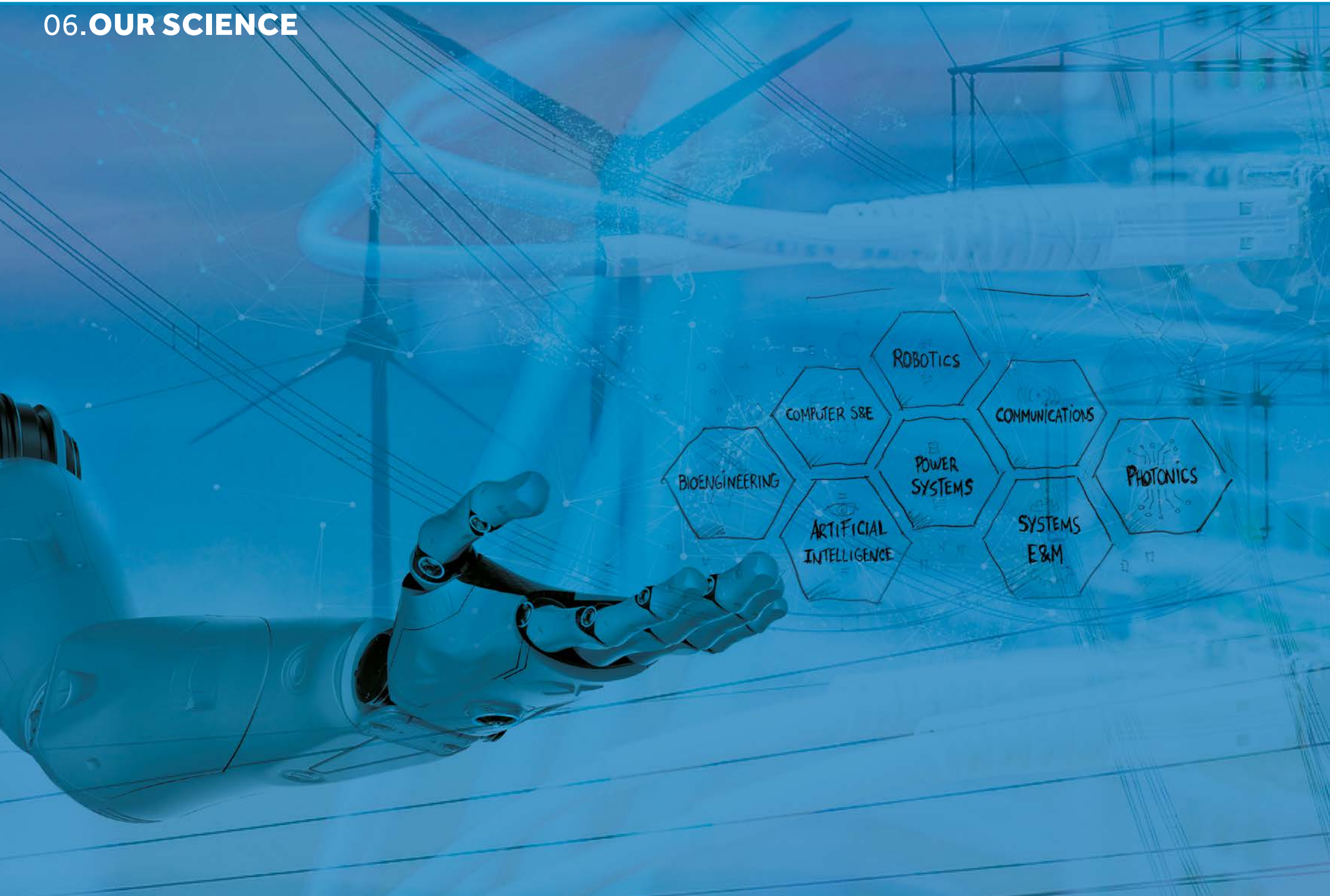
International (projects)

R&D Services and Consulting
579k€

Other (projects)

Other Funding Programmes
797k€

06.**OUR SCIENCE**



Science impacts culture, civilisation, technology, and human social, environmental and economic progress. At INESC TEC, **we produce science** with a **real impact** on our daily lives. Our scientific research sets the foundations for our mission. INESC TEC's success and sustainability are an outcome of the quality of its scientific research.

INESC TEC uses a comprehensive and inclusive **framework of scientific domains** to increase its impact and improve cohesion among its researchers while facilitating communication with the wider community. The **eight** scientific domains are: artificial intelligence, bioengineering, communications, computer science and engineering, photonics, power and energy systems, robotics and systems engineering and management. These are forums for discussing and planning the Institute's research trajectory, and platforms for strategising, with medium to long-term goals.

Naturally, research at INESC TEC varies from basic to applied, and from established and well-known topics in which INESC TEC is internationally renowned, to strategic topics nearing critical mass. We believe that the selected Scientific Domains strike the appropriate balance between essence, recognition, and ambition.

06. **OUR SCIENCE**

6.1 ARTIFICIAL INTELLIGENCE

Steering Committee
Jaime Cardoso, Rita Ribeiro, Alípio Jorge, João Gama and Andry Pinto

Artificial Intelligence is a decades-old scientific domain which has recently boosted its importance and impact in science, the economy and society in general. Stemming mostly from Computer Science, AI has strong influences from other scientific fields, namely mathematics, neuroscience, linguistics, psychology, philosophy, and physics. Nowadays, Artificial Intelligence has powerful algorithms that can approach very difficult tasks, only doable by humans until little more than five or ten years ago, with astounding quality.

Although the success of current neural and statistical approaches is almost blinding, there is a very important legacy of symbolic methods. They matter not only to the human dimension of AI, but also to the possibility of powering non-symbolic solutions with new cognitive layers that can be engineered and designed. Besides the fundamental need for large amounts of high-quality data (for correct application), the growing influence of Artificial Intelligence calls for swift advances in the trustworthiness of the delivered tools, chiefly the interpretability of predictions and decisions, generalisation to unseen and even unpredictable situations, and robustness to biased data or unethical results.

COMPETENCES

- AI Ethics
- Audio and Signal Understanding and Forecasting
- Bayesian Approaches
- Bioinformatics
- Cheminformatics
- Medical Informatics
- Computer Vision and Pattern Recognition
- Decision Support
- Deep Learning and Reinforcement Learning
- Distributed and Federated Machine Learning

FLAGSHIP PROJECTS **2023**

AI4REALNET

AI For Real-World Network Operation
Coordinator: INESC TEC
Funding: Horizon Europe, 6M€
2023-2027

ai4realnet.eu

What if Artificial Intelligence (AI) were to be used to support decision-making and increase resilience and safety in the operation of critical infrastructures typically operated by humans in the energy and mobility sectors?

This is the goal of AI4REALNET, which started in October 2023. The project, coordinated by INESC TEC, will develop new algorithms and social-technical systems to inspire operators of critical infrastructures (namely power grids, railway, and air traffic management) and contribute to putting Europe at the forefront of AI. All results will become available as open-source assets.

TEXT2STORY

Extracting journalistic narratives from text and representing them in a narrative modelling language
Coordinator: INESC TEC
Funding: FCT, 250k€
2019-2023

text2story.inesctec.pt

Journalistic content is distributed in multiple formats. However, textual content is still the main representation for information. The Text2Story project, that ended in 2023, researched the challenging problems in information extraction and automatic production of media content. Researchers were able to extract narrative/stories from news articles or collections of related news articles (unstructured data) about the same (or related) subject, representing those narratives in intermediate data structures (structured data) and making this available to subsequent media production processes (semi-automatic generation of slide shows, infographics and other visualizations, video sequences, games, etc.). A conceptual framework and operational pipeline for the extraction of narratives from textual sources was developed. The project focused on the automatic processing of journalistic text in written Portuguese.

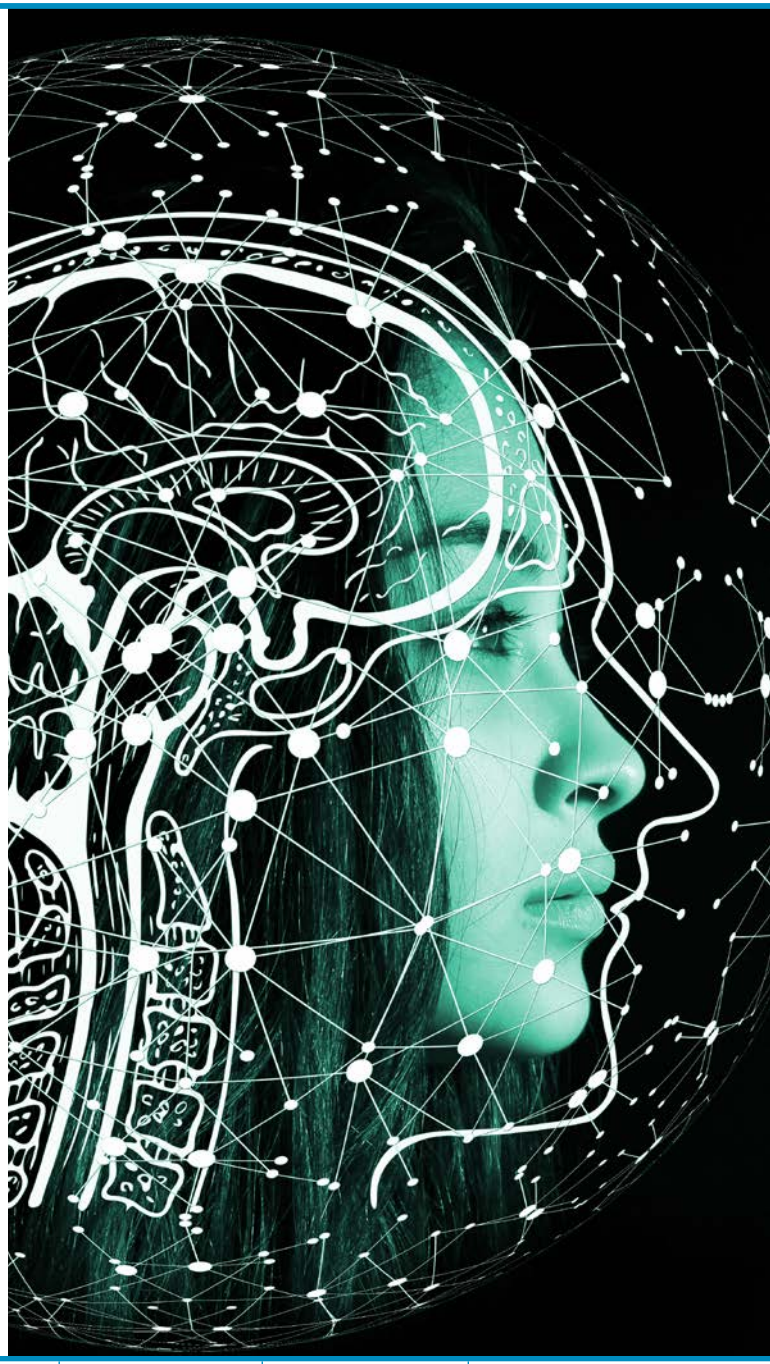
06. OUR SCIENCE

6.2 BIOENGINEERING

Steering Committee
João Paulo Cunha, Ana Maria Mendonça and Hélder Oliveira

Bioengineering is a rapidly growing and evolving domain at the intersection of engineering and life sciences. It combines fundamental engineering principles, practices, and technologies in medicine, biology, environment, and health sciences to provide effective solutions to problems in these fields.

The domain addresses the development of mathematical theories and models, physical, biological, and chemical principles, computational models and algorithms, devices and systems for the early detection and diagnosis of different types of diseases, ageing-related impairments, rehabilitation, occupational health and wellness, and environmental-biology interactions, among others.



COMPETENCES

- Affective Computing & Human-Machine Symbiosis
- Bioinformatics & Computational Biology
- Biomechanics & Biorobotics
- Biomedical Engineering in Education
- Industry & Society
- Biomedical Signal & Image Processing
- Biometrics
- Bionics
- Wearable & Implantable technologies
- Biosensors

FLAGSHIP PROJECTS **2023**

TAMI

Transparent Artificial Medical Intelligence
INESC TEC as a project partner
Funding: P2020, in copromotion with CMU, 1.1M€
2020-2023

www.inesctec.pt/en/projects/tami

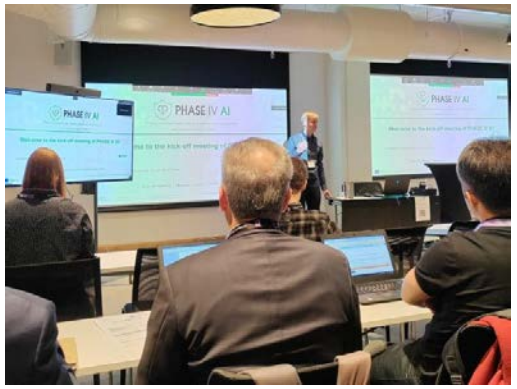
The TAMI project aimed at bringing explainability to AI methods supporting clinical professionals from screening to daily clinical practice, focusing on decision support systems relying on imagiological data. The research developed explored four topics:

- Generate self-explanatory AI-based decisions that minimise bias, act ethically in their context and enhance trust of end-users;
- Customisable multimodal and privacy-preserving explanations, that adapt to whom will consume them;
- Quantitative methods to objectively evaluate and compare the suitability of different types of explanations for specific use cases;
- Foster new strategies for presenting human understandable explanation.

INESC TEC research had significant impact on the AI tools applied to colposcopies and chest X-Ray images. The TAMI platform will be available for commercial, scientific, and academic use, and will provide "consumers" access to self-explanatory AI decisions for target screening and diagnosis procedures, as well as access to filtered and anonymised datasets for research purposes.

PHASE IV AI

Privacy compliant health data as a service for AI development
INESC TEC as a project partner
Funding: Horizon Europe, 6.6M€
2023-2026

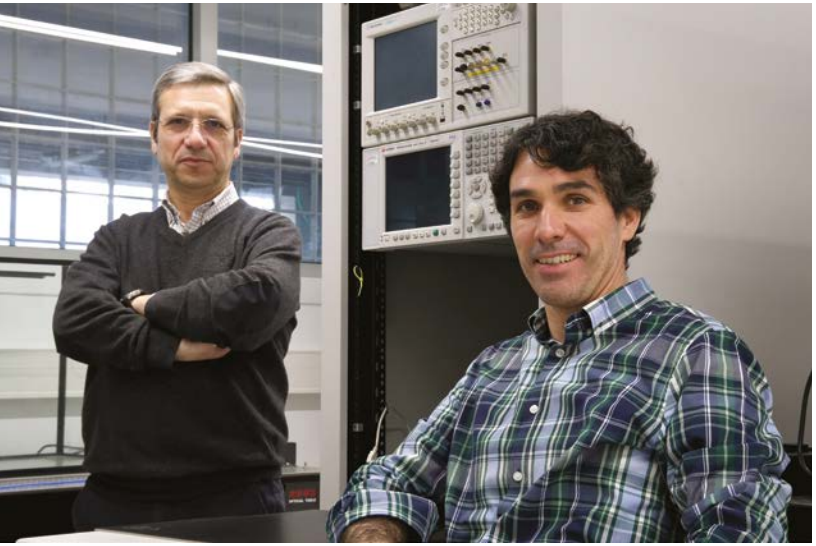


www.phase4ai-project.eu

This European project puts Artificial Intelligence at the service of health, in areas like cancer. The main goal of the PHASE IV AI project is to facilitate the generalised access to anonymised medical data towards developing tools to support preventive healthcare and clinical decision-making INESC TEC's participation focuses on two areas: telecommunications and multimedia, namely AI algorithms for artificial data generation, and human-centred computing and information science, with the development of software technologies, which will allow access to privacy-preserving data through distributed computing.

06. OUR SCIENCE

6.3 COMMUNICATIONS



Steering Committee
Manuel Ricardo and Rui Campos

Digital network communications underpin the Internet and the myriad of services we increasingly depend on. Their continued improvement and breakthroughs will be indispensable for the widespread digital transformation and the control of extreme environments presenting major threats or opportunities.

Pressing challenges for all kinds of digital networks include enabling ever-increasing bandwidth-intensive and latency-sensitive applications, and ensuring high levels of secure data transmission while being highly energy- and spectrum-efficient, in the case of wireless systems.

COMPETENCES

- Communications architectures and protocols
- Electronics
- Multimedia
- Network and resource management
- Network security
- Optoelectronics and photonics
- Reconfigurable hardware systems
- Signal processing
- System modelling
- System simulation

FLAGSHIP PROJECTS **2023**

CONVERGE

Telecommunications and Computer Vision Convergence Tools for Research Infrastructures
Coordinator: INESC TEC
Funding: Horizon Europe, 8.8M€
2023-2026

converge-project.eu

INESC TEC leads a European project that combines radio communications with computer vision towards 6G. The CONVERGE project aims to develop a set of innovative tools to support research infrastructures. In the future, research supported by these tools is expected to play a major role in the healthcare, industry, automotive, telecommunications and media sectors.

This set of tools is unprecedented in the world: on the one hand, it will provide the scientific community with a series of exclusive and open data, and, on the other hand, it will improve the competitiveness of research infrastructures and the companies involved.

TERRAMETA

Reconfigurable Metasurfaces for Ultra-high-rate Wireless Communications
Coordinator: INESC TEC
Funding: Horizon Europe, 6M€
2023-2026

terrameta-project.eu

Researching innovative technologies for the sixth generation (6G) of mobile communications, supporting the digital transition process of the European business ecosystem through the demonstration of Reconfigurable Intelligent Surfaces (RIS) THz – this is the main goal of the TERRAMETA project. Led by INESC TEC, the project brings together 13 European partners to carry out tests in telecommunications scenarios.

The project aims to transfer the latest and most innovative technologies from THz RIS hardware to test and promote worldwide demonstrations for the THz communications network supported by reconfigurable intelligent surfaces, in practical application scenarios. Hence, it will be possible to demonstrate the feasibility of applying THz RIS in an "Industrial Edge" environment, and outdoor telecommunications scenarios with real equipment.

06. OUR SCIENCE

6.4 COMPUTER SCIENCE AND ENGINEERING

Steering Committee
Ana Paiva, Hugo Paredes, Ana Alonso, João Canas Ferreira and Manuel Barbosa

Computers, ranging from ever so scaled down programmable devices, the ubiquitous smartphones to supercomputers currently capable of performing more than a trillion operations per second, have become a central, and increasingly indispensable, component of everyday life. Computer science and engineering are the linchpins to the unstoppable evolution of computing and enable its application to an ever-growing plethora of computer-based solutions. Additionally, computer systems in crucial sectors such as utilities, healthcare, transportation, and finance present new, often unanticipated, risks that defy our knowledge and present hard and intricate challenges associated with interoperability, scalability, security, and criticality. Worldwide, computing systems in organisations account for over 10% of all global energy consumption and approximately 2% of global CO2 emissions, making the sustainability of much of our innovation also a significant challenge.

The concept of Data Spaces is currently a promising approach to the challenges of integrating multiple heterogeneous data sources. Significant contributions are anticipated to enable the execution of queries on distributed data, incorporating greater guarantees of data resilience and security, and avoiding open data transfer. This will improve trust in the application of access policies, vital to promote data sharing.

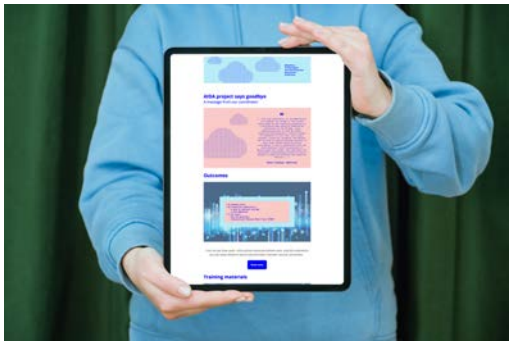
COMPETENCES

Agile Methods	Computer architecture	Computer Graphics	Embedded Systems	Formal Methods	Human-Computer Interaction	Immersive Environments	Information Security	Information Systems	Information Retrieval

FLAGSHIP PROJECTS **2023**

AIDA

Adaptive, Intelligent and Distributed Assurance Platform
INESC TEC is a project partner
Funding: P2020 in copromotion with CMU, 1.1M€
2020-2023



aida.inesctec.pt

Improving the RAID platform, a system marketed by the telecommunications analyst Mobileum for the comprehensive risk management in companies, thus making it compatible with 5G networks and edge computing - this was the objective of the AIDA project. The main result from the AIDA project is, therefore, the prototype of what Mobileum envisages as the next generation of the RAID platform.

A complete prototype of AIDA was deployed and demoed by the end of the project in a realistic scenario in the sector of the telecommunication services. RAID's platform is currently applied around the world in revenue assurance, business assurance and fraud management, among others. It also opens market opportunities, namely through the exploration of emergent federated machine learning techniques that will reinforce the analytic capabilities of the platform and may, in certain cases, obviate confidentiality issues. Other results of the project include: 41 papers published, six of them in Q1 A/A* publications and 11 software prototypes.

BIGHPC

A Management Framework for Consolidated Big Data and HPC
INESC TEC is a project partner
Funding: P2020, in copromotion with UT Austin, 1.1M€
2020-2023

www.inesctec.pt/en/projects/bighpc

BigHPC aims at simplifying the management of computing and storage resources at HPC infrastructures, supporting Big Data and parallel computing applications, through a novel framework that can be seamlessly integrated with existing HPC centers and software stacks.

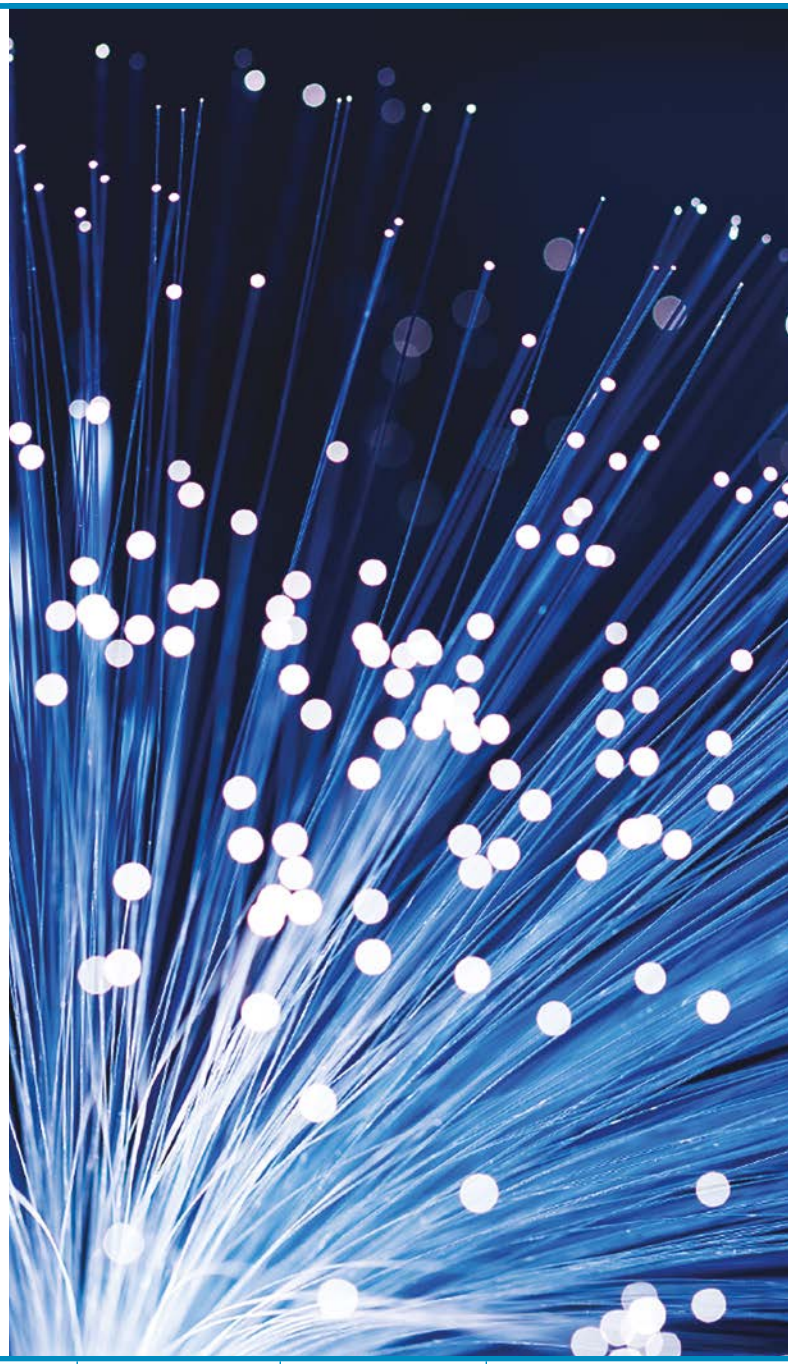
The contributions of the project are expected to have a direct impact on science, industry and society, by accelerating scientific breakthroughs in different fields and increasing the competitiveness of companies through better data analysis and improved decision-support processes. The BigHPC project produced 3 software prototypes and 15 conference papers, seven of them in A/A* publications.

06. OUR SCIENCE

6.5 PHOTONICS

Steering Committee
Diana Viegas, Pedro Jorge and Nuno Silva

Photonics is widely recognised as a unique toolbox for cutting-edge science and technology, with impact spanning from telecommunications to medicine and computing. Combining native properties of light and using methods like data processing and sensor fusion, optical devices and light-based solutions are now ready to drive a new revolution in industry, enabling sensors for real-time monitoring from the nanoscale to industrial environments, as well as ultra-efficient networks and edge computing solutions.



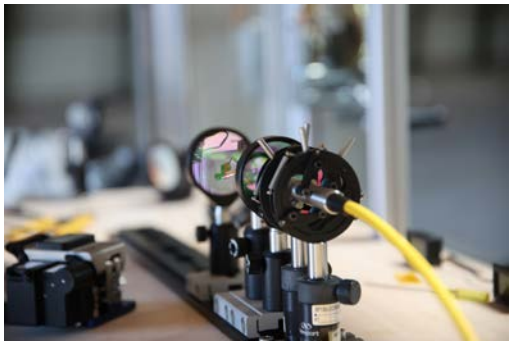
COMPETENCES

- Fibre Optic Sensors
- Fibre lasers
- Remote Sensing
- Optical microfabrication
- Metallic and dielectric nanostructures
- Optofluidics
- Integrated optics
- Optical resonance structures
- Optical signal processing
- Optical computing

FLAGSHIP PROJECTS **2023**

WIPTHERM

Innovative Wireless Power Devices Using micro-Thermoelectric Generators arrays
INESC TEC was a project partner
Funding: H2020, 2.3M€
2019-2023



wiptherm.eu

WiPTherm focused on the design and deployment of an innovative Wireless Energy Transfer (WET) system, capable of recharging the energy storage components used in CubeSat technologies at large distances in harsh spatial environments. For this, INESC TEC deployed a high-power fibre laser at 1550 nm solution capable of long-distance and wireless energy transfer exploiting micro-thermoelectric generator arrays on the satellite side.

INNOAQUA

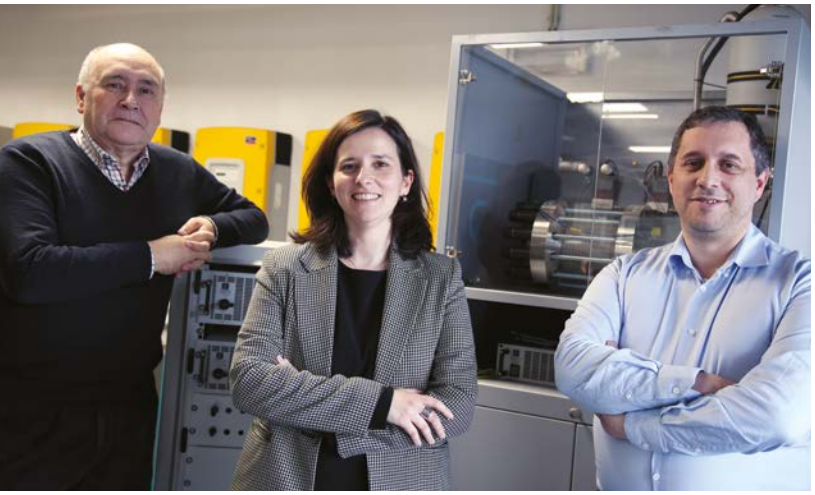
Innovative approaches for an integrated use of algae in sustainable aquaculture practices and high-value food applications
INESC TEC is a project partner
Funding: Horizon Europe, 6M€
2023-2027

innoaquaproject.eu

Innoaqua project focuses on the improvement of the algae production cycle, aiming to increase product value with sustainable practices. One of the strategic lines where INESC TEC is collaborating is on the design and maintenance of digital twins of algae production facilities, to monitor aquaculture environments and adapt in real time. In particular, a physical layer of optical sensors will provide real time information on relevant parameters such as dCO2, nutrient level, photosynthetic radiation level, enabling the digital twin with diagnostic capabilities.

06. **OUR SCIENCE**

6.6 POWER AND ENERGY SYSTEMS



Steering Committee
João Peças Lopes, Clara Gouveia and Ricardo Bessa

This Domain envisions supporting society's full and enduring decarbonisation by adopting a multidisciplinary strategy that acts on the whole energy value chain - by planning and operating it across multiple energy carriers, infrastructures, and users in an integrated, interconnected, and digitalised energy ecosystem. This will rely on the combination of model-based and data-driven methods for modelling, optimising, and controlling energy systems while proposing novel policy and regulatory solutions. Research outcomes include concepts, models, methodologies, and tools useful for addressing the decision problems of citizens, communities, multi-utilities, system operators, regulators, policymakers, and government bodies, divided into four research lines: 1) Cost-effective decarbonisation and digitalisation of energy systems; 2) Evolving and de-centralising energy-driven business models and markets; 3) Resilience and reliability of energy systems; 4) Smart control architectures and centres of the future.

A laboratory infrastructure on smart grids and electric vehicles enhances the research and innovation capabilities of the Group by providing technological support for the validation of theoretical concepts.

COMPETENCES

- Steady-state and dynamic power system operation and control
- Electricity markets modelling and simulation
- Distributed energy resources modelling and aggregation
- Sector coupling modelling
- Power electronics
- Modelling and real-time simulation of cyber-physical systems
- Reliability analysis of energy systems

FLAGSHIP PROJECTS **2023**

SMART4RES

Next Generation Modelling and Forecasting of Variable Renewable Generation for Large-scale Integration in Energy Systems and Markets
INESC TEC was a project partner
Funding: Horizon 2020, 3.9M€
2019-2023

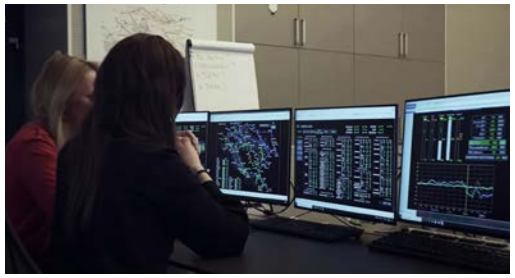
www.smart4res.eu

The Smart4RES project aimed to bring substantial performance improvements to the whole model and value chain in renewable energy sources (RES), forecasting, focusing on optimising synergies with storage and supporting power system operation and participation in electricity markets. INESC TEC developed a patented vertical federated learning algorithm for distributed learning and forecasting with data owned by different entities, and developed algorithmic solutions and a software prototype for a data market.

Moreover, it developed a stochastic tool for dispatching synchronous and virtual inertia under forecast uncertainty in isolated power systems and a risk-aware methodology for ranking flexibility options and balancing risk/stakes to solve voltage and congestion problems in electrical grids. The INESC TEC team published six papers in Q1 journals.

ATTEST

Advanced Tools Towards cost-efficient decarbonisation of future reliable Energy SysTems
Coordinator: INESC TEC
Funding: Horizon 2020, 3.99M€
2020-2023



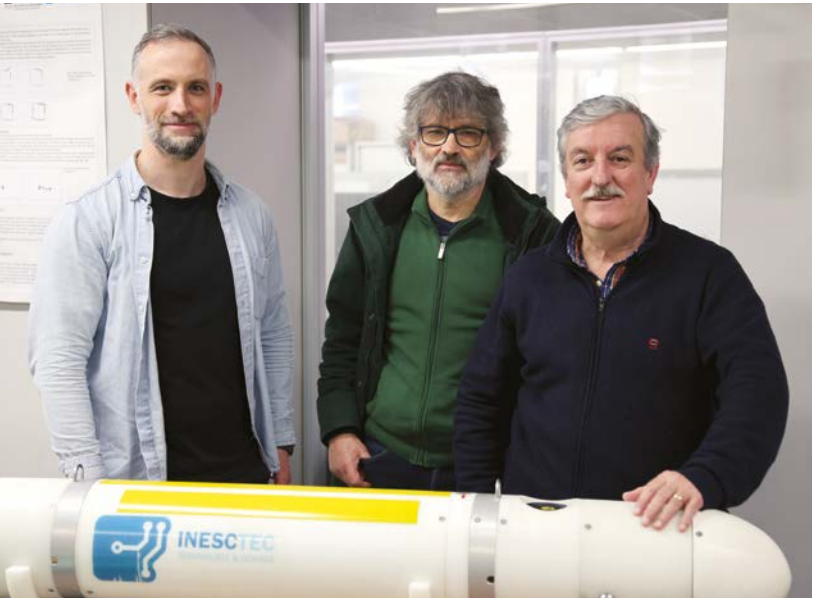
attest-project.eu

Over three years, the ATTEST team – led by INESC TEC - studied and developed solutions for the planning and operation of energy transmission and distribution network infrastructures. The results are now materialised in a set of 12 optimisation tools, which are available to producers, traders, and operators of energy networks. Divided into three modules – planning, operation, and asset management – the tools, designed to operate in an integrated manner, feature algorithms that favour "clean" or low-emission technologies.

The 12 tools are available in open source and have been demonstrated in real world transmission and distribution networks in Croatia, as well as evaluated through simulation on real networks from Portugal, Spain, and United Kingdom. Among other scientific results are three papers in Q1 journals and three international conferences.

06. **OUR SCIENCE**

6.7 ROBOTICS



Steering Committee
Bruno Ferreira, Eduardo Silva and António Paulo Moreira

As robots become smarter, more autonomous, valuable for various purposes, and increasingly interactive with humans, novel and unforeseen challenges emerge. Making complex robotic systems easier to program and use, endowing robots with capabilities to operate in complex and dynamic environments or allowing autonomous robots to work in areas shared with humans are examples of problems that need new tools and paradigms.

COMPETENCES

Control systems	Navigation	Simultaneous localisation and mapping	Computer vision	Mobile robots	Autonomous systems	Marine robots	Manipulators	Industrial robots	Multi-robot systems

FLAGSHIP PROJECTS **2023**

K2D

Knowledge and Data from
the Deep to the Space
INESC TEC was a project partner
Funding: P2020, 1.4M€
2020-2023

www.k2d.pt

K2D is a flagship project of the MIT Portugal programme – part of the international partnerships that the Portuguese Government established with North American research institutions. It ended in 2023 and the focus was on the development of a global and disruptive ocean monitoring system using underwater cables, capable of operating at different depths – from the deep sea and abyssal platforms to the surface. In September 2023, the installation of the second prototype of a smart underwater cable (two km long) took place in the vicinity of the Port of Sesimbra, in the open sea and at depths greater than 100 meters – with the support of the Portuguese Navy.

The research and development of the three sets of sensors that are installed along the cable to gather real-time data was carried out by INESC TEC, CINTAL and the University of Minho. As in the case of the first prototype, the installation of the K2D system took place during the largest operational exercise of unmanned systems in the world, REP(MUS) 2023.

SCORPION

Cost effective robots for smart
precision spraying
Coordinator: INESC TEC
Funding: H2020, 2.5M€
2021-2023

scorpion-h2020.eu

The WETA robot, developed within the scope of the SCORPION project, is able to perform precision spraying in mountain vineyards or terraces, and apply UV-C treatments, avoiding the application of fungicides. WETA's levels of precision and autonomy make it possible to reduce waste of phytopharmaceutical products, reducing costs for winegrowers and environmental impact.

Equipped with an advanced sprayer, this robot can work in offset mode and perform tail recovery, while reducing human and animal exposure to pesticides, water use and labour costs. This was one of the main outputs of the SCORPION project, that closed in October 2023.

06. OUR SCIENCE

6.8 SYSTEMS ENGINEERING AND MANAGEMENT

Steering Committee
Beatriz Oliveira, António Lucas Soares, José Coelho Rodrigues and Lia Patrício

Systems Engineering and Management research seeks to advance the design, implementation, and improvement of systems for decision support, human-centred operations, intelligence, technology management, and innovation.

Significant challenges arise from optimisation in complex organisations and networks at multiple levels, customer centric service design, and technology-based innovation management and policy, targeting improvements in business performance, productivity, innovation, resiliency, and economic, social, and environmental sustainability.

COMPETENCES

- Data and Information Management
- Digital Enterprise Architecture
- Industrial Information Systems Design
- Operations Research
- Operations Management
- Advanced Analytics
- Decision Sciences
- Service System Design and Innovation, Service System
- Transformation
- Technology Management and Policy

FLAGSHIP PROJECTS **2023**

TRF4.0

Transformer 4.0 – Digital revolution of power transformers
INESC TEC was a project partner
Funding: P2020, in copromotion with MIT - POCI, 2M€
2020-2023

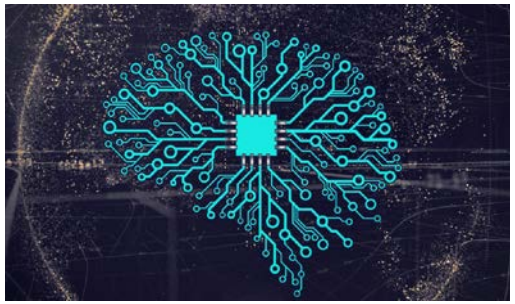
www.mitportugal.org/research/flagship-projects/transformer-4p0-digital-revolution-of-power-transformers

The MIT-Pt flagship project Transformer4.0 (TRF4.0), aimed at developing a novel concept for the digital twin of a complex energy grid device, was finished in 2023. TRF4.0, involved a multidisciplinary team from business and research with competencies in engineering (informatics, mechanics, materials) and organisational development (sociotechnical systems).

Key results: a proof-of-concept for the digital platform managing digital twin instances of Power Transformers and a set of tools (using machine learning and optimization techniques) for managing the life cycle of the Power Transformer. Impact: Paved the way for the company's digital transformation program, centred around the digital twin concept.

TRUST AI

Transparent, Reliable and Unbiased Smart Tool for AI
Coordinator: INESC TEC
Funding: Horizon 2020, 3.9M€
2020-2025



trustai.eu

TRUST-AI has progressed in multiple fronts in 2023. The machine learning algorithms were fully developed, pushing the state of the art in genetic programming, and resulting in publications at top conferences in the field. Also, the counterfactual module had made important progress, being close to completion.

Finally, the TRUST-AI platform was evolved into a second version, where it is possible to run additional analysis (including counterfactuals and what-if), and customizations for each use case have begun. A paper on the platform was submitted to an international journal, while several papers on the use cases are in progress.

07.**OUR INNOVATION**

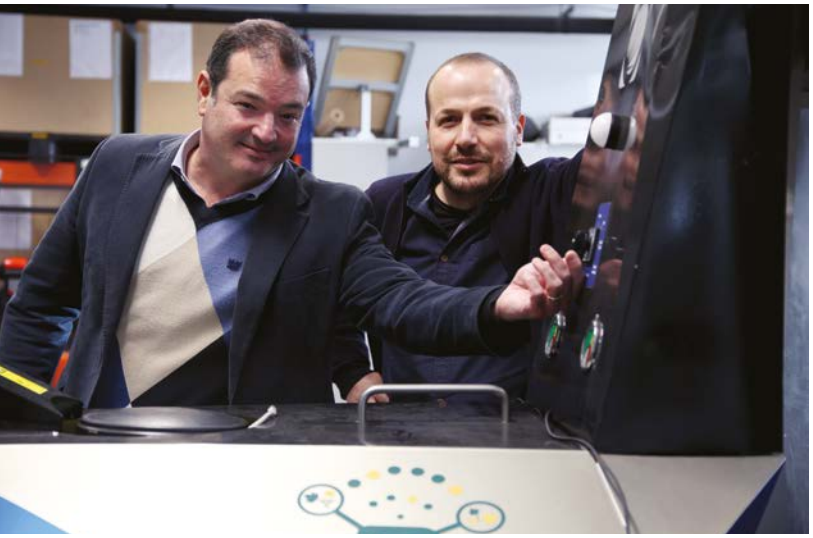
We address the **entire innovation cycle**, and as digital technologies are at our core research and innovation activities, we have all the means to develop highly relevant, impactful, and innovative solutions, resulting from both the incorporation of advanced and sophisticated technologies and their cross-fertilisation to many other sectors or applications. We collaborate with digital technology developers and providers to develop **new technologies, products, services and business models**; We boost the modernisation of many other sectors of the Portuguese economy, by developing and supporting the adoption of innovative digital solutions; and we promote the creation of new companies and sectors, particularly in the most disruptive areas.

Therefore, we created the **TEC4** internal initiatives as an organisational approach aiming at structuring and promoting the market-pull innovation process, targeting specific economic sectors, such as Agro-Food, Energy, Health, Industry, and Sea. Each TEC4 addresses the market's challenges by mapping its needs with our scientific and technological competences and experience.

Also, it is part of our innovation strategy to have an active role in the definition and implementation of relevant public policies and programmes, and of collective initiatives, thus contributing to the development of more complete and efficient innovation eco-systems.

07. OUR INNOVATION

7.1 TEC4AGRO-FOOD



Team
André Sá (Business Developer) and Filipe Neves dos Santos (Coordinator)

TEC4AGRO-FOOD's mission is co-creating the digital (r)evolution in agro-food and forestry through research and technological development in digital technologies and robotics, for the creation of long-term value for INESC TEC from customers, markets, and relationships.

COMPETENCES

- Robotics and Automation
- Operations Management and Logistics
- Supply and Collaborative Networks
- Innovation and Technology Management
- Business Intelligence
- Decision Support Systems
- Artificial Intelligence, Data Science and Machine Learning
- Big Data
- Digital Twins
- Geospatial Information Systems/ Spatial Data Infrastructures (SDI)

OUTCOMES

Intermetrics

Intermetrics is a software that aims to provide and calculate real-time information on climatic and agronomic indicators from data collected from meteorological stations. By providing accurate and up-to-date information on weather patterns, farmers can make more informed decisions and optimise crop production. The solution developed helps to ensure the long-term viability of crops and livelihoods and allows farmers to adapt to changing climate conditions. Intermetrics software is the main component of the INFRAVINI commercial solution - a thematic Spatial Data Infrastructure to support the management of climate change in vineyards, currently one of the biggest challenges in the sector.

BB-SPECTRAL

BB-SPECTRAL (MyNPK) is an intelligent photonics technology for instant and on-site measurement of chemical compounds such as nitrogen, phosphorus, and potassium (NPK) using the spectral information of highly complex samples, as liquid fertilisers. The technology allows for better management and optimization of the fertilizer composition through its chemical network and nutrient flux according to the nutritional needs of plants. The goal? To improve crop production, reduce fertilizer waste, minimize water consumption, and reduce environmental impact. INESC TEC ranked third in the EARTO Innovation Award 2023 - Impact Expected, by the European Association EARTO (European Association of Research and Technology Organisations) thanks to this technology.

07. OUR INNOVATION

7.2 TEC4ENERGY

Team
Nuno Campos (Business Developer) and João Peças Lopes (Coordinator)

TEC4ENERGY fosters the decarbonisation and digitalisation of the Energy Sector, aiming at establishing a continuous dialogue with stakeholders, developing fruitful collaborations that address the energy sector challenges and needs. TEC4ENERGY focuses on the Societal Challenges and Innovation Strategies for Smart Specialisation defined by EU policies - the energy sector will be heavily digitalised, decentralised, under a user-centric and market-based approach, involving a large-scale integration of renewable power sources and the development of a smart grid infrastructure that requires the conceptualisation and development of disruptive solutions.

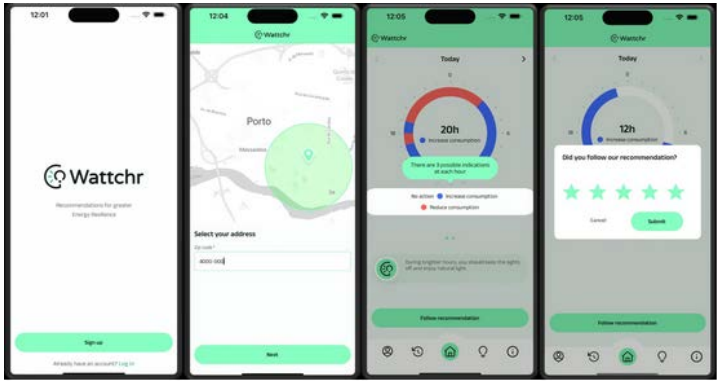
COMPETENCES

- Applied Photonics
- Computational Intelligence
- Electricity Markets and Regulation
- High assurance software
- Industrial Electronics
- Optimisation and Decision-Aid
- Power Systems Planning
- Power Systems Reliability
- Power Systems Dynamics Analysis and Operation
- Probabilistic and Fuzzy Modelling

Wattch.r

The **Wattch.r Portuguese Energy Application**, developed under the European Project InterConnect (led by INESC TEC), is a custom-designed application, aiming at getting information about how consumers can support the grid and the energy system. Thanks to this app, everyday consumers are informed about the potential participation for the following day whilst keeping track of the current actions to be taken in the current day.

Wattch. r makes use of: Interoperable Recommender (IRec), which provides information about the operating conditions of the EU grid and assigns the best hours in the day to increase or reduce energy consumption; DSO Interface (DSOi), which specialises the actions considering the geographies of Portuguese consumers and their impact in the distribution grids; and Semantic Interoperable Framework (SIF), that unites the different digital platforms via semantic representations of devices and systems.



07. OUR INNOVATION

7.3 TEC4HEALTH

Team
Carlos Ferreira (Business Developer) and Miguel Coimbra (Coordinator)

TEC4HEALTH's main goal is to develop innovative science-based technologies and services to provide better care and improve health for all. TEC4HEALTH induces a market pull drive into R&D, targeting all the value chain actors and processes in the healthcare and well-being sectors. To accomplish this, it aims to explore the activities within the health sector where technology needs and roadmaps indicate a high potential for applying INESC TEC's competences.

COMPETENCES

- Artificial Intelligence
- Biomedical Instrumentation
- Information Systems
- Health Management
- Medical Robotics

OUTCOMES

iLof

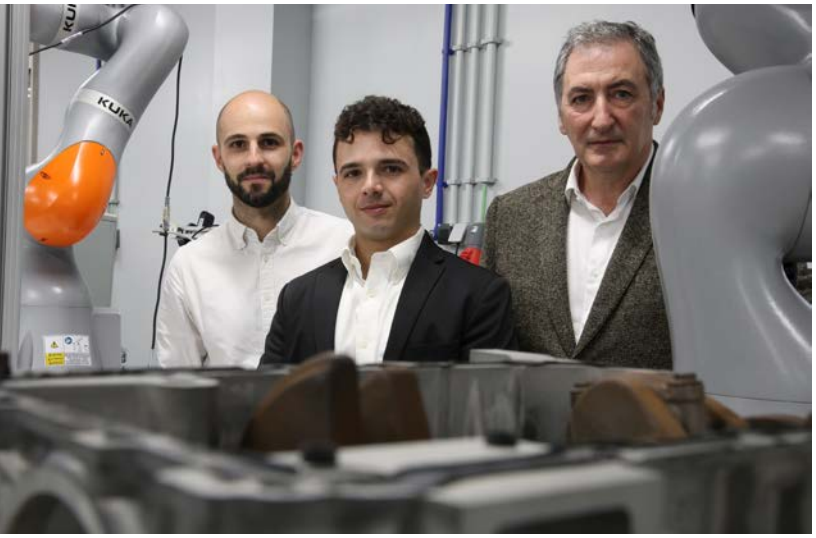
iLof is a technology that combines an innovative optical system with a digital platform for application in personalised medicine. By identifying molecular patterns, iLoF technology can stratify patients, allowing the identification of patients who can benefit most from specific treatments. Unlike current solutions, iLoF technology is unique in terms of speed and ability to analyse patterns involving nanostructures.

CADPath

CADPath is an AI technology that aims to support pathologists. Thanks to this tool, they will be able to analyse the digitalised image of a colorectal histological sample and obtain the classification of the sample in real time, either without neoplasia, low-grade or high-grade lesions. This technology was developed under the CADPATH.ai, an IMP Diagnostics (IMP Diagnostics Molecular & Anatomic Pathology laboratory) project partially funded by the COMPETE 2020 programme.

07. OUR INNOVATION

7.4 TEC4INDUSTRY



Team
António Almeida (Business Developer), Pedro Senna (Project Manager) and Américo Azevedo (Coordinator)

TEC4INDUSTRY's main goal is to create innovative science-based digital products and services for industry, contributing to the Portuguese economy's resilience and growth. TEC4INDUSTRY facilitates the creation of an innovative, responsive, and sustainable industry by promoting the convergence of multidisciplinary knowledge and differentiating skills of an organisation with decades of experience in research and development of unique solutions.

COMPETENCES

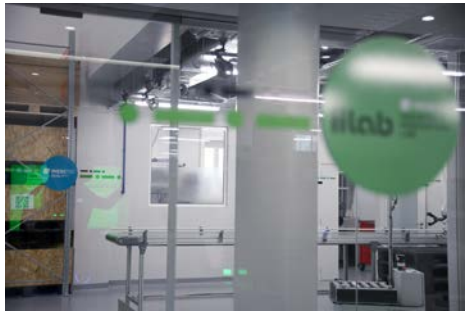
- Artificial Intelligence for Industry
- Industrial Robotics
- Information Management
- AR/VR technologies
- Operations Management and Optimisation
- Computer Vision
- Automation & Industrial Control Systems
- Digital Platforms
- IoT and Interoperability
- Innovation Management

TESTBED 5G

Framed within the scope of the National TestBed Network, TESTBED 5G is upgrading technologies capabilities from national companies through the development of 165 pilots. INESC TEC plays a pivotal role in this initiative, spearheading the enhancement of 12 innovative solutions tailored for the manufacturing industry through its cutting-edge Industry and Innovation Laboratory (iiLab).

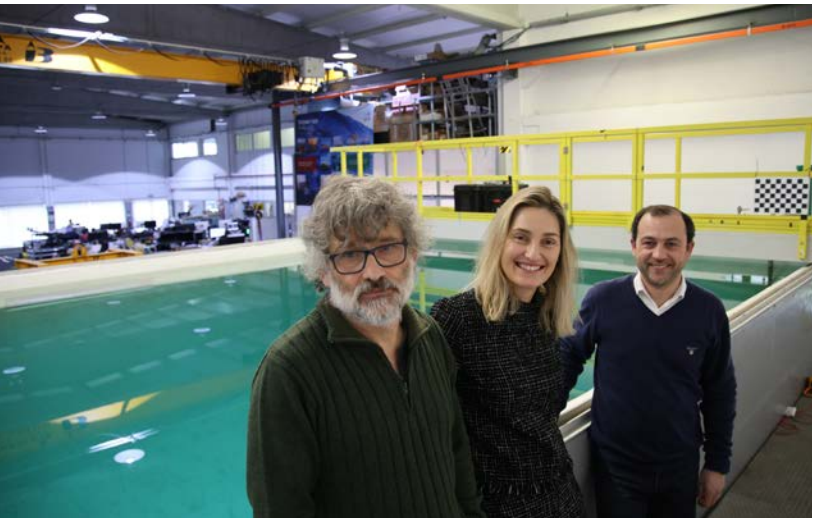
Leveraging the potential of 5G technology in conjunction with other Industry 4.0 enablers like robotics, information systems, image processing, and smart sensors, INESC TEC collaborates closely with technology companies to enhance their products' capabilities utilizing 5G networks. Presently, over half of the planned pilots in industry domain are either underway or completed.

The TESTBED 5G consortium boasts a unique consortium including NOS, Sonae MC, and Wells, with collaborative support from CEIIA, INESC TEC, and Ericsson. This consortium spans six strategic locations nationwide, encompassing Lisbon, Porto, Maia, and Matosinhos.



07.OUR INNOVATION

7.5 TEC4SEA



Team
Eduardo Silva (Coordinator), Ana Paula Lima (Communication, dissemination and continuous engagement) and Carlos Pinho (Business Developer)

The goal of TEC4SEA is to induce a market pull drive into R&D activities targeting sea and deep-sea challenges towards a sustainable Sea Economy. TEC4SEA presents INESC TEC as a worldwide institution of reference capable of empowering the Blue Economy through sustainable approaches for exploring and exploiting living and non-living ocean resources.

COMPETENCES

- Optical and biosensors
- Broadband communications
- Heterogeneous data integration and management
- Virtual and augmented reality
- Offshore RES and multiple energy vectors integration
- Digital twins, logistics optimisation solutions
- Mission oriented robotic platforms
- On-board processing solutions and optimisation
- Perception solutions, 3D mapping and data fusion
- Underwater positioning systems and navigation algorithms

OUTCOMES

Biosampler

Biosampler is a technology developed by INESC TEC and CIIMAR. The technology has been evolving over the years of collaboration between both entities; In 2023, it was tested in an extreme environment, descending to 15 meters deep in the cold waters of the melting glaciers located in the Svalbard fjords, in the Arctic. The objective was to collect environmental DNA. How? By coupling the biosampler to the IRIS robot, developed by INESC TEC. This action allowed the autonomous collection of samples by researchers.

TEC4Sea

TEC4Sea is a technological platform that aims to support the research, development and testing of robotics, telecommunications, and sensors equipment for operations in maritime environments. It was inaugurated in 2023 and it is composed of two major facilities: the Support Point, located in the Port of Leixões (a laboratory and a small workshop), and the Mar Profundo research vessel, currently moored in the Leça da Palmeira Marina.

07. OUR INNOVATION

7.6 TECPARTNERSHIPS

Team
António Gaspar (Business Developer), José Nina Andrade (Business Developer) and Augustin Olivier (Coordinator)

TECPARTNERSHIPS' main goal is to explore new sectors in markets where technological needs and roadmaps indicate a high potential for the application of INESC TEC's competencies and lines of research. Evaluates the possibility of technology transfer from INESC TEC to these sectors, allowing companies to become internationally competitive, with innovative products. Also, it aims to facilitate the creation of science-based products and services, so that the research developed in the institution and its associates translates into significant value to companies and institutions, thus addressing their technological challenges, and exploring the institution's experience in the sectors where it has traditionally operated.

OUTCOMES

In 2023, the exploration of the strategic analysis results of companies related to INESC TEC's core competencies continued. The analysis focused on the areas of artificial intelligence (AI), computer science, robotics, and computer vision, aiming to identify potential technology adopters in Portugal. This effort led to 54 meetings with entities that had not previously engaged with INESC TEC, resulting in a set of leads currently under analysis.

In the realm of internationalisation, two complementary lines of action were pursued. The first line involved promoting the institution and seeking potential partners for participation in European programs. The second line focused on disseminating and pursuing research and development contracts, with a particular emphasis on the French market. This strategy was propelled by the renewal of our "Agrément CIR" certification, obtained from French scientific authorities.

Within these lines of action, 76 meetings were conducted with new entities unfamiliar with INESC TEC. A set of leads has also been generated and is currently being pursued. Additionally, TECPARTNERSHIPS participated in specialised international events, some of which featured a dedicated stand.


ABB

Our research and development activities anchor in advanced research infrastructures. These facilities ensure several activities, **ranging from excellence-driven academic research to market-driven innovation**. Besides playing a pivotal role in our mission across domains, such as bioengineering, communications, optics, power and energy, and robotics, our infrastructures demonstrate our commitment to providing the national research community with experimental means to carry out impactful science.

Also, they underpin innovative research – our infrastructures have been instrumental in developing technologies that address societal challenges – and contribute to attracting national and international talent – critical for advancing scientific knowledge – and forge strategic partnerships with Portuguese and foreign entities.

Our advanced research infrastructures also support our teams as we conduct **cutting-edge field experiments**, many in remote and hostile environments, such as deep sea, flooded mines, arctic waters, or islanded electrical systems, requiring heavy and complex equipment.

08. OUR INFRASTRUCTURES

8.1 NEURO-ENGINEERING LABORATORY

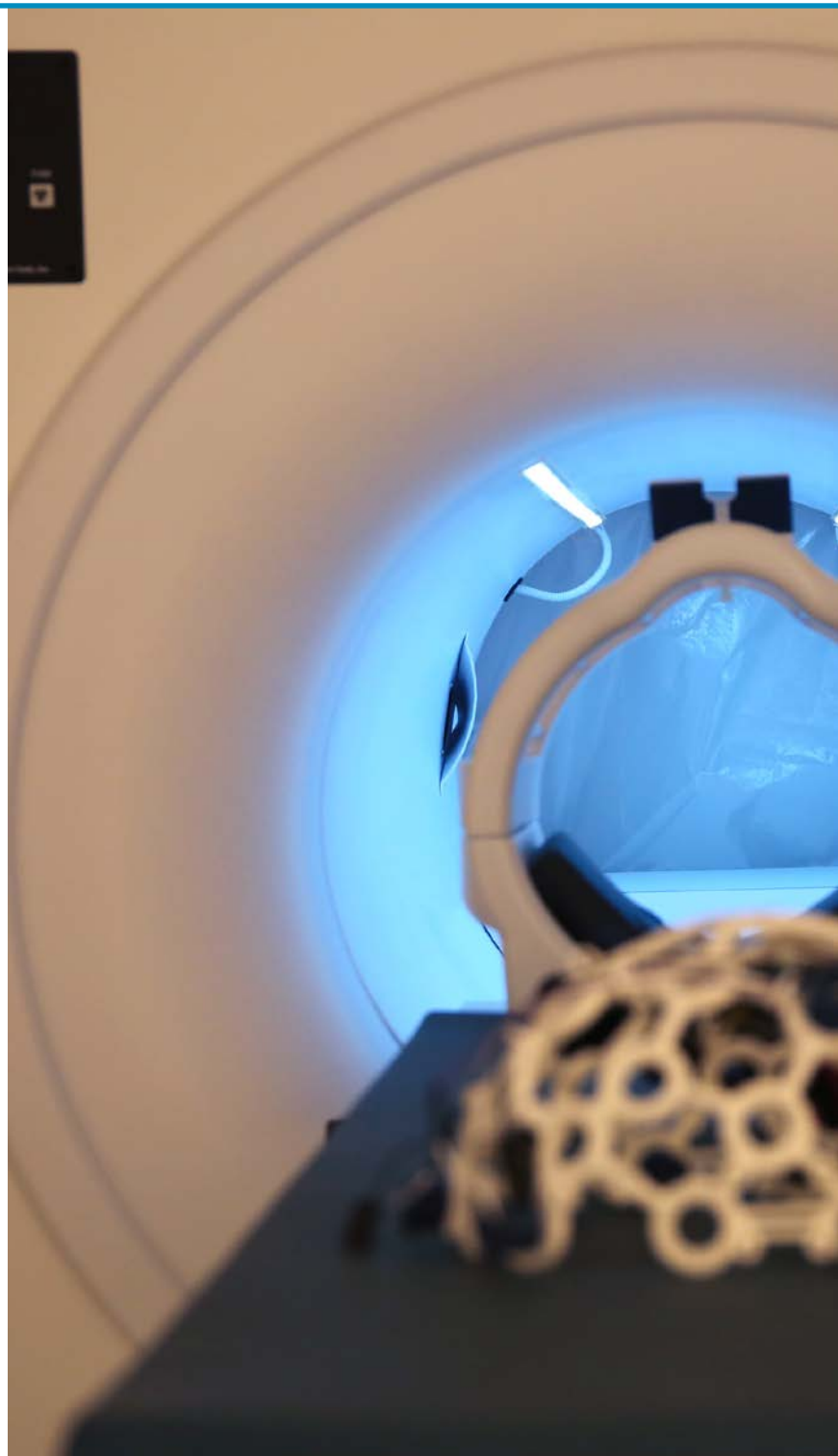
INESC TEC BRAIN Lab has a strong focus on researching new biomedical engineering methods for neurological diseases (e.g., Parkinson's, Alzheimer's, Autism and Epilepsy), namely by working on neuroimaging, quantified movement semiology, gait impairment analysis, adaptative deep brain stimulation (DBS), brain connectivity, neuro-robotics, among others.

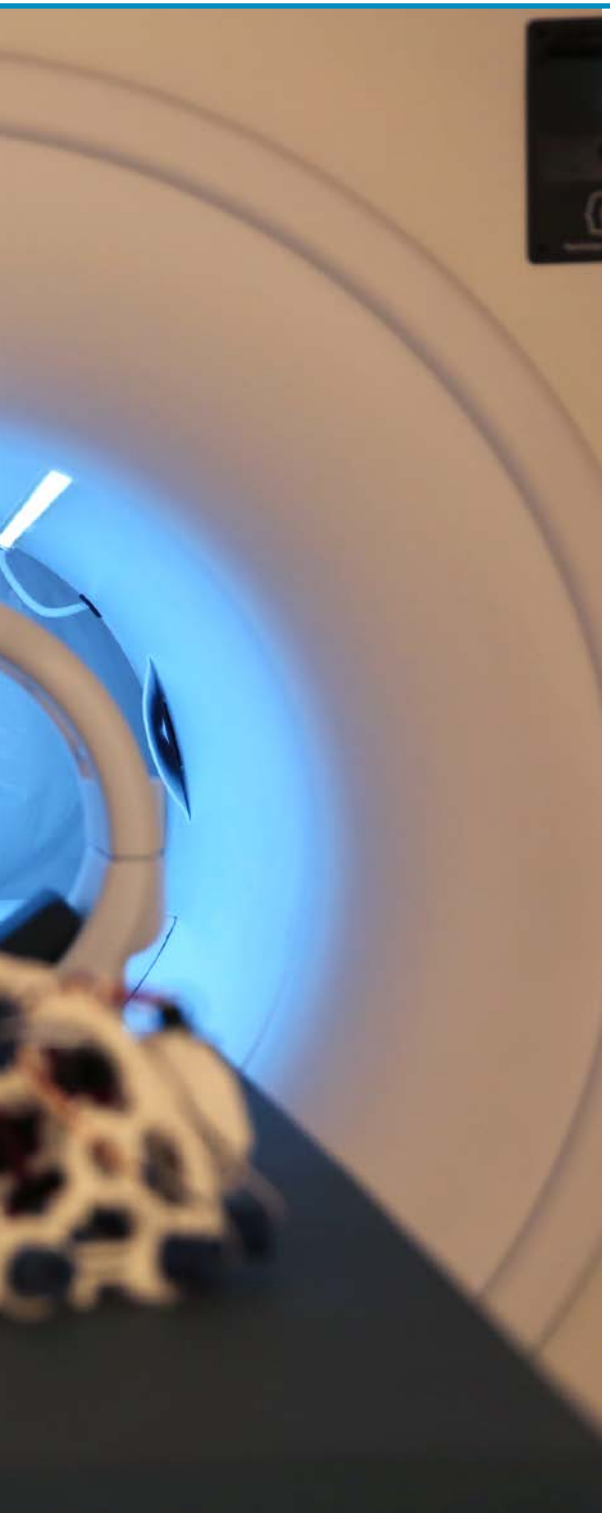
Location
INESC TEC headquarters

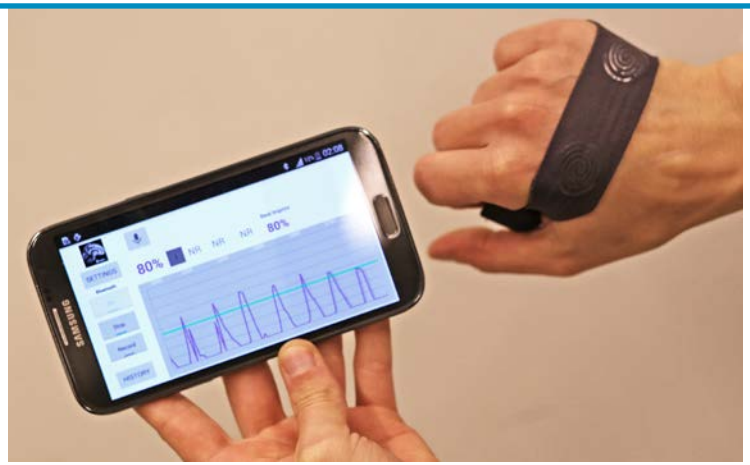
Responsible researcher
João Paulo Cunha

The Neuro-Engineering Laboratory, named of BRAIN (Biomedical Research And INnovation), provides multimodal brain imaging & signal methodological contributions to novel exploratory approaches to neuroscience problems, from neuron cell-sized sensing to fMRI neuroimaging and Computer Vision, both human and animal body motion macro analysis. This widespan capacity of studying the neurological system has delivered major contributions in cell photonics sensing, human behaviour analysis & prediction and advanced neuroimaging & neurosurgery aiding computerised tools, some of them with real translation to the clinical usage for the benefit of patients and healthcare professionals.

The laboratory is divided in five main research lines: 1) Brain imaging (& signals); 2) Man-machine symbiosis with edge-AI (e.g. Brain-Computer Interfaces); 3) Multimodal Computer Vision Analysis for neurological diseases; 4) Neurosurgery Aiding Systems; and 5) Macro-to-nano bio-neuro-sensing. BRAIN Lab also operates the Stim-BRAIN Lab, which is an advanced Brain Imaging infrastructure (that offers scientific services to third-parties, apart for our own research project) with an f-MRI simulator (mock scanner) fully equipped with synchronised 64ch video-Electroencephalogram (EEG) medical systems from Micromed, wearable EEG devices, video cameras, MRI compatible pads and audio system to simulate f-MRI experiments, and prepare stimulation protocols to be deployed in MRI scanners at the CHUSJ or any other clinical center. This infrastructure is used for fMRI and Video-EEG-fMRI paradigms development and testing for neuroscience projects with clinical partners.







ACHIEVEMENTS

- Organising the main Bioengineering Portuguese Meeting 2023 – BRAIN Lab was the main host and organiser of the 7th IEEE Portuguese Meeting in Bioengineering 2023 (ENBENG 23), held at the Serralves Foundation, Porto, on June 22 and 23, 2023, also serving as the Editors of the respective proceedings of this conference indexed on IEEE Xplore.

- New video-EEG system – the BRAIN Lab received and installed a new 64 channels video-EEG machine that is integrated with the BRAIN Stimulation room with the MRI simulator and the neurocognitive paradigm design tools for video-EEG-fMRI scenarios. This new system is a very important upgrade to the previous infrastructure and is also offered to the neuroscience community of the Porto region.

08. OUR INFRASTRUCTURES

8.2 COMPUTER GRAPHICS AND VIRTUAL ENVIRONMENTS LAB

The Computer Graphics and Virtual Environments Lab supports the development of solutions for human augmentation to face the challenges of today's society. From training and certification to promoting healthy habits and sustainable behaviour, this lab is focused on the development of interactive technologies for authoring and collaborating in immersive environments.

Dual location
- Porto (GIG @ FEUP)
- Vila Real (MASSIVE @ UTAD)

Responsible researcher
António Coelho

The mission of the Computer Graphics and Virtual Environments Laboratory (CG&VE) is to research in the field of Computer Graphics and Human-Computer Interaction, with particular emphasis on Immersive Environments. From the fundamental research of technologies and algorithms to support digital mediation in virtual environments, to user-centric authoring tools, the laboratory has developed several innovative computational tools, also keeping the focus on the study of human perception and augmentation, with a view to improving the processes associated with the application areas of Industry 5.0, Health, Tourism, Culture and Education.

The laboratory intends to be a reference in the field of multisensory virtual reality, perceptual equivalence, human performance, and technology, creating innovative solutions in a wide set of areas of application, within the following research lines:

- Studies in human augmentation for enhanced performance in professional and personal activities
- Multisensory virtual environments to provide enhanced presence and immersion
- Immersive learning environments and authoring tools to enhance training and education
- Serious Games and Gamification to promote increased motivation and efficacy in immersive learning, cultural heritage, and behaviour change
- Immersive 360º video tools to improve communication
- Extended reality frameworks to deploy the most cost-effective solutions
- 3D multimodal interaction in immersive environments, including haptics and pseudo-haptics

ACHIEVEMENTS

- Extended framework for the assisted creation and edition of virtual environments to be used collaboratively in Virtual Reality (VR) and Augmented Reality (AR).

- VR Training Platform for radiological and nuclear emergencies in project INCLUDING, that brings together a Federation of European Practitioners in the field.

- Core research and prototyping in 3D multimodal interaction in immersive environments, including: Shape-changing haptic devices; DeskVR interaction; Immersive visualization; Co-creation framework for game-design.

08. OUR INFRASTRUCTURES

8.3 CLOUDINHA LABORATORY

The CLOUDinha laboratory plays a crucial role in INESC TEC's research and innovation endeavors, supporting the sharing of scientific knowledge and promoting its transfer to both the scientific community and the broader society.

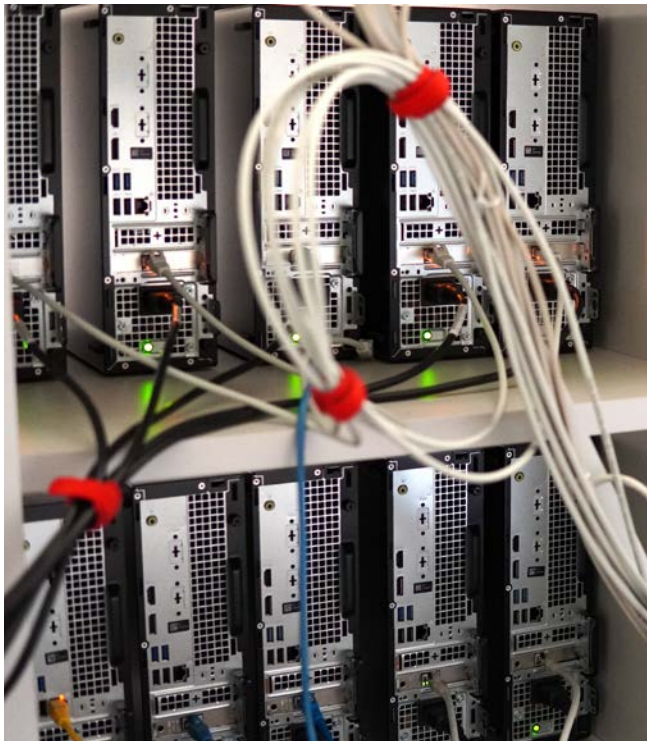
Location
INESC TEC site placed in Universidade do Minho

Responsible researcher
Ricardo Gonçalves

The CLOUDinha laboratory provides computational support to research and development activities of INESC TEC and University of Minho, providing bare metal, virtualisation, and security features such as trusted hardware.

The cluster is composed of different generations of hardware namely, Haswell, Kaby Lake, Comet Lake, Coffee Lake and Raptor Lake. It is currently composed of 106 micro-ATX machines based on commodity hardware with Intel Core i3,i5, and i9 CPUs, 8GB, 16 GB, and 64GB of memory, and heterogeneous storage hardware including HDDs, SSDs, and NVMe devices. The machines are connected through either a 1 Gb or 10 Gb network.

In addition to these, the cluster has four rack servers based on Intel Xeon hardware, with 32GB, 64GB, 192GB of memory, and heterogeneous storage hardware including SSDs, NVMe, and persistent memory devices. They are connected through either a 1 Gb or 10 Gb network, while some of them also have programmable network capabilities (DPDK). The heterogeneous hardware nature of the cluster is important for supporting different research projects that may require specific hardware features (e.g., different storage or network technologies, access to trusted hardware capabilities).



ACHIEVEMENTS

In 2023, this INESC TEC laboratory provided the computational infrastructure to develop, optimise and test the software prototypes being developed by researchers in topics such as:

- Distributed systems and data management
- Storage systems and databases
- Privacy and security
- Blockchain and Internet of Things
- Bioinformatics

These software prototypes were developed under the scope of INESC TEC's research and innovation projects, as well as PhD and MSc theses. In particular, 7 ongoing PhD theses and 13 completed MSc theses used the CLOUDinha Laboratory as computational infrastructure for the research work. Moreover, 22 of these works exclusively used commodity hardware resources, 3 of them conducted their experiments on the enterprise-grade rack servers, and the remainder resorted to both resource types. All these works resulted in thousands of hours of computation.

THE MAIN OUTCOMES

3 journal publications
6 conference papers
2 workshop papers
5 communications
16 open-source software prototypes

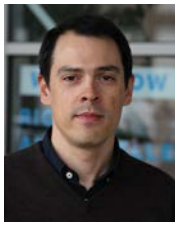
08. OUR INFRASTRUCTURES

8.4 COMMUNICATIONS LABORATORY

The Communications Laboratory (ComLab) at INESC TEC serves as an infrastructure for communications research, bridging simulations and experimentation.

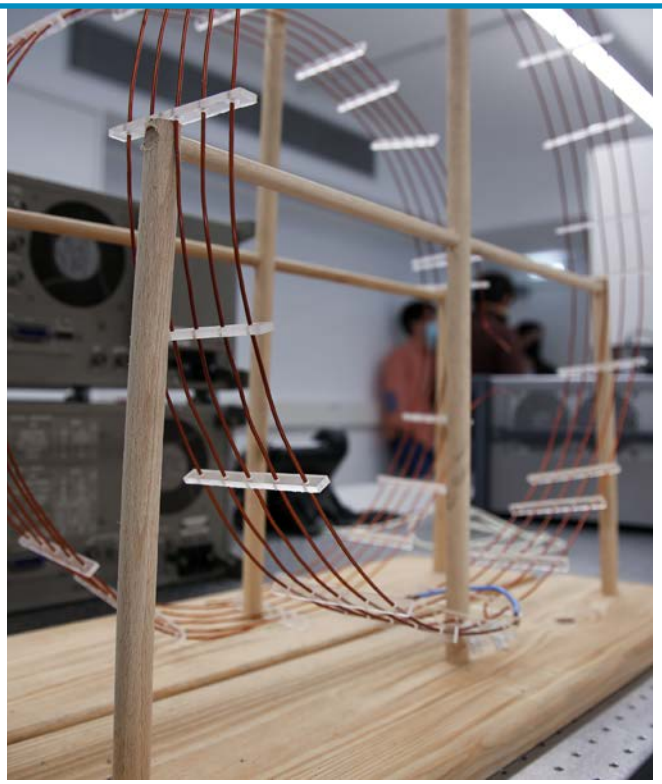
Location
INESC TEC headquarters

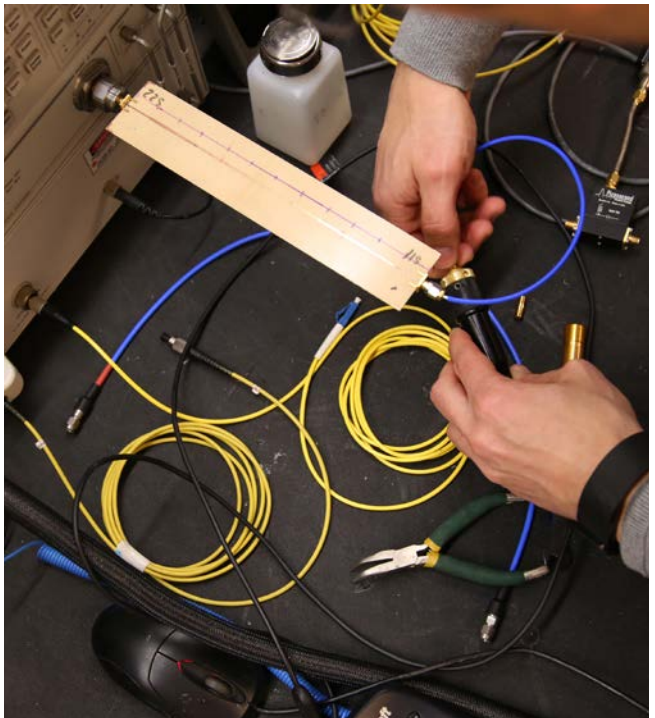
Responsible researcher
Luís Pessoa



The Communications Laboratory (ComLab) was established in 2006 at INESC TEC's main building, following a successful proposal to FCT under the National Program for Scientific Hardware Renewal. Established to push the boundaries of communications and sensing technologies, ComLab is a well-equipped infrastructure that includes optical, electronic, and RF communications test equipment, an anechoic chamber for precise antenna characterisation and a state-of-the-art Low Earth Orbit (LEO) Satellite communications gateway. It supports a broad spectrum of research from satellite communications, 5G and 6G technologies to human sensing, fostering collaboration with academic and industrial partners.

ComLab is also dedicated to training the next generation of researchers and engineers, offering them invaluable hands-on experience with cutting-edge technology. This makes ComLab not just a laboratory but a thriving community at the forefront of telecommunications research and development, committed to driving scientific breakthroughs and technological innovations that address the challenges of today and tomorrow. The main objective of the ComLab is to support the experimental evaluation and testing of next generation communications and sensing solutions in a controlled environment, enabling the validation of simulation results and preparation for subsequent testing in real-world scenarios.





ACHIEVEMENTS

- Implementation of the initial prototype modules of a vision-aided reconfigurable intelligent surface at 6.5 GHz suitable for human activity sensing.

- Establishment of an initial waveguide-based experimental setup for the characterisation of antenna-array unit cell elements.

- Establishment of a test assembly suitable for the characterisation of biological tissues using optical signals.

- Integration of a LEO Satellite communications gateway in the laboratory giving support for new Wi-Fi and 5G-based backup communications solutions for disaster management scenarios.

- Kick-off of the extension of the laboratory facilities to a complementary room, enabling research on beyond 5G and 6G communications in cooperation with a telecom operator.

- Implementation of the prototype of a mobile 5G cell, using the robotic dog to move the 5G Base Station aware of its users and obstacles, which has important applications not only for disaster management scenarios but also for providing on-demand communications in areas without enough network coverage and capacity.

- Contributions to training sessions and support of the ongoing works related to the CTM Summer Internships, B.Sc. curricular internships and MSc and PhD theses.

08. OUR INFRASTRUCTURES

8.5 EMSO

The European Multidisciplinary Seafloor Observatory – Portugal (EMSO-PT) is a research infrastructure lead by IPMA (Instituto Português do Mar e da Atmosfera) and involving 15 other research institutions working on ocean science or technology, including INESC TEC.

Location
North Atlantic

Responsible researcher
José Miguel Almeida

The goal of EMSO-PT is to organise the Portuguese contribution to the EMSO-ERIC network, a large-scale European Research Infrastructure, networking fixed deep sea multidisciplinary observatories, with the scientific objective of real-time, long-term monitoring of environmental processes related to the interaction between the geosphere, biosphere, and hydrosphere. It is a geographically distributed infrastructure at key sites in European waters, spanning the Arctic, the Atlantic, and the Mediterranean, up to the Black Sea. It will be in place by the end of the decade.

The Portuguese participation in EMSO has been focused on the Azores and Cadiz nodes, in cooperation with France and Italy. These observatories will merge "off-the-shelf" technology, which will ensure that they will meet the international standards, with novel approaches (based on networked, autonomous observation platforms), that will contribute to more sustainable monitoring operations and create the basis for the development of new marine products and services, creating value and qualified jobs.

INESC TEC involvement in EMSO-PT addresses the establishment of long-term non-fixed observatories, and such work is organised along two complementary lines: relocatable nodes and long-endurance mobile platforms.

ACHIEVEMENTS

EMSO-PT finished its first implementation phase in 2023.

The main achievements of EMSO-PT during 2023 were:

- The operationalisation of the two new gliders.
- Improvements on the mobile EMSO-PT node. Several improvements to the Turtle 3 robotic lander have been made to increase the mobile EMSO-PT node's deployment times and add extra functionalities and robustness.

08. OUR INFRASTRUCTURES

8.6 INDUSTRY AND INNOVATION LAB

INESC TEC Industry and Innovation Lab (iiLab) discloses the state-of-the-art in advanced production technologies through the demonstration of research, experimentation, and advanced training results.

Location
INESC TEC site placed in PORTIC

Responsible researcher
António Paulo Moreira

iiLab supports technology-based innovation in public and private organisations, thus contributing to the development of skills in the development, adoption, and implementation of advanced production technologies, leading to a sustainable competitiveness in the circular economy context.

This infrastructure allows:
- Demonstration of concepts and advanced technologies in the areas of robotics, automation, industrial cyber-physical systems (Internet of things) in the form of a show-room.
- Dissemination of INESC TEC's expertise for the industry and the community in general.
- Experimentation and prototyping space for technological companies.
- Tailor-made training for senior managers and senior executives of industrial companies.

This lab main activities are the demonstration of concepts and advanced technologies in the areas of robotics, automation, and industrial cyber-physical systems, the experimentation and prototyping space for technological companies, and tailor-made training for senior managers and senior executives of industrial companies.

ACHIEVEMENTS

In 2023, in addition to concluding the new iiLab (PORTIC) facilities and equipping them (first half of the year), several actions have been carried out in order to:

- Organise an efficient and attractive innovative laboratory for showroom and collaboration with private and public companies interested in testing, demonstrating, validating, and/or to implementing industry 4.0 enabling technologies (such as robotics, automation, digital twin, industrial internet-of-things, among other technologies).

- Design and develop innovative and advanced training courses and educational programs, mainly oriented for companies and industrial clusters.

- The implementation and deployment of a dedicated 5G infrastructure, coupled with Network Operating System (NOS), positions iiLab as a trailblazing laboratory for testing and validating 5G-ready digital solutions. This initiative, conducted in collaboration with national technology companies, particularly small and medium-sized enterprises (SMEs), not only solidifies iiLab's pioneering role but also facilitates the exploration and realization of the extensive benefits associated with 5G technology.

08. OUR INFRASTRUCTURES

8.7 LABORATORY OF MICROFABRICATION

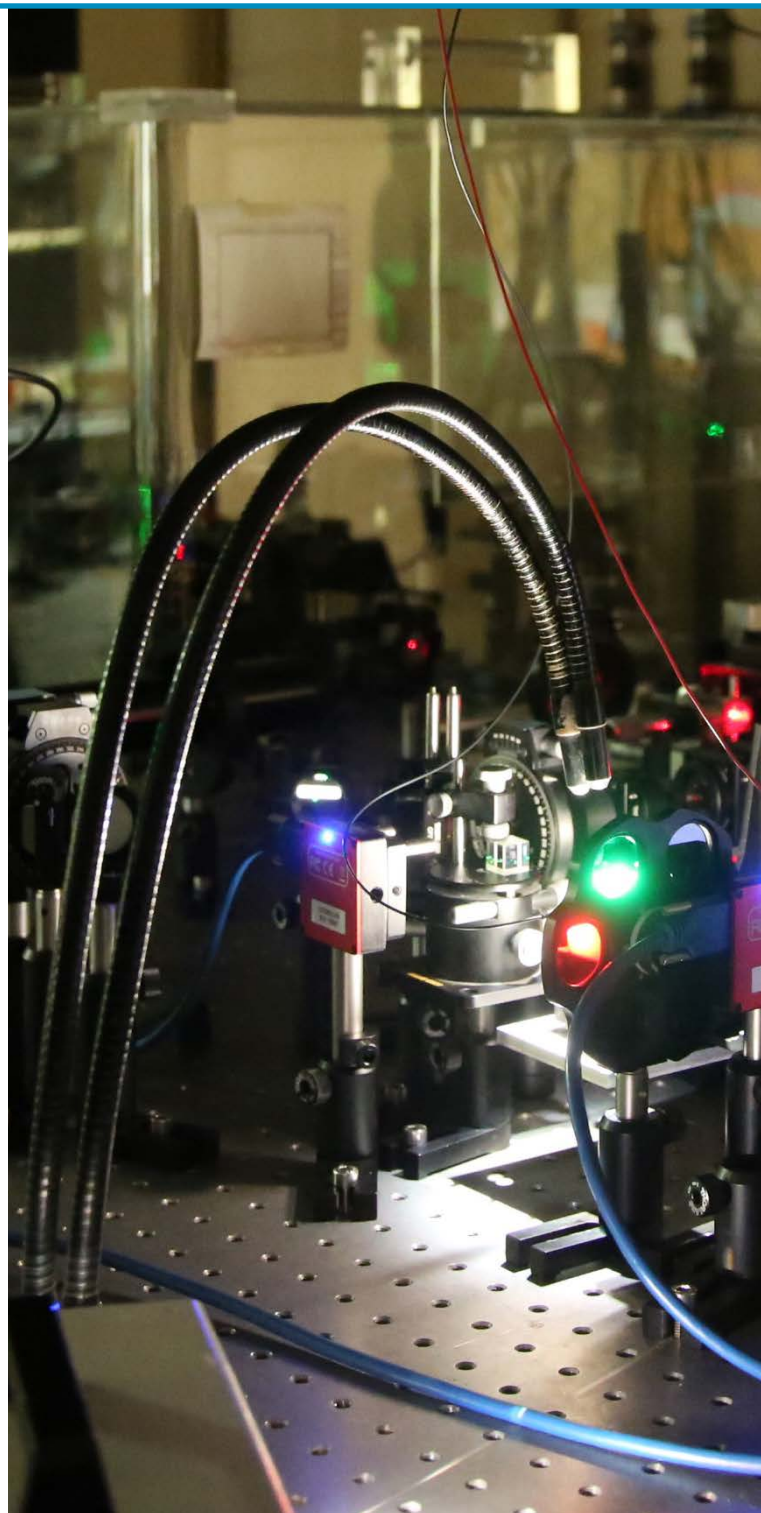
INESC TEC Microfabrication Lab deals with materials modification using femtosecond laser exposure due to non-linear absorption. This high versatile technique excels in 3D fabrication with high resolution and therefore offers high potential to many applications where standard planar (2D) fabrication techniques cannot match in terms of performance.

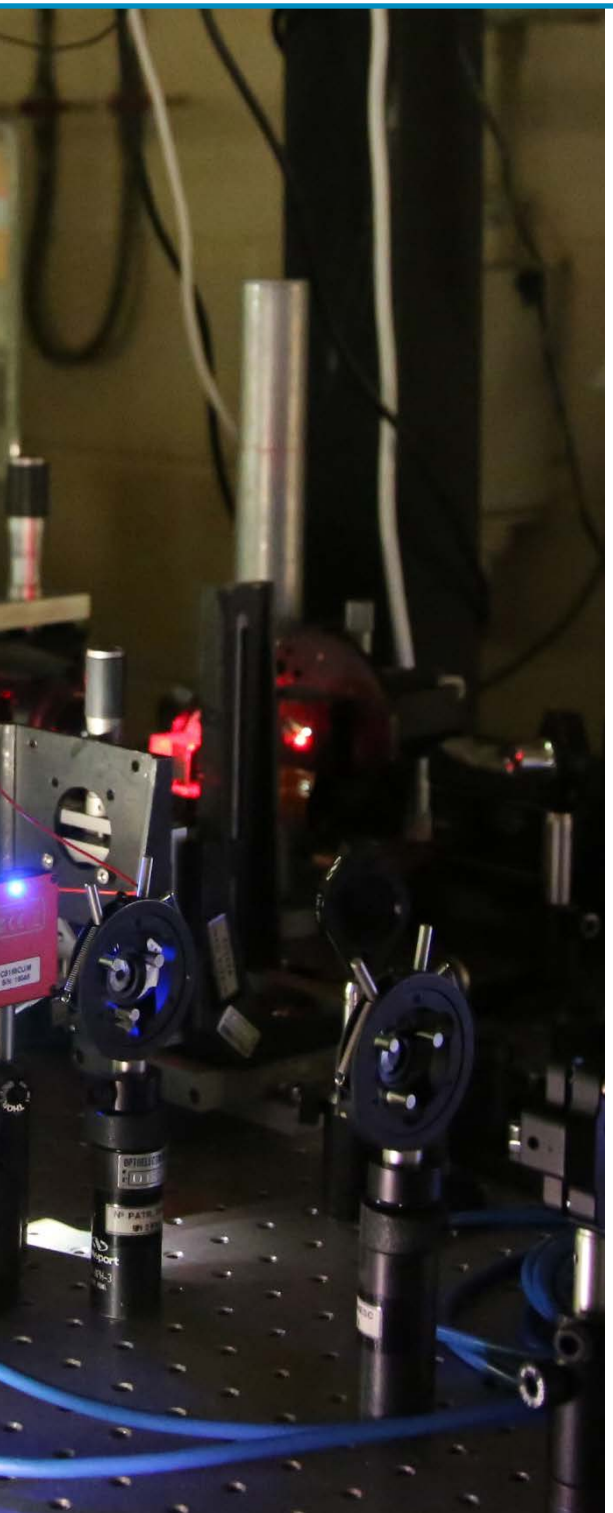
Location
INESC TEC site located in FCUP

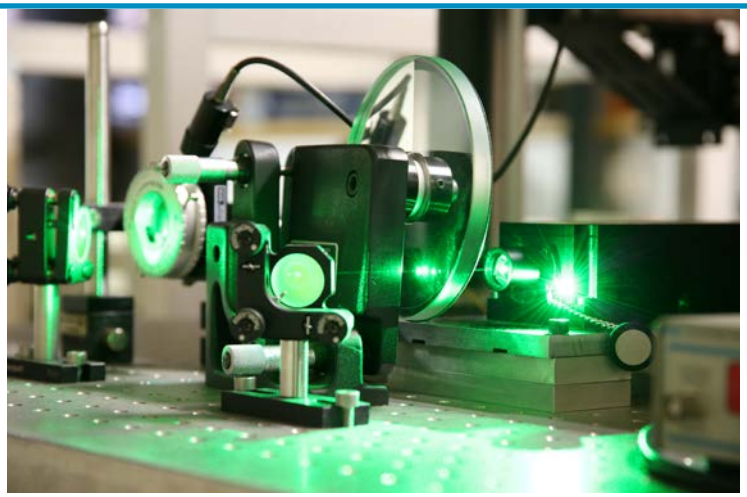
Responsible researcher
Paulo Marques

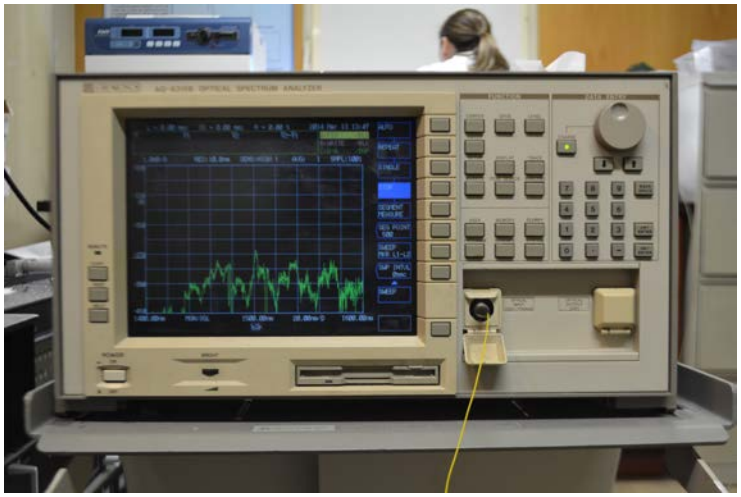
The Microfabrication Laboratory explores non-traditional microfabrication techniques based on the femtosecond laser direct writing capabilities, to support mainly the activities on integrated optics and optofluidics, but also other areas of research. It can produce microchips, to implement biosensors and micro and nanostructures, as well as first order Bragg gratings and long period gratings, made by point-by-point laser direct writing, to implement better and more reliable sensing heads. Laser marking and surface treatment is also possible. A second femtosecond laser fabrication set-up dedicated to Bragg and long period gratings fabrication machine is currently undergoing a refurbishment in terms of positioning stages and beam conditioning. This major upgrade will permit to address fabrication in multicore fibers and use the cladding of standard fibers as a substrate.

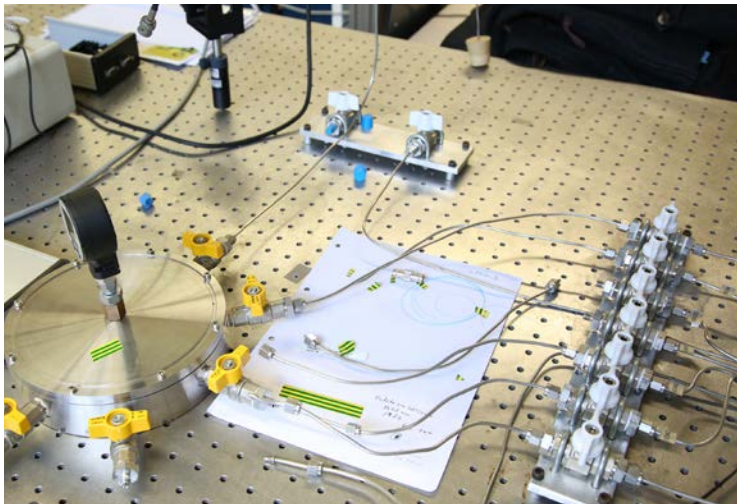
This facility is complemented with a ISO 6/7 cleanroom where standard 2D micro/nanofabrication techniques can be used. The cleanroom is managed by CEMUP MNTEC (University of Porto), that made its micro/nanofabrication equipment available in this infrastructure for widespread use.











ACHIEVEMENTS

- Fabrication of integrated optics or optofluidic devices.

- Micromachining and laser welding of glasses.

- Machining and waveguiding writing in Ultra Low Expansion (ULE) glasses.

- Exploration of glass poling techniques for the fabrication of active devices fabricated by femtosecond.

- 3D metallic electrode fabrication.

- Fabrication of microfluidic and optofluidic devices using FLICE techniques for sensing applications.

- Fabrication of Bragg and long period gratings (first and higher order structures).

08. OUR INFRASTRUCTURES

8.8 ROBOTICS AND AUTONOMOUS SYSTEMS LABORATORY

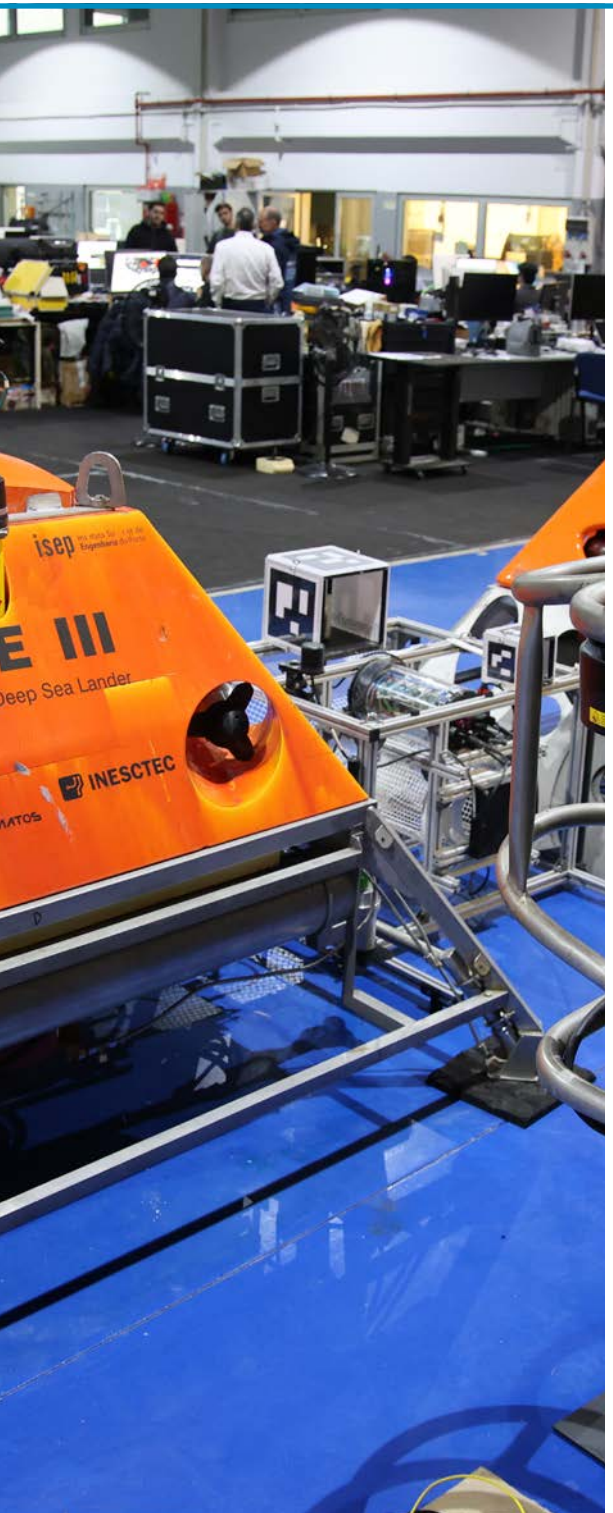
The mission of the Robotics and Autonomous Systems Laboratory (RAS) is the research of excellence in Autonomous Systems, enabling the observation and operations in complex, unstructured and harsh environments.

Location
INESC TEC sites placed in ISEP and in FEUP

Responsible researcher
José Miguel Almeida

The Robotics and Autonomous Systems Laboratory (RAS) supports R&D activities, technical training of human resources, as well as advanced education programs. The multiple-purpose robotic operations include data gathering, inspection, mapping, surveillance, and/or intervention. The impact in the economic and social fabric development is also part of the objectives - by contributing to the performance, competitiveness and internationalisation of Portuguese companies and institutions.

The facilities include two test tanks, the larger one has dimensions 10mx6m and is 5m deep, and a workshop for prototyping. The laboratory infrastructure comprehends a large set of robotics platforms (underwater, surface, aerial, and terrestrial), most of them ready to operate in real environments. It also includes many sensors and auxiliary equipment that can be operated independently or integrated into larger systems.



ACHIEVEMENTS

- Reorganisation of the physical space at the FEUP campus, creating more space for PhD students.

- Upgrade of robotic platforms taking advantage of ongoing projects:

  • Integration of a new horizontal propulsion system for the MARES AUV, with 4 thrusters;
  • Integration of a new inspection camera and laser lines for scaling in the CRAB ROV;
  • Finalisation and demonstration of a new ASV prototype for carrying a payload up to 200 kg;
  • Upgrade of EVA AUV for 1000 m deep and high resolution cameras and laser lines for sea bed mapping for Vulnerable Marine Ecosystems surveys;
  • Integration of an eDNA sampler in IRIS AUV adding a new capabilities for environmental surveys.

- Development of a synchronised versatile underwater acoustic pinger, to transmit arbitrary coded signals for underwater positioning.

- Integration of a 2km long observatory in an underwater communications cable (SMART Cable), off the coast of Sesimbra.

- Continuation of the upgrade of the scientific instruments available with new development equipment, navigation systems, LiDARS, Multibeam sonars, thermal cameras, and several underwater sensors.

- Follow up on the training of technicians to operate workshop facilities, help programming sensor drivers, and provide support to field operations.

08. OUR INFRASTRUCTURES

8.9

SMART GRIDS AND ELECTRIC VEHICLE LABORATORY

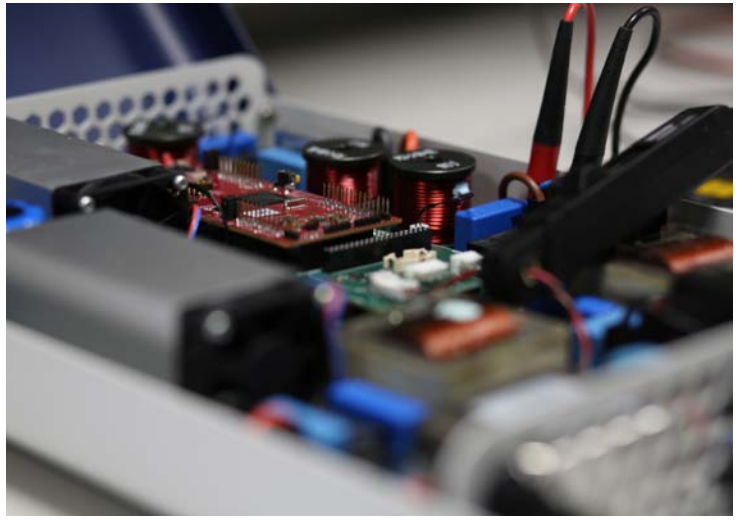
The Smart Grids and Electric Vehicle Laboratory (SGEVL) provides a set of experimental laboratorial-scale testbeds that support applied research activities in different areas of power and energy systems domain: Electric Mobility, Hybrid AC/DC power grids, advanced protection architectures for modern power systems, Hydrogen integration, Energy Management and interoperability, and AI for energy.

Location
INESC TEC headquarters

Responsible researcher
Justino Rodrigues

The SGEVL is a multifunctional and multipurpose electric and digital infrastructure that offers a distinctive integrated capacity to simulate, prototype and test solutions for the energy system of the future, providing support and services to the scientific and industrial ecosystem. SGEVL is an important research infrastructure providing testing and validation capabilities to the research activities carried out within Power and Energy scientific and innovation developments.

Recognised by the Portuguese Foundation for Science and Technology (FCT), as part of the National Roadmap for Research Infrastructures of Strategic Interest, the SGEVL is a modern infrastructure with the ability to cover state-of-the-art and beyond state-of-the-art prototype solutions. SGEVL is well-positioned to integrate the different research and innovation networks and to provide newer and updated services to business and industrial partners to generate applied results. This involves providing means to support research activity regarding experimental demonstration capabilities targeting several TRL, as well as services to the scientific, educational, business and industrial community. SGEVL can serve not only INESC TEC researchers but also temporarily I&D researchers external to the infrastructure (national and international), whilst ensuring financial stability from newer sources and revenue opportunities.



ACHIEVEMENTS

- Continued development of a laboratory scale validation facility including hydrogen producing electrolysers (under the scope of the Horizon 2020 GREENH2ATLANTIC project). A PEM electrolyser was commissioned, and its delivery is expected to 2024.

- Improvement of the hybrid AC+DC microgrid, previously initiated as part of an energy supply solution for a novel telescope infrastructure (under the scope of the Portugal 2020 SmartGlow project).

- Expansion of the EV charging and V2G testbed with new EV chargers (prototypes and commercial) and new charging locations (under the scope of the H2020 POCITYF and H2020 GreenDataAI projects).

- Continued development of a grid automation and protections testbed, considering digital protection units, initiated under P2020 SCALE project, and to be continued in the Alliance for Energy Transition project in the scope of Recovery and Resiliency Plan (PRR).

- Implementation of interoperable solutions for EV charging, smart appliance, and energy management, using the microgrid testbed (under the scope of the Horizon 2020 InterConnect).

- Reinforcement of the SGEVL microgrid, though the installation and successful testing of two additional hybrid PV inverters with storage.

08. OUR INFRASTRUCTURES

8.10 TECHNOLOGY FOR SEA INFRASTRUCTURE

The TEChnology for Sea infrastructure (TEC4SEA) is a platform designed to support multidisciplinary research, development, and testing of marine robotics, telecommunications, and sensing technologies for operation in oceanic environments.

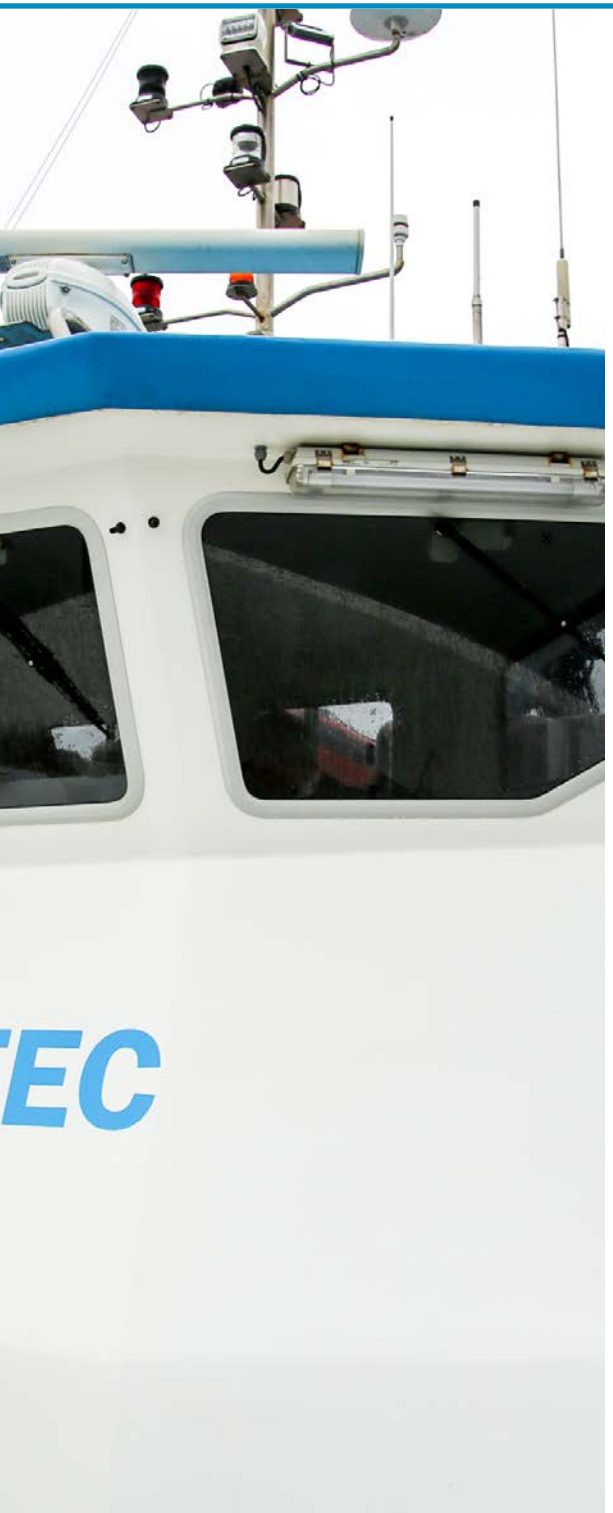
Dual location
INESC TEC site placed
in Porto de Leixões (Leça da Palmeira)
and in CINTAL Gambela Campus (Algarve)

Responsible researcher
Paulo Mónica

The TEChnology for Sea infrastructure (TEC4SEA) contributes to the development of technology for maritime environments by making available facilities, resources, and know-how to economic agents and researchers.

It is open to both the R&D community and the industrial sector, and provides the equipment, expertise, and logistics needed to support those communities in developing, evaluating, and validating technological solutions designed for maritime environments, thus fostering and advancing the blue economy.

TEC4SEA is a vertically integrated infrastructure; its expertise and resources range from pure conceptual research to field deployment missions, with strong industrial and logistic competences in prototype production and an eclectic set of laboratories, testbeds, equipment, and support facilities for experiments in controlled and real environments. It can thus support researchers in all phases of technology development, from conception and theoretical analysis to prototype development, field deployment, and technology validation.



ACHIEVEMENTS

- Inauguration of the north facilities on March 17th. The event included a formal presentation of the TEC4SEA infrastructure and visits to the Mar Profundo research vessel (RV) and the lab facilities at Administration of the Ports of Douro, Leixões, and Viana do Castelo, SA (APDL).

- The RV Mar Profundo supported missions for several research projects (Atlantis, EU-SCORES, Nessie), external entities such as IPMA (survey and data gathering on Vulnerable Marine Ecosystems, a task that Portugal had to perform within the scope of its EU responsibilities), and joint international robotic exercises (deploying several underwater systems along two weeks, within the scope of the REP(MUS)23 naval exercise), showing the potential of the vessel as a mobile laboratory at sea.

- The RV Mar Profundo had its first dry docking for hull inspection and preventive maintenance.

- The infrastructure attracted new international projects, financing sources, and research partners. Additionally, during this year, the number of entities potentially interested in adhering to the infrastructure grew, an indicator of a healthy and diverse ecosystem around this infrastructure, from which many synergies and technological advances should be expected.

- The Scientific Roadmap for the next funding phase of the Infrastructures in the Portuguese Roadmap of Research Infrastructures (to start in 2024) was consolidated.

08. OUR INFRASTRUCTURES

8.11 TRIBE LAB

INESC TEC TRIBE LAB prioritises Industry-Relevant Projects, forging strategic partnerships with industry stakeholders to drive real-world impact, whose researchers directly contribute to projects that advance agriculture and forestry, boosting profitability, sustainability, and automation. This collaborative environment fosters interdisciplinary teamwork, accelerating innovation and delivering tangible results that shape the scientific community and beyond.

Location
INESC TEC site placed in FEUP

Responsible researcher
Filipe Santos

INESC TEC TRIBE LAB was conceptualised in 2013 with a clear mission: to pioneer robotics, automation, and IoT-based solutions. The aim is to revolutionise smart precision agriculture and forestry, ensuring that operations are conducted at the "right time, right tool/product, right amount, right place" for optimal outcomes, focusing on enhancing profitability, sustainability, and automation across three primary environments: Permanent Crops, Forest biomass harvesting, and Protected Cultivation (Greenhouses and Controlled Environment Agriculture).

The lab's research, development, and technology deployment activities are guided by a comprehensive ten-year roadmap (2020-2030), meticulously aligned with European agendas, Food and Agriculture Organization of the United Nations (FAO) agricultural priorities, and the TEC4AGRO-FOOD Innovation Area agenda. By addressing societal challenges and leveraging cutting-edge innovation, its multi-disciplinary team strives to be at the forefront of transforming the agricultural landscape for a sustainable future. TRIBE LAB operates with dynamic flexibility, focused on research and developing cutting-edge physical prototypes, with the capability to quickly create prototypes on demand, ready to address emerging societal challenges.

ACHIEVEMENTS

- The recognition from The Mixing Bowl and Better Food Ventures as a key player in the "2022 Crop Robotics landscape," solidifying our position among the most influential players globally.

- The successfully organised first edition of the "Synergy Day: Robotics and IoT for Vineyards," by joining six European projects to showcase over 10 prototypes of IoT and robots developed in-house.

- The possibility of consolidating and continue the research and development of 28 software and hardware prototypes, to achieve higher TRLs (average TRL 6). Among them are WETA and Modular-E, two robots built from scratch to simplify the process of technology transfer and meet end-users' needs.

- Reach successful public technology demonstrations and tangible results for H2020 and HE projects (such as SCORPION, NOVATERRA, DEMETER, AgRoboFood (DIH) and WATSON), P2020 (such as SPIN, SMARTCUT, SMARTDRYING, INCAFO, RePLANT, InOlive, Wine4cast) and PRR projects (Agenda transForm, Vine&Wine, InsectERA, Blockchain.PT).

- Contributions to the academic community with 22 scientific publications in international and indexed peer review journals, 5 master's theses, and 14 PhD works.

- Participation in several relevant national and international events for the area either with demonstration of prototypes developed in our laboratory, or with oral presentations or active participation (such as World FIRA 2023, European Robotics Forum 2023, embedded world, AgroIN, EU CAP Network workshop Innovative arable crop protection - using pesticides sustainably, Photonics Partnership Annual, myEUspace competition, Innovation and Technological Modernisation in the Portuguese Army). Aligned with the projects, the prototypes were presented in 5 public demonstration sessions.

09. OUR OPENNESS TO SOCIETY

COMMUNICATING OUR ACHIEVEMENTS

"INESC TEC CIÊNCIA E SOCIEDADE" PODCAST AND VIDEOCAST

- First season of the "INESC TEC Ciência e Sociedade" Podcast and Videocast.
- Four episodes, focused on Artificial Intelligence and Health.
- Broadcast on YouTube (videocast) and Spotify (podcast), and other streaming platforms such as Google Podcast.

1700 views

280 listeners

"INESC TEC CIÊNCIA E SOCIEDADE" MAGAZINE

- 6th edition of the "INESC TEC Ciência e Sociedade" Magazine.
- Theme: "Empowering the Blue Economy through Innovation and Technology".
- Digital and printed versions.

1920 website visits

4725 page views

"INESC TEC SCIENCE BITS" PODCAST

- Podcast - "INESC TEC Science Bits" among the five nominees in the "Science, Technology and Education" category of the PODES awards.

11 new episodes

+4000 streams/downloads

"INESC TEC ON THE SPOTLIGHT"

- Five long-features.
- Deepening themes such as immersive learning, telecommunications, forest management, and energy communities.

2050 total page visualisations

We seek to take science, technology, and innovation beyond our doors, and we know that communication plays a fundamental role in this process.

Through several science communication activities, we keep pushing the envelope to provide society with information about the knowledge we produce, the technology we develop, and the solutions we create that address multiple challenges.

In line with the global communication trends and targeting different audiences, we communicate through different channels and produce different and innovative types of content, such as podcasts, videocasts, long-features, magazines, or videos.

INTERNATIONAL DAY OF WOMEN & GIRL IN SCIENCE

- Social media campaign about the International Day of Women & Girl in Science named BOLD.
- Four conversations with eight women, about four topics: education, work-life balance, leadership, and future.

1043 views

BRINGING OUR COMMUNITY TOGETHER

"INESC TEC AUTUMN FORUM"

- 8th edition of the "INESC TEC Autumn Forum".
- Academia, industry, and public administration actors together to discuss the role of interface entities in innovation ecosystems.
- Exploring the development of these ecosystems, projecting the future from the current context, based on national and international cases.

225 in-person participants

327 online participants

SPREADING THE WORD ABOUT OUR WORK

- News in several other countries, such as Spain, the United Kingdom, the United States of America, Turkey, and Russia.
- Circulating press releases among national and international media, building rapport with journalists, and making editorial proposals.

+40 press releases

+1200 news stories

In 2023, we strengthened our commitment to openness to society by communicating our institution's scientific and technological achievements to contribute to giving visibility to R&D activities and a more informed society; organising events to bring together our community to discuss science, technology, and our contributions to society; building rapport with journalists and outlets to share with national and international media the outcomes of the work we carry out every day.

10. OUR COMMUNITY

We cherish our community and we promote an internal organisational culture that facilitates the exchange of ideas, networking and the creation of synergies, as well as socialisation and leisure activities.


FUN


INESC

11. OUR CONTRIBUTIONS TO PUBLIC POLICIES

Through Science, Technology and Innovation
With innovative research and collaborations, INESC TEC's 380 active R&D projects in 2023 tackled a broad spectrum of the United Nations Sustainable Development Goals. These projects emphasised affordable and clean energy, industry, innovation and infrastructure, good health and well-being, and life below water and on land.

In partnership with relevant stakeholders, more than ten projects were directed towards enhancing and transforming infrastructure sectors in areas like hospital management, education, and intelligent transport systems for urban road policing. They also included consulting and studies for utility providers (electricity and water) and national observatories.

The sixth issue of the "INESC TEC Science & Society" magazine was also published, focusing on "Empowering the blue economy through innovation and technology," and a new science podcast and videocast emerged from the magazine. The first season, with four episodes, focused on Artificial Intelligence and Health, as the first issue of the magazine, published in 2020.

Through Institutional Expertise
The annual Autumn Forum, under the motto "Innovation ecosystems: the role of interface entities," once again focused on discussing a topic of national interest from economic and public policy perspectives.

Regionally, INESC TEC engaged in the Advisory Committee for a study by CCDR-N on best practices in regional innovation systems and governance models for smart specialisation strategies. We also participated in the Focus Group for the Interim Evaluation of the Northern Regional Operational Programme.

On a national scale, INESC TEC continued its support for the development and operation of innovation ecosystems. This included participation in 11 Clusters and 12 CoLABs (Collaborative Laboratories), with academic and business partners, to exploit knowledge generated in research institutions and tackle significant societal challenges. INESC TEC actively participated in the Council of Associate Laboratories, contributing to the preparation of legislation and funding programs, and contributed to the National Semiconductor Strategy.

The Institute also maintained its role in hosting the National Coordination of the UT Austin Portugal Program, a key actor in fostering collaborations with the US, and oversaw the installation of Deucalion, Portugal's premier supercomputer, at the University of Minho on the Azurém Campus in Guimarães.

Through Enhanced Capability
In 2023, INESC TEC's Public Policy Office had its first full year of operation. This new organisational structure was established to enhance the involvement of the Institute's community with public policies, aiming to promote the effective application of scientific evidence generated by INESC TEC research among public entities and policymakers.

PlanApp organised a training workshop titled "Science and Public Policy: How to Build Bridges Between Researchers and Policymakers?" for INESC TEC researchers. This initiative aimed to narrow the gap between science and public policy by fostering the development of evidence-informed policies. It also sought to raise awareness and empower the scientific community to address this need. Moreover, INESC Brussels HUB crafted policy and intelligence briefs that mirror the research focus of INESC TEC, advocating for EU policies that align with and support its research and innovation goals.

WE ARE SCIENCE.
WE ARE TECHNOLOGY.
WE ARE INNOVATION.
WE ARE INESC TEC.

CAMPUS DA FEUP
RUA DR. ROBERTO FRIAS
4200-465 PORTO
PORTUGAL

T +351 222 094 000
INFO@INESCTEC.PT
WWW.INESCTEC.PT

INESCTEC | INSTITUTE FOR SYSTEMS AND COMPUTER ENGINEERING, TECHNOLOGY AND SCIENCE

FUNDING INSTITUTIONS

fct Fundação para a Ciência e a Tecnologia

FITEC Fundo de Inovação, Transferência de Tecnologia e Economia Circular | PI PROGRAMA INTERFACE | Programa Nacional de Reformas | REPÚBLICA PORTUGUESA

This work is financed by National Funds through the Portuguese funding agency, FCT - Fundação para a Ciência e a Tecnologia, within project LA/P/0063/2020.