INSTITUTE FOR SYSTEMS
AND COMPUTER ENGINEERING,
TECHNOLOGY AND SCIENCE

INESCTEC

INESC TEC PRESENTATION

from knowledge
generation to
science-based
innovation

INESCTEC

INESC TEC
IN BRIEF

35 YEARS
LEADING R&D
IN ENGINEERING

We cover the knowledge-to-value production chain
We transfer knowledge, technologies and people
We enable science-based innovation
We offer advanced consulting and training
We create spin-offs

WE ARE **NETWORKED INTELLIGENT SYSTEMS**
WE ARE **POWER AND ENERGY**
WE ARE **INDUSTRIAL AND SYSTEMS ENGINEERING**
WE ARE **COMPUTER SCIENCE**
WE ARE **INESC TEC**

PERVASIVE INTELLIGENCE
WITH SOCIAL RELEVANCE

INESCTEC

OUR MISSION

FOSTER PERVASIVE INTELLIGENCE

Contribute to **Portuguese companies and institutions' competitiveness and internationalisation**

OUR MISSION
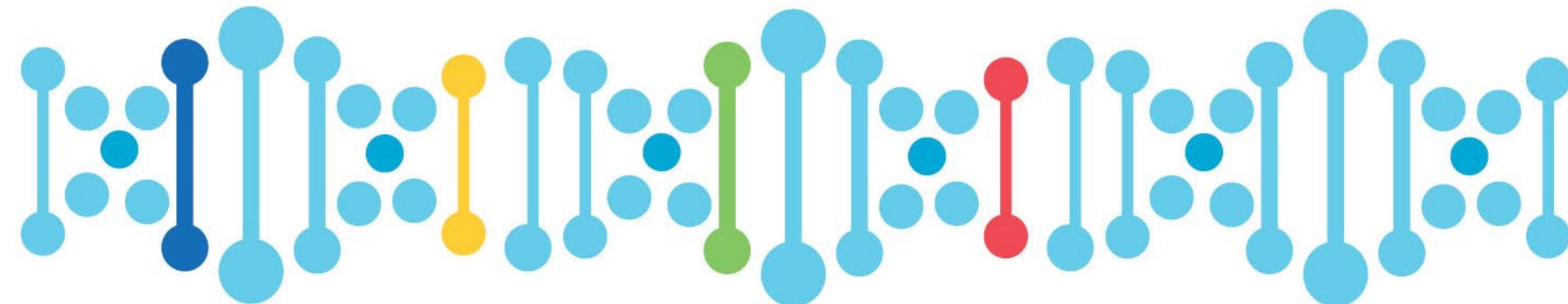
EXCEL IN RESEARCH

To be **socially relevant** and **internationally influential**

OUR VISION

RELEVANT PLAYER
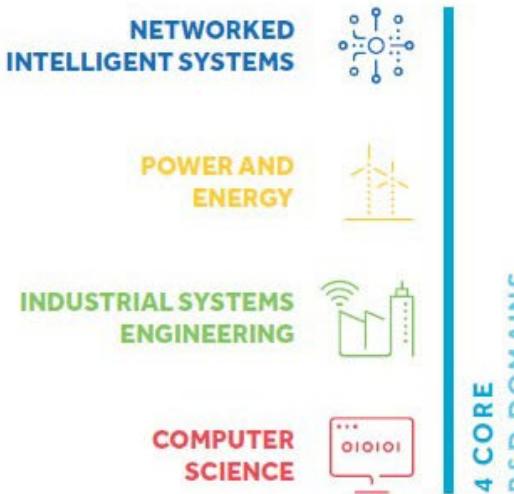
To be a relevant international player in science and technology in the domains of **Networked Intelligent Systems**, **Power and Energy**, **Industrial and Systems Engineering** and **Computer Science**

A UNIQUE MANAGEMENT MODEL
TURNING SCIENCE INTO ECONOMIC VALUE

INESCTEC

RESEARCH
CLUSTERS BEHIND SCIENCE PUSH

Clusters of research centres build a multidisciplinary environment to optimise resources and maximise synergies

INNOVATION
TEC4 BEHIND MARKET PULL

Strategy-driven platforms addressing and impacting great societal challenges and market needs

NETWORKED INTELLIGENT SYSTEMS

POWER AND ENERGY

INDUSTRIAL SYSTEMS ENGINEERING

COMPUTER SCIENCE

4 CORE R&D DOMAINS

TEC4 AGRO-FOOD

TEC4 ENERGY

TEC4 HEALTH

TEC4 INDUSTRY

TEC4 SEA

5 PLATFORMS SOCIETAL CHALLENGES AND MARKET NEEDS

A MARKET-BASED APPROACH
TEC4s TO ADDRESS REAL WORLD CHALLENGES (MAIN MARKETS)

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TEC4
AGRO-FOOD

Co-shaping the digital (r)evolution in agro-food and forestry

TEC4
ENERGY

Decarbonisation and digitalisation of the energy sector

TEC4
HEALTH

User-centred ICTs to improve health care and personal wellbeing

TEC4
INDUSTRY

Foster transformation for an innovative, collaborative, human-centred, digital and sustainable industry

TEC4
SEA

Bringing the autonomous and digital worlds to a sustainable sea economy

A MULTIDISCIPLINARY ENVIRONMENT
COMPETENCIES ORGANISED IN CLUSTERS TO MAXIMISE SYNERGIES

NETWORKED INTELLIGENT SYSTEMS

- Applied Photonics
- Biomedical Engineering Research
- Robotics and Autonomous Systems
- Telecommunications and Multimedia

POWER AND ENERGY

- Power and Energy Systems

COMPUTER SCIENCE

- Advanced Computing Systems
- Artificial Intelligence and Decision Support
- High-Assurance Software
- Information Systems and Computer Graphics

INDUSTRIAL AND SYSTEMS ENGINEERING

- Enterprise Systems Engineering
- Industrial Engineering Management
- Innovation, Technology and Entrepreneurship
- Robotics in Industry and Intelligent Systems

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MULTIFACETED TEAMS
GROWING IN EXCELLENCE
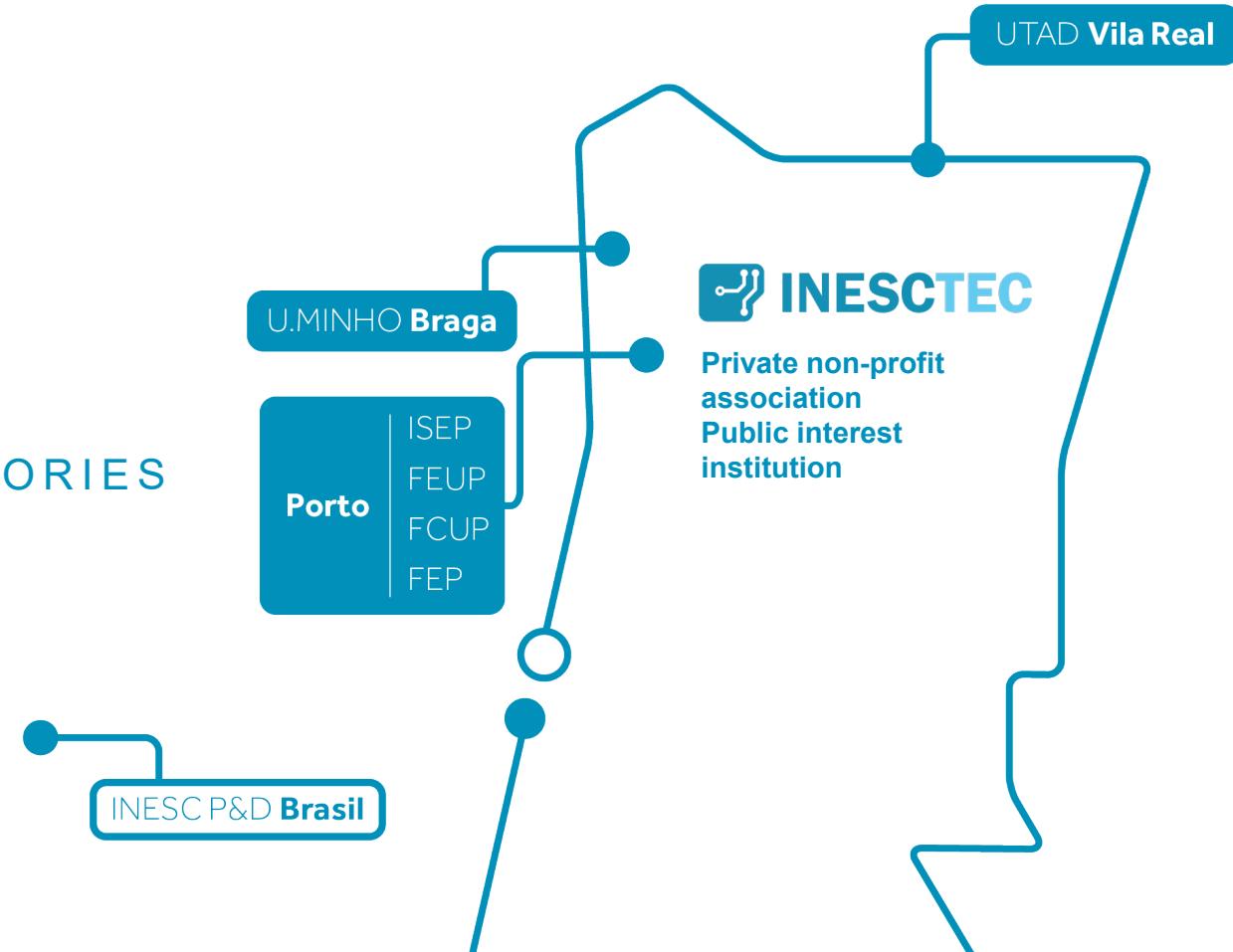
INESCTEC

6 SITES

3 CITIES

19 LABORATORIES

UTAD **Vila Real**

U.MINHO **Braga**

INESCTEC

Private non-profit association
Public interest institution

Porto
ISEP
FEUP
FCUP
FEP

A mirror organisation
INESC P&D Brasil coordinates the joint work of research groups within its associates (belonging to 18 top Brazilian universities and INESC TEC).

INESC P&D **Brasil**

A TALENT INCUBATOR
CHOOSING PEOPLE AS THE DRIVING FORCE

+800
INTEGRATED RESEARCHERS

+350
INTEGRATED PHDS

+25
NATIONALITIES

+200
PEOPLE GOING TO THE MARKET/YEAR

Our researchers constitute the foundations of our strategy. INESC TEC is one of the **leading Portuguese organisations in scientific employment**.

INESC TEC is also a **hub of talent**, with more than 200 professionals from 18 countries transferred to market per year.
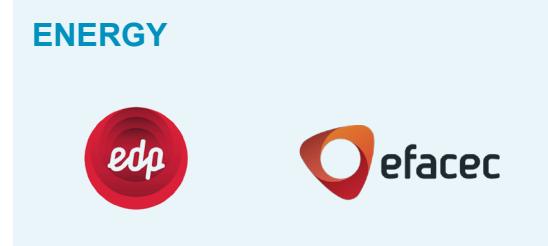
INESC TEC

SOME OF OUR MOST IMPORTANT CLIENTS

A RELEVANT ROLE IN THE ECOSYSTEM

INESCTEC

AGRO-FOOD

AMORIM CORK COMPOSITES

Herculano Trailers and Machinery for Agriculture

ASSOCIATIONS

COTEC Portugal

ORDEM DOS ARQUITECTOS

AUTOMOTIVE

BOSCH

MABOR

CATERING

gertal

MINT AND OFFICIAL PRINT OFFICE

iNCM

ENERGY

edp

efacec

REN

galp

EDA Electricidade dos Açores

Vestas

SIEMENS

Electricidade da Madeira

FINANCING

NATIXIS

HEALTH

centro hospitalar do Porto

INDUSTRY

KYAIA

IKEA

A.SILVAMATOS METALOMECÂNICA

Riduba

MTEX SOLUTIONS

PRECISÃO LASER

SOFTWARE

outsystems

randtech computing

Critical manufacturing

AppGeneration digitally powered

TELECOMMUNICATIONS

wavecom

eurico ferreira Portugal

SPACE

esa European Space Agency

LOCAL ADMINISTRATION

maia CÂMARA MUNICIPAL

TRANSPORTATION

APDL ADMINISTRAÇÃO DOS PORTOS DO DOURO, LEIXÕES E VIANA DO CASTELO

Infraestruturas de Portugal

INTERNATIONALISATION
PUTTING INESC TEC ON THE EUROPEAN AND INTERNATIONAL MAPS

INESC Brussels HUB
5 organisations of the INESC holding

European KICs
EIT Raw Materials
EIT Manufacturing
EIT Digital

EARTO
European Association of Research and Technology Organisations

EFFRA
European Factories of the Future Research Association

AIR Centre
Atlantic International Research Centre

French Ministry of Higher Education, Research and Innovation
French companies benefit from a tax credit for contracted R&D services provided by INESC TEC

INESC P&D Brasil
New associates

MoUs with research organisations
Japan (AIST e NICT)
India (NIO, NCPOR
IIT Goa, NIT Goa
and TERI)

And more…

INESCTEC

SCIENTIFIC ADVISOR FOR PUBLIC POLICIES
AN ESSENTIAL PARTNER FOR NATIONAL STRATEGIC ORIENTATIONS

Active role in S&T administrative simplification
National level (OE, P2020 and P2030)

Permanent involvement in the update of the smart specialisation
Regional and national level in the institute's areas of expertise

Scientific and technical coordination of the Minho Advanced Computing Center, home of Deucalion a EuroHPC supercomputer
Deucalion, the second largest computer in the world supported by ARM processors, with hybrid architecture

Participation in several Collaborative Laboratories
Leading entity of ForestWISE CoLAB

FORESTWISE   BUILT   B2E   VINES&WINES   VORTEX   VASCO DA GAMA   +ATLANTIC   FEEDINOV   SFCOLAB   SMART ENERGY LAB   AQUAVALOR
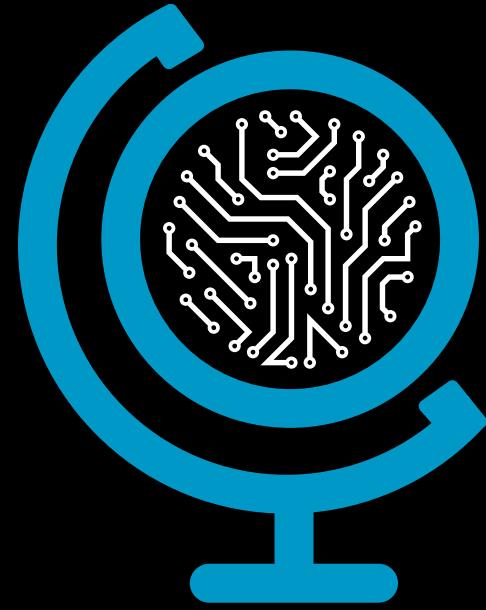
IMPACT
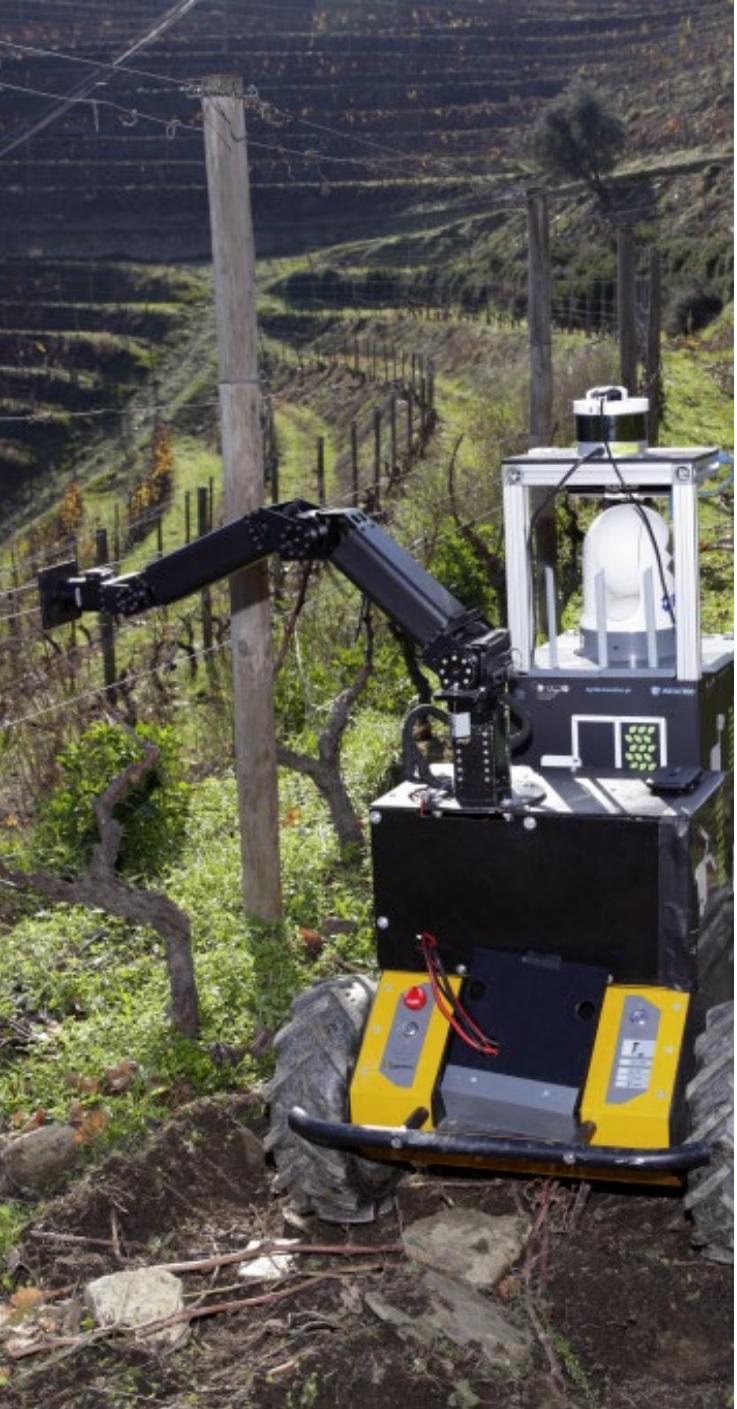
TEC4 AGRO-FOOD

Co-shaping the digital (r)evolution in Agro-Food and Forestry

Co-shaping the digital (r)evolution in Agro-Food and Forestry through research and technological development in Information and Communication Technologies and Electronics (ICT&E) and Robotics.

TEC4
AGRO-FOOD

Main innovation services

Advanced Consulting and Research and Technological Development in:

- Smart Precision Agriculture and Forestry
- Food Security
- Bioeconomy

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TEC4 AGRO-FOOD

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RoMoVi

Modular and cooperative robot for steep slope vineyards

Robotic components and mobile platform, modular and extensible, for use in steep slope vineyards, capable of carrying out monitoring and logistical operations independently.

SMART FERTILIZERS

Slurry tankers for precision fertilisation in the context of agriculture 4.0

Smart and cost-effective slurry tankers to increase the efficiency of the fertilisation operation in the environmental, agronomic and economic components.

TEC4 AGRO-FOOD

INESCTEC

DEMETER

Building an interoperable, data-driven, innovative and sustainable European agri-food sector

Large-scale deployment of farmer-driven, interoperable smart farming-IoT based platforms, delivered through a series of 20 pilots across 18 countries (15 EU countries).

SCORPION

Cost effective robots for smart precision spraying

Focus on steep slope vineyards but with impact on other high-value permanent crops (olive groves and fruiticulture).

TEC4
AGRO-FOOD

INESCTEC

FOCUS

Advances in forestry control and automation systems in Europe

To develop integrated planning and control systems for forestry based supply chains.

BIOTECFOR

Biobusinesses and technology for efficient valorisation of endogenous forestry resources in the North of Portugal and Galiza

Increasing the development of the Green Economy and maximise the utilisation efficiency of the forestry resources.

TEC4 ENERGY

Decarbonisation and digitalisation of the energy sector

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.

INESCTEC

TEC4 **ENERGY**

Main innovation services

- Energy conversion and power electronic converters
- Optimisation of electrical network operation
- Power systems expansion planning
- Large scale integration of RES and DER in power systems
- Energy efficiency
- Managing electric mobility grid integration
- Energy management systems

- Electricity markets and regulation
- Asset management and predictive maintenance for power system components
- Power system digitalisation (smart metering, IoT, big data and cybersecurity)
- Advanced sensing for power system operation
- Laboratory services for smart grid solutions testing

INESCTEC

TEC4 ENERGY

FLAGSHIP PROJECTS

INTERCONNECT

Interoperable solutions connecting smart homes, buildings and grids

The biggest European project led by a Portuguese entity to deliver more efficiency to consumers' energy use.

EFACEC DMS

Advanced modules for DMS (Distribution Management Systems)

EFACEC DMS was installed all over the world (CERN, Tunisia, Algeria, Romania, Vietnam, Brazil, Mozambique, Greece and Portugal).

TEC4 ENERGY

INESCTEC

INOVGRID

The first smart city in Portugal

After the pilot in Évora, InovGrid allowed EDP to introduce the concept of cities with an integrated and smart electrical system in Portugal, Spain and Brazil.

MERGE

Mobile energy resources for grids of electricity

Evaluating the impacts that plug-in electric vehicles will have on the EU electric power systems regarding planning, operation and market functioning.

TEC4 HEALTH

User-centred ICTs to improve health care and personal wellbeing

Inducing human-centred systems engineering towards personalised medicine, healthier life style and better health systems management.

INESCTEC

TEC4 HEALTH

Main innovation services

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

TEC4 HEALTH

FLAGSHIP PROJECTS

INESCTEC

LNDetector

A computer-aided diagnosis (CAD) system for lung nodule diagnosis

Automatic detection, segmentation and classification of pulmonary nodules system in computed tomography images.

3dBCT

3D models for aesthetic evaluation and prediction of breast cancer interventions

A decision support system using pattern recognition techniques to objectively evaluate the overall aesthetic result of breast cancer treatments.

TEC4 HEALTH

FLAGSHIP PROJECTS

INESCTEC

RADAR

Autonomous robot for disinfection in hospitals

360º cleaning of closed spaces using ultraviolet-C radiation, effectively eliminating all bacteria and viruses.

RECAP

Research on European children and adults born preterm

To improve the health, development and quality of life of children and adults born preterm or with low weight.

TEC4 INDUSTRY

Foster transformation for an innovative, collaborative, human-centred and sustainable industry

Converging knowledge and competencies towards solutions for the Retail and Manufacturing Industry.

INESCTEC

TEC4
INDUSTRY

Main innovation services

- Digital Maturity assessment and roadmapping
- Resilience and optimisation in operations
- Advanced simulation for factory design and operational planning
- Adaptable, autonomous and collaborative robotics
- Predictive maintenance and consumer forecasting
- Business model innovation and technology management
- Advanced training in industry 4.0 and emergent technologies

TEC4 INDUSTRY

FLAGSHIP PROJECTS

SCALABLE 4.0

Scalable automation for flexible production systems

Using integrated collaborative robotics with production management and simulation systems in order to dynamically adapt the automation levels to the production needs.

FASTEN

Flexible and autonomous manufacturing systems for custom-designed products

An open and standardised framework to produce and deliver fast and autonomously low-cost and tailor-designed products.

TEC4 INDUSTRY

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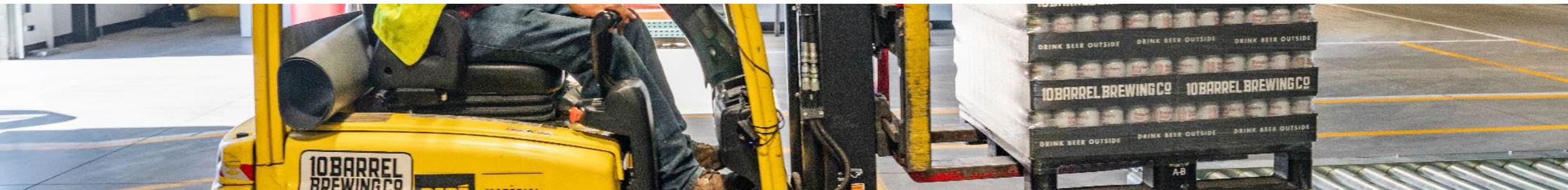
ADAPTPACK

Adaptive and modular robotic palletising systems with high flexibility

Agile system development and highly flexible modular architecture to significantly reduce the design, construction and assembly times of new equipment.

TRUST AI

Transparent, Reliable and Unbiased Smart Tool for Artificial Intelligence

Creating a disruptive tool that can be applied to different sectors where human intervention still plays a vital role, such as healthcare, retail, energy, banking, public administration and insurance.

TEC4
SEA

Bringing the autonomous and digital worlds to a sustainable sea economy

Inducing R&D activities targeting sea and deep-sea challenges towards a sustainable Sea Economy.

INESCTEC

TEC4 **SEA**

Main innovation services

- Development of optical and biosensors
- Broadband communications solutions
- Heterogeneous data integration and management
- Development of virtual and augmented reality solutions
- Offshore RES and multiple energy vectors integration
- Digital Twins, logistic 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

INESCTEC

TEC4
SEA

INESCTEC

TURTLE

Autonomous robotic deep sea lander

First underwater robotic platform for deep water fully developed in Portugal. It is capable of staying at the bottom of the sea for long periods of time, and autonomously relocating itself and surfacing for maintenance operations.

BLUECOM+

Cost effective broadband communications at remote ocean areas

Networked tethered balloons working as wireless access points, enabling the extension of broadband Internet access from land and the use of standard access technologies in shore zones.

TEC4 SEA

INESCTEC

SEABIODATA

Portuguese seamounts biodiversity data management

Data management system (physical, chemical, ecological), integrating info from campaigns and data from observations, improving ecosystems surveillance and monitoring.
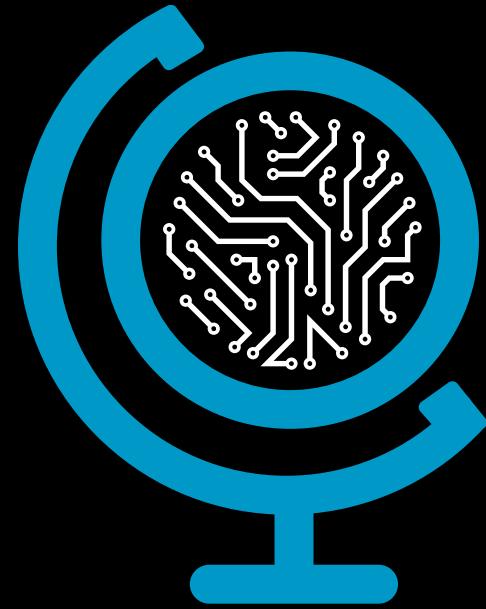
MARINEYE

Multitrophic oceanic monitoring
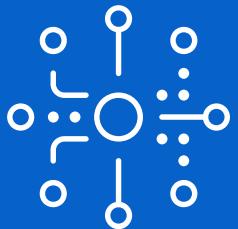
An innovative multitrophic autonomous system with adequate sensors and sufficient autonomy and robustness to improve the integrated physical-chemical and biological monitoring of the marine environment.

COMPETENCIES

Towards autonomous networked intelligent hybrid systems enabled by ubiquitous sensing and processing of information

NETWORKED INTELLIGENT SYSTEMS

Research Lines
— Sensing
— Communications
— Computer Vision
— Autonomous Systems
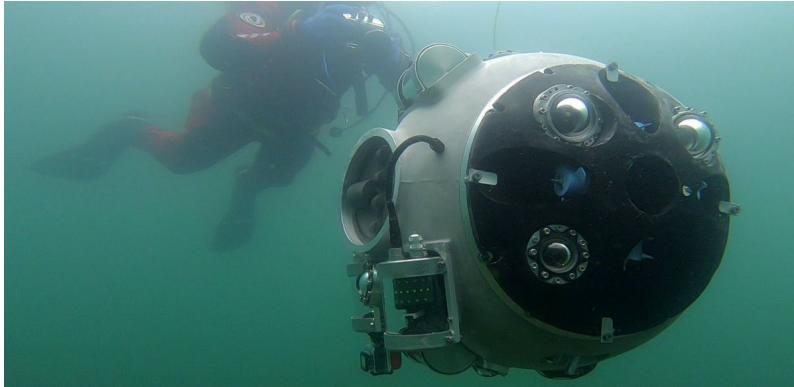
NETWORKED INTELLIGENT SYSTEMS

Futuristic scenarios

- **Networked systems collect information in extreme environments** (deep sea or human body)

- Process it using **artificial intelligence tools**

FEATURED R&D ACHIEVEMENTS

UNDERWATER MINE EXPLORER ROBOT
Real-world validation in experiments of an autonomous robot for exploration of flooded mines. This robot is endowed with multiple sensors for extended perception of the environment allowing its autonomous operation inside flooded galleries.

LABEL FREE METHOD FOR MEDICAL ANALYSIS
New method and corresponding sensing system for direct analysis of biological entities in complex solutions. It deals with AI analysis of backscattered signals from optically trapped cells or biomolecules and has a very strong potential for medical and environment applications.

NETWORKED
INTELLIGENT SYSTEMS

FEATURED R&D ACHIEVEMENTS
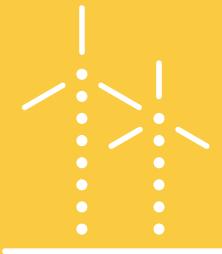
REGION IDENTIFICATION IN IMAGES AND VIDEO FRAMES
Flexible strategies combining computer vision techniques and deep machine learning models for processing images and videos, while seeking to minimise required training data and favouring online training.

RAMAN ENDOSCOPY
Development and application of Raman fiber endoscopy based on new fibers such as hollow core PCFs and plastic fibers. The fiber endoscope aims to detect cancer tumors by Raman spectroscopy, complementing existing characterisation methods.

NETWORKED INTELLIGENT SYSTEMS

INESCTEC

A digital and decarbonised energy system

POWER
AND ENERGY

Research Lines
— Towards 100% RES integration and Massive integration of power electronic-based interfaces
— Large-scale modelling and optimisation of energy systems
— Data-driven methodologies for energy systems
— Asset management and predictive maintenance
— Cybersecurity and IoT for critical infrastructures

INESCTEC

POWER AND ENERGY

Transformation of the energy sector towards the full decarbonisation of the power system

- **Energy efficiency and Renewable-based Energy Sources** (RES) integration

- Use of advanced **mathematical modelling and digital technologies**

INESCTEC

FEATURED R&D ACHIEVEMENTS

DIGITALISING THE POWER SYSTEM
The biggest European project ever led by a Portuguese entity started in 2019. INESC TEC is responsible for the InterConnect's leadership, a €36M project, with 51 partner institutions from 11 European countries, which aims at digitalising the power system.

NEW SOLUTIONS TO IMPROVE THE ELECTRICITY NETWORK
INESC TEC is the technical coordinator of H2020 InteGrid project that brings together 14 partners and is funded at around €15M. Within InterGrid's scope, a total of 175 residential and business participants started the testing of new solutions aimed at improving the functioning of the electricity network.

POWER AND ENERGY

INESCTEC

FEATURED R&D ACHIEVEMENTS

IMPROVING HYDROELECTRIC POWER PLANTS

The development of new technology solutions to improve the performance of hydroelectric power plants. This is the goal of the €18M European project XFLEX Hydro.

INTEGRATION OF RENEWABLE ENERGY SOURCES

EU-SysFlex project aims at promoting the identification of possible constraints and solutions allowing the large-scale integration of electric energy produced from renewable sources, maintaining and optimising the current levels of service quality for consumers in the European electricity system.

POWER AND ENERGY

INESCTEC

Leading complex decision-making in end-to-end, customer-centric, sustainable and agile supply chains

INDUSTRIAL AND SYSTEMS ENGINEERING
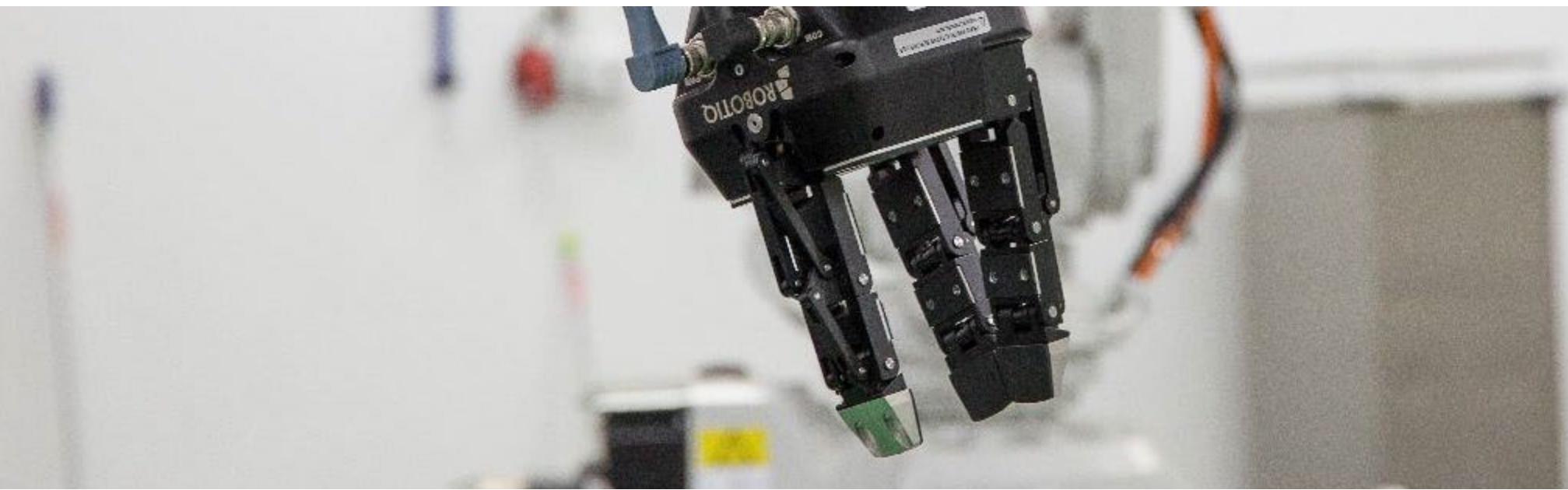
Research Lines
— Operations Management in manufacturing and services
— Operations Research and Management Science: decision support in a digitised industry
— Industrial Information Systems
— Autonomous Systems
— Technology enabled Innovation and Service Design

INDUSTRIAL AND SYSTEMS ENGINEERING

Fully integrated supply chain across different industries

- Highly flexible, adaptable and intelligent **automation**, **control and robotics**

- Smart **sensor networks**

- Industrial **IoT- based information architectures**

- **Human-robot interface** and responsive collaboration

FEATURED R&D ACHIEVEMENTS

COLLABORATIVE ROBOTS

Integration of augmented reality in collaborative robotics systems in the structural steel sector, and overview of the use of collaborative robots in industry 4.0 regarding the human role and safety.

MATHEMATICAL PROGRAMMING-BASED HEURISTICS

New insights were obtained on how to deal with uncertainty and hybridise heuristics and mathematical programming (matheuristics). These approaches have been applied on emerging topics related to car-sharing.

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INDUSTRIAL AND SYSTEMS ENGINEERING

FEATURED R&D ACHIEVEMENTS

INDUSTRIAL AND SYSTEMS ENGINEERING
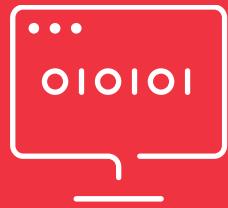
LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Multiple vehicle synchronisation in a full truck-load pickup within the biomass supply chain. New ways of exploring the marketing-operations interface in the delivery service model in grocery retail.

ASSET MANAGEMENT

Predictive and prescriptive models for asset management and reliability engineering to control the health status across the whole life cycle of the asset (e.g. a health index for the hydropower system to monitor the effects of the newly designed flexible power services).

Powering dependable digitalisation

COMPUTER SCIENCE

Research Lines
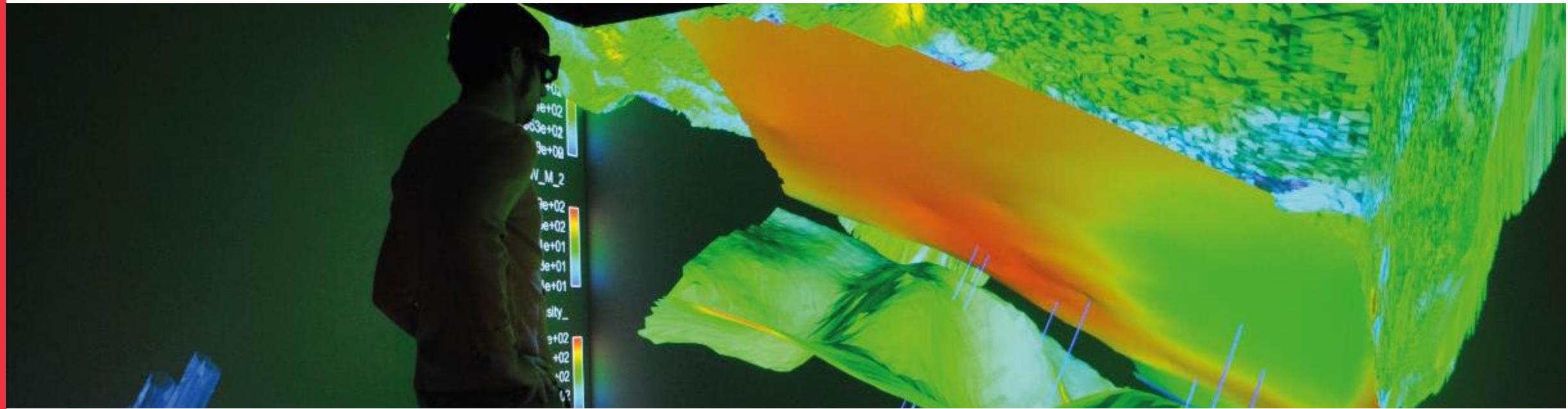
— Artificial Intelligence
— Cyber Security
— Computer Graphics and Virtual Environments
— Information Management Systems
— Decision Support Methods
— Parallel and Distributed Systems
— Software Engineering

INESCTEC

COMPUTER SCIENCE

Information and communications systems evolution

- As computing became **fully decentralised, mobile, autonomous and ubiquitous,**

hard and intricate challenges came along, associated to **scalability, security and criticality**

FEATURED R&D ACHIEVEMENTS

CREATION OF INESC TEC'S DATA SCIENCE HUB

This hub promoted several scientific initiatives together with the other clusters, such as project proposals, a workshop with the Imperial College's Data Science Institute, an advanced training action and the first iteration of INESC TEC's data science toolbox.

CONSULTANCY CONTRACT WITH AMAZON

In 2019, INESC TEC delivered the outcomes of the consultancy contract with Amazon, established to assess the security of one of their critical Amazon Web Services.

FEATURED R&D ACHIEVEMENTS

RESEARCH DATA ALLIANCE PORTUGAL
INESC TEC created and promoted the Research Data Alliance Portugal (RDApt) node, a member of the RDA Europe 4.0, which aims to lead a EU Open Science Strategy through a consolidated European network of National Nodes.

OPTIMISATION RESEARCH
INESC TEC's research on the efficiency and optimisation of special purpose computing systems was published in ACM Computing Surveys and the IEEE Transactions on Very Large Scale Integration Systems.

OUR LABORATORIES
## DEMONSTRATION, EXPERIMENTATION AND ADVANCED TRAINING

LABORATORY OF SMART GRIDS AND ELECTRIC VEHICLES *

IILAB - INDUSTRY AND INNOVATION LAB

LABORATORY OF INDUSTRIAL ROBOTICS AND AUTOMATION

LABORATORY OF ROBOTICS AND IOT FOR SMART PRECISION AGRICULTURE AND FORESTRY
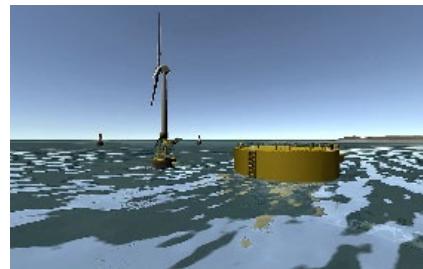
ROBOTICS AND AUTONOMOUS SYSTEMS LABORATORY

TEC4SEA RESEARCH INFRASTRUCTURE *

EMSO PT - EUROPEAN MULTIDISCIPLINARY SEAFLOOR AND WATER COLUMN OBSERVATORY *

ATLANTIS LABORATORY


LABORATORY OF SOFTWARE ENGINEERING

MASSIVE - LABORATORY OF COMPUTER GRAPHICS AND VIRTUAL ENVIRONMENTS
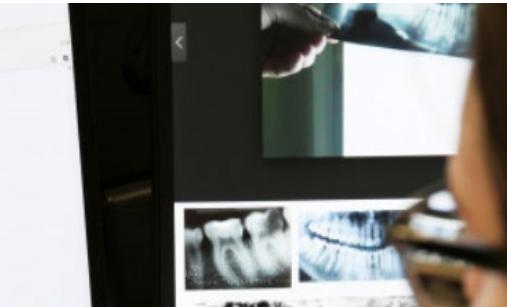
* Roadmap for strategic infrastructures in Portugal

OUR LABORATORIES
DEMONSTRATION, EXPERIMENTATION AND ADVANCED TRAINING
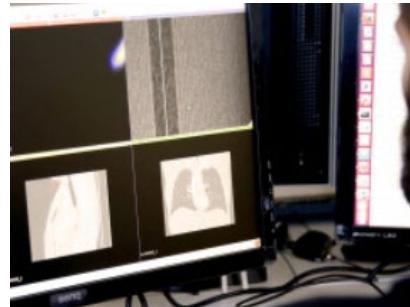
LABORATORY OF SOUND AND MUSIC COMPUTING
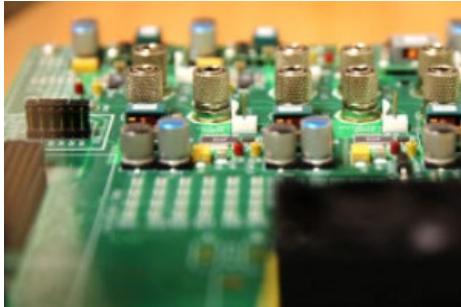
BIOMEDICAL IMAGING LABORATORY

NEUROENGINEERING AND ADVANCED HUMAN SENSING LABORATORY
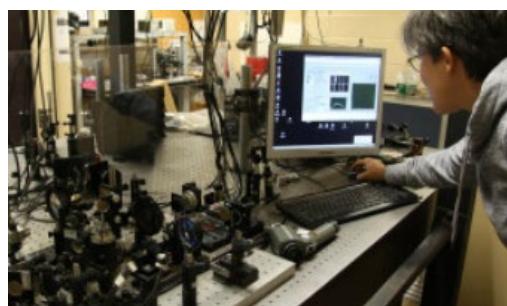

BIOINSTRUMENTATION LAB

OPTICAL AND ELECTRONIC TECHNOLOGIES RESEARCH LABORATORY

LABORATORY OF MICROFABRICATION

IMAGING LABORATORY

CLOUDINHA LABORATORY

INFORMATION SYSTEMS LABORATORY

Campus da Faculdade de
Engenharia da
Universidade do Porto

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