INESC TEC INTERNATIONAL VISITING RESEARCHER PROGRAMME 2025 EDITION

Call Announcement

Deadline: June 13, 2025

Introduction

The **Institute for Systems and Computer Engineering, Technology and Science – INESC TEC** is pleased to announce the opening of the **INESC TEC International Visiting Researcher Programme (IIVRP) – 2025 Call for Applications.**

INESC TEC is a world-class R&D organisation in the field of ICT, which supports the advanced training of researchers and their active participation in international collaborative networks. The institution is strongly committed to promoting intercultural awareness and understanding in the research arena.

This new Call builds on the success of previous IIVRP editions and aims to complement other mobility funding schemes managed by INESC TEC. The 2025 edition is open to applications from **senior researchers worldwide** who wish to collaborate with an INESC TEC host and their team on world-class, curiosity-driven research across various scientific fields aligned with INESC TEC's global presence. **Bright PhD and Master's students affiliated with foreign organisations** are also welcome to apply, though preference will be given to senior researchers.
For this Call, the topics that candidates may pick to frame their applications are listed in Appendix I of this announcement.

Supported visits shall encourage **long-lasting international research partnerships**, **research through co-authored publications** and **collaborative research funding proposals** among other potential collaborative scientific outcomes. It is fundamental that both the hosts and the visitors themselves regard this scheme as a first step towards developing the partnership further beyond the funded visit. The scheme welcomes visitors who are establishing a partnership with INESC TEC hosts for the first time or who already have some collaboration going on but want to deepen their relationship with INESC TEC.

We will be accepting applications until **June 13 (23:59 UTC+1), 2025**. Research visits may begin any time from **September 30, 2025**, and must conclude no later than **July 31, 2026**. Each visit should last between **one and three months**.

Applicants admitted to the scheme will benefit from an immersive experience in INESC TEC's ecosystem to explore and develop collaborations in the institution's fields of knowledge, engage in interdisciplinary and collaborative research with scientific peers and acquire and transfer new knowledge. During their stay, they are also expected to engage in events organised by INESC TEC and prepare internal and/or public-facing activities whereby they can present the research work they are undertaking at INESC TEC.

Candidate Profile and Eligibility Requirements

For this edition, INESC TEC will only accept applications from **individuals affiliated with universities or other research-performing organisations outside of Portugal**, regardless of their nationality. Candidates admitted to this edition are expected to retain their affiliation with the home institution during their intake at INESC TEC.

The program is primarily aimed at senior researchers, but outstanding PhD and Master's students from foreign institutions may also apply

Individuals who have already been visiting researchers in the previous editions of the IIVRP are not excluded from submitting a new application for the current Call. However, they will not be considered first-time applicants, and their applications will lose priority to new candidates.

How to Apply

Applicants meeting, in principle, the eligibility requirements (see Candidate Profile and Eligibility Requirements) and sought profiles must first identify one topic from the **list of available research topics (see** here**)** proposed by INESC TEC, and aligning with their interests and those of their home institution.

Each topic has at least a scientific host at INESC TEC, who will act as an **INESC TEC Host.**

When choosing a topic, applicants may interact with INESC TEC's hosts for questions strictly related to the scope of the work underpinning the topic. However, at this stage, applicants are discouraged from sending any documents required by the application process to their potential hosts.

To apply for a research visit at INESC TEC, applicants must fill out and submit **this online application form** with the following documents **in English** attached:

- Complete CV - the CV must have a maximum of 2 pages (font-size: 11 points) and include the **Google Scholar URL**;
- A one-page motivation letter that should clearly state the proposed research objectives and their potential impact beyond the visiting period; applicants must demonstrate a clear and explicit vision for achieving joint outcomes such as international co-authored publications, policy briefings, or funding applications;

- A letter of support from their supervisor/manager at the home institution on official letterhead, **confirming their agreement to the applicant visiting INESC TEC** under the Programme[1] and **providing sound arguments for their support.**

Evaluation

As applications come in, INESC TEC's International Relations Service will be performing eligibility checks. Applications based on incomplete forms, with missing mandatory documents or that diverge substantially from our specifications (e.g. being written in a language other than English) will be rejected without further review.

After the submission deadline, an evaluation panel appointed by the Board of Directors of INESC TEC will analyse applications moving forward. The host(s) of the topics picked by the applicant will also be required in the first instance to assess if the candidate(s) potentially match the profile sought.

Applications will be reviewed against the following criteria:

- **Applicant's suitability:** Does the candidate's profile make them suitable to carry out the proposed work?
- **Impact:** Is there a strong likelihood of significant outcomes arising from the visit, including international co-authored publications, policy briefings, advancement of the relevant academic field, and/or funding applications?
- **Sustainability and legacy**: Is there convincing evidence of the sustainability and legacy of the collaboration beyond this investment, with potential long-term benefits for INESC TEC and the candidate's home institution?
- **International projection:** Does this collaboration have the potential to improve INESC TEC's international standing in a given research line/area?

During the evaluation period, the panel may wish to interact further with applicants to clarify any information in their applications. Applicants should be available to hold a virtual meeting or respond to questions by e-mail from the panel or a panel member.

All applicants shall be notified of the panel decision and whether they will receive financial support under this Call by e-mail (with a delivery receipt notification), **normally six weeks after the submission period ends. If we receive a high volume of applications, we may need more time to notify candidates.**

[1] Applicants are accountable for informing their home institution about the intention to apply for this research programme and ascertaining whether their full-time participation potentially creates any conflicting issues with their home institution, including regarding IP matters.

Financial Assistance and Mobility Contract

For the period of the visit, INESC TEC will confer upon admitted applicants the status of Visiting Researchers. Admitted applicants must retain their primary affiliation to their home institution throughout the visit, and any changes to this status should be immediately communicated to INESC TEC.

Admitted applicants will sign a mobility contract that specifies not only the rights and duties of admitted applicants but also the components of the financial assistance they are entitled to after being accepted into the Programme:

- Monthly allowance[2]: net amount of 1600 Euros to cover living expenses for each month of the mobility period.
- One-off travel allowance: €350 euros for travels within Europe and €750 for travels outside of Europe.
- Work accident insurance.[3]

The contract will be signed before the start of the mobility period, with admitted applicants receiving an up-front instalment corresponding to 50% of the monthly allowance plus travel allowance. The payment plan will be detailed in the contract.

If admitted candidates fail to comply with any requirements established by this Call, the mobility contract, or INESC TEC's policies applicable to external staff visiting the Institute, they may be forced to return all the funding received from INESC TEC under the Programme.

Admitted applicants are responsible for their own housing and accommodation. However, they may contact the IIVRP Team or the Admin Assistant of their host Centre for guidance on these and other matters, such as visas (if applicable). Applicants are welcome to bring their families, but INESC TEC cannot assist with the related formalities.

Visit extensions under the IIVRP will not be allowed.

Work Plans

Work Plans must underpin all visits supported through this Programme and should align with the research topic proposed by INESC TEC while fitting applicants' research needs and goals. They

[2] The funds granted are chargeable as income by the Portuguese tax system. The monthly allowance mentioned will be the amount transferred by INESC TEC, assuming that the visiting researcher presents a certificate of fiscal residence and fills out the tax form RFI (to be provided by INESC TEC services) to avoid double taxation in Portugal. More information here.

[3] Visiting Researchers should check if they need other types of insurance, and if so, arrange it before arriving in Portugal. Examples include health and travel insurance.

should also set the proper context for two-way knowledge transfer between the applicant and INESC TEC and potential collaborations extending beyond the internship.

Before the visit starts, the scientific host at INESC TEC will arrange to meet virtually with the admitted applicant to discuss both parties' expectations regarding the work plan and its outcomes. The scientific host and the admitted applicant will work together to devise a realistic work plan ahead of the visit, with clear goals and outcomes.

Depending on the workplace of the host of the admitted applicant, the work plan can be carried out in one of INESC TEC's poles in Porto, Braga or Vila Real. **This scheme does not fund remote or hybrid visits, i.e., visitors are expected to travel to and stay in Portugal for the duration of their work plan, which must be from one to three consecutive months long.**

The working languages are English and Portuguese.

Acknowledgements and Reporting

All activities funded through this scheme must be branded and advertised as an INESC TEC International Visiting Researcher Programme Award, and INESC TEC branding must be included on all associated documents and outputs, such as scientific publications or presentations.

Admitted applicants commit to submitting, a few days before the end of their mobility period, a report[4] detailing their progress against the goals set in the work plan. In writing their reports, admitted applicants should respect any restrictions on confidential information or intellectual property that may have been required by INESC TEC or their home institution. After completing the visiting research period and submitting their report, INESC TEC will issue a certificate of completion.

Since outcomes and impacts take time to be tracked, the IIVRP Team, for up to three years between January and March, will ask both the host and the admitted applicant to complete a short survey to capture how the relationship is progressing and any related outcomes of the visiting period at INESC TEC that were not captured by the post-visit report. Hosts and visitors not complying with this requirement may be deemed ineligible for future editions of the IIVRP.

Data Protection

For further information on how INESC TEC processes your personal data, please click on this link.

Non-Discrimination Policy

[4] As per a report model to be provided by INESC TEC.

INESC TEC actively promotes a policy of non-discrimination and equal access so that no candidate can be privileged, benefited, harmed or deprived of any right or exempted from any duty based on their country of origin, age, sex, sexual orientation, marital status, economic situation, education, genetic heritage, reduced capacity for work, disability, chronic illness, nationality, ethnic origin or race, language, religion, political or ideological convictions and trade union membership. INESC TEC celebrates diversity and is committed to creating an inclusive environment for all its employees and visitors.

Additional Information

- Financial assistance and cost of living in Portugal

The financial support granted to admitted candidates was estimated to help them cover most of their living expenses during their stay in Portugal and visit to INESC TEC. Nevertheless, we encourage all candidates to consider, while preparing their applications, all potential costs involved in their participation in such a mobility programme to understand if they might need to complement the monthly allowance with other funds (e.g.: personal savings, grants). For more information on the cost of living in Portugal, consult this website.

- Suggested reading on the cost of living in Portugal: Numbeo Cost of Living in Portugal.

Contacts for Queries

International Relations Service (SRI)

internationalrelations@inesctec.pt / + 351 22 209 40 19

The SRI has published a quick guide for foreign newcomers covering some topics of interest for potential applicants under this Programme.

Annexe 1 – List of Available Research Topics

Research Topic		Description of the research topic	Topic Owner and Co-Owner	Topic Owner and Co-Owner Email	Centre
1	Optimal Design and Real-Time Operation of Hybrid Renewable-Hydrogen-Storage Energy Systems	The proposed research focuses on the development of advanced tools for the optimal sizing and real-time operation of hybrid energy systems that integrate Renewable Energy Sources (RES), green hydrogen production (via electrolysers) and energy storage solutions. The goal is to design flexible and cost-effective energy facilities tailored to different use cases (e.g., industrial self-consumption, green H2 multi-offtaking, etc.). The research will explore novel optimization algorithms and AI-based control strategies that can adapt to dynamic market and grid conditions, with a focus on enabling real-time decision-making.	Filipe Joel Nunes Soares	filipe.j.soares@inesctec.pt	Power and Energy Systems
2	Optimisation of Hydrogen Injection in Natural Gas Networks	This research addresses the optimisation of hydrogen injection into natural gas distribution networks while ensuring compliance with operational and quality constraints. The model's purpose is to simulate a gas flow, integrating pipe flow dynamics, thermal demand, node elevation and gas blending to determine optimal hydrogen injection strategies across multiple nodes. It should enable the computation of several economic and environmental KPIs.	Filipe Joel Nunes Soares	filipe.j.soares@inesctec.pt	Power and Energy Systems
3	Hybrid Microgrid Control and Automation: Advanced Control Strategies for Grid-Forming Inverters in Renewable Energy Systems	Hybrid microgrids—integrating AC and DC sub-networks—offer a resilient and efficient platform to host high shares of renewables. This topic focuses on the development of control and protection strategies tailored for hybrid AC/DC microgrids, using real-time simulation and hardware-in-the-loop testing via OPAL-RT platforms. It aims to ensure stable operation and fault resilience under scenarios with high renewable penetration. The visiting researcher will contribute to model-based design, protection coordination, and	Habib Ur Rahman Habib	habib.habib@inesctec.pt	Power and Energy Systems

		energy transition strategies aligned with Fit for 55 and REPowerEU goals. Activities include building OPAL-RT-based hybrid microgrid testbeds, simulating inverter-based DER control, and testing adaptive protection schemes. The project supports INESC TEC's mission to lead in sustainable power system innovation and provides a collaborative platform for joint publications and future proposals.			
4	AI-Driven Predictive Maintenance for Renewable Energy Converters	This topic targets the development of machine learning-based predictive maintenance models for power electronic converters used in renewable energy systems—especially those in wind and solar applications. Drawing from extensive thermal and electrical stress data collected via real-time simulation and field measurements, the project aims to apply AI techniques such as Random Forests, Gradient Boosting, and Deep Learning to predict component degradation (e.g., IGBT wearout) and failure risks. The visiting researcher will work on data processing, model training, and validation using datasets from INESC TEC's simulation platforms (OPAL-RT and FLORIS). This research supports improved reliability, reduced downtime, and lower O&M costs in high-renewable grids. The visitor will contribute to model deployment, scenario testing, and possibly integrating these models into real-time protection or control systems.	Habib Ur Rahman Habib	habib.habib@inesctec.pt	Power and Energy Systems
5	Real-Time Co-Simulation for Grid-Forming Inverter Stability in High-Renewable Microgrids	This project focuses on developing a real-time co-simulation framework to assess the stability of grid-forming inverters (GFIs) in microgrids with high renewable penetration. It integrates real-time digital simulation (OPAL-RT), power hardware-in-the-loop (PHIL), and communication network emulation to investigate both small-signal and transient stability under realistic operational scenarios. Emphasis is placed on dynamic interactions between GFIs, communication delays, and seamless transition from grid-connected to islanded modes. The framework will enable experimental validation of advanced control strategies and uncover stability limits critical to the reliable operation of inverter-dominated grids. The visiting researcher will contribute to modeling,	Habib Ur Rahman Habib	habib.habib@inesctec.pt	Power and Energy Systems

		experimentation, and data analysis using INESC TEC's Smart Grids Lab and OPAL-RT infrastructure. This research supports the deployment of resilient, 100% renewable-ready microgrids and aligns with EU priorities in grid digitalization and decarbonization.			
6	Resilient Protection Strategies for Inverter-Dominated Hybrid AC/DC Grids Using Real-Time Fault Emulation	This project aims to develop and validate protection strategies for hybrid AC/DC microgrids dominated by inverter-based renewable generation. Traditional protection systems often fail in such environments due to low fault currents and complex converter dynamics. The research will design adaptive protection logic and advanced fault detection for both AC and DC segments, addressing bidirectional fault propagation and converter coordination. Using OPAL-RT real-time simulation and Power-Hardware-in-the-Loop (PHIL), the project will emulate realistic fault conditions to evaluate system behavior and test physical relay hardware. The visiting researcher will contribute to modeling, protection logic development, and fault scenario experimentation. The result will be validated protection schemes that maintain microgrid resilience and selective fault isolation under a wide range of scenarios, supporting safe and reliable deployment of inverter-dominated hybrid energy systems.	Habib Ur Rahman Habib	habib.habib@inesctec.pt	Power and Energy Systems
7	Data-Driven Reliability Assessment of Power Converters in Renewable Energy Systems	This research topic aims to develop data-driven methodologies for assessing and predicting the reliability of power electronic converters in renewable energy systems, focusing on wind turbines and photovoltaic (PV) installations. The core idea is to leverage operational data from these systems to identify patterns leading to converter failures and to create statistical models that quantify failure rates and lifetimes. By analyzing large datasets (such as SCADA measurements, environmental conditions, and maintenance records), the project will apply statistical analysis to characterize common failure modes and use machine learning algorithms to predict faults or degradation trends before they cause system downtime. Methodologically, the project will perform statistical modeling of converter failure distributions (e.g. survival analysis or other	Habib Ur Rahman Habib	habib.habib@inesctec.pt	Power and Energy Systems

		reliability models) and develop predictive analytics tools for real-time health monitoring. Machine learning techniques (such as anomaly detection or regression models trained on historical failure data) will be employed to forecast impending converter malfunctions. By integrating these approaches, the research aims to support proactive maintenance strategies and improve failure analysis, ultimately enhancing the availability and performance of wind and solar energy systems.			
8	Sustainable Cities: Tech-based innovation contributions to Sustainable Development Goals in cities	The research explores the differences and similarities between smart cities and sustainable cities. Having a starting point two systematic literature reviews about both paradigms and a thematic analysis to identify key themes, definitions, and characteristics that differentiate and connect these two urban development concepts, it addresses contemporary urban challenges more holistically in convergence towards the concept of 'smart sustainable cities', which leverage technology to achieve sustainability goals.	Cristina Machado Guimarães	cristina.m.guimaraes@inesctec.pt	Innovation, Technology and Entrepreneurship
9	Human-Centric Technology Adoption in Manufacturing: Socio-Technical Integration Strategies for Industry 5.0	This research topic focuses on advancing human-centric approaches to technology adoption within manufacturing environments grounded in socio-technical integration principles. It aims to understand how technological innovation can effectively align with organizational structures, workforce needs, and cultural practices to foster more adaptive, sustainable, and inclusive industrial systems. The study will investigate key enablers and barriers to successfully adopting advanced manufacturing technologies and identify strategies that support transparency, collaboration, and skill development. The outcomes will contribute to developing practical frameworks, tools, and roadmaps to guide manufacturing organizations through the digital transition, supporting the broader goals of Industry 5.0.	Ana Simões	ana.c.simoes@inesctec.pt	Enterprise Systems Engineering
10	Exploring a new paradigm for reality awareness in control centres	PMUs are becoming a pervasive sensing tool in transmission systems, and are likely to invade the domain of distribution soon, in large scale. Signals from PMUs arrive with a high frequency and convey information on the dynamic behaviour of the systems.	Vladimiro Miranda	vmiranda@inesctec.pt	Power and Energy Systems

		However, the approach followed to deal with such signals remains reactive and not pro-active, in the sense that an estimation of the system state is made relative to past conditions sensed. The research topic proposed relates to the development of a different concept, mimicking the working of the human brain, where a control centre would be organised permanently in prediction mode, mostly supported by Bayes theorem principles. Sensor signals would then adjust an internal map of the external reality while allowing to update rolling predictions (instead of updating a state estimation of the past).			
11	Enhancing Object Recognition and Localization in Retail Environments through Generative AI	In this research topic, we aim to develop an innovative Generative AI pipeline that leverages advanced computer vision techniques to analyze RGB and depth data captured by robots navigating supermarkets in Portugal. The project focuses on recognizing and accurately locating products displayed on shelves, ultimately creating a Digital Twin representation of the retail space. By integrating AI image inference for object recognition, we use Generative AI approaches to differentiate products based on 2D data. Additionally, we employ optical character recognition (OCR) to read product labels and analyze 3D depth data to enhance object localization precision. The use of large language models (LLMs) will facilitate matching object descriptors retrieved from images with a comprehensive object database via Retrieval-augmented generation (RAG) techniques, ensuring an efficient inventory management system that improves customer experience. A key objective is to evaluate how effectively this novel approach compares with established solutions like TensorFlow and AWS Rekognition.	Rafael Arrais	rafael.l.arrais@inesctec.pt	Robotics in Industry and Intelligent Systems
12	Creating a Photogrammetry-Based Representation of Retail Spaces Using Advanced Imaging Techniques	In this research topic, we aim to develop a photogrammetry-based representation of retail environments using RGB and depth images collected by robotic agents navigating supermarkets. Our approach will employ advanced techniques such as Neural Radiance Fields (NeRFs) and Gaussian Splatting to create highly detailed 3D models of the retail space. NeRFs utilize deep learning to synthesize novel views of a scene by modeling volumetric representations, capturing	Rafael Arrais	rafael.l.arrais@inesctec.pt	Robotics in Industry and Intelligent Systems

		intricate details and realistic lighting conditions. Gaussian Splatting enhances rendering efficiency by representing points in 3D space as Gaussian distributions, allowing for smoother transitions and better handling of occlusions. A key innovation of our project is the integration of depth information, already being collected, into this approach to further improve the accuracy and quality of the results. The ultimate goal is to create a web-based viewer that provides retail employees with an accurate and continuously updated depiction of their store as new data is collected.			
13	Developing a Generative AI Approach for Error Identification in Robot Operations	In this research topic, we aim to develop a Generative AI approach to identify errors in robot operations by analyzing their logs and performance metrics. The core idea is to supply large language models (LLMs) with operational data, utilizing techniques such as Retrieval-Augmented Generation (RAG) and Model Context Protocol (MCP) to enhance the AI's contextual awareness. By continuously monitoring Robot Operating System (ROS) logs and robot metrics, our goal is to create an AI agent capable of recognizing failure patterns and suggesting strategies to address their root causes. Additionally, we will assess the software source code that may have originated the failure situation, providing insights based on this analysis. Innovative contributions include an explainable diagnostic tool that detects faults and offers actionable insights, creating a proactive maintenance framework. This framework could significantly improve reliability and efficiency in robotic systems across various applications, ultimately enhancing operational performance and reducing downtime.	Rafael Arrais	rafael.l.arrais @inesctec.pt	Robotics in Industry and Intelligent Systems
14	Developing a Lingua Franca for ROS Simulators	In this research topic, we aim to create a lingua franca for ROS-compatible simulators to streamline the adaptation of source code across different simulation environments. As new simulators emerge, the need for a standardized interface becomes critical to reduce the time spent managing various configurations and adapting code. Our innovation is akin to developing a universal adapter, similar to the USB-C standard, allowing developers to seamlessly integrate their ROS applications into any simulation environment	Rafael Arrais	rafael.l.arrais @inesctec.pt	Robotics in Industry and Intelligent Systems

		without extensive code rewrites. This unified interface will define common protocols, APIs, data formats, and configuration parameters, enabling interoperability among simulators like Gazebo, Webots, Unity, and NVIDIA Isaac Sim. Additionally, we will establish a common structure for assessing simulation compliance with user intentions, facilitating integration into CI/CD pipelines. This project leverages INESC TEC's extensive experience in robotic simulations and CI/CD integration, promising to enhance reproducibility, accelerate research and development, and foster collaboration within the robotics community.			
15	Automating Robotic Task Generation through AI-Driven State Machine Synthesis	In this research topic, we aim to develop an innovative approach that utilizes AI to automatically generate state machine representations for robotic tasks by integrating AI-based planning with the structured benefits of task scripting. Traditional task scripting relies on manually defined state machines, which can become a bottleneck in dynamic environments. By employing techniques such as reinforcement learning, we propose to automate the creation of state machines, allowing AI to learn from interactions in simulation and propose new state transitions. This AI-driven state machine synthesis will include learning-based structure generation, where the AI designs entire state machine frameworks, and hybrid representation learning that combines deep learning with symbolic reasoning to ensure safety and compliance. Our goal is to create a system that not only generates effective task scripts but also maintains the transparency and reliability necessary for industrial applications, ultimately enhancing the flexibility and autonomy of robotic systems.	Rafael Arrais	rafael.l.arrais @inesctec.pt	Robotics in Industry and Intelligent Systems
16	Genome-Scale Digital Twins for Precision Agriculture	Genome-scale Digital Twins lie at the heart of the latest in vivo molecular diagnosis in precision agriculture developed at INESC TEC, as a consequence of the projects MetBots, OmicBots, and Phenobots. It aims to make an inferential diagnosis given the metabolic quantification from robot platform spectroscopy sensors that measure the composition of soil, fertilizer, fruits, and leaves, which are integrated with climate and water to serve as input in the	Rui Martins & Nelson Machado	rui.c.martins @inesctec.pt	Robotics in Industry and Intelligent Systems

		genome-scale metabolism of plants, simulating in detail the physiological response of each plant organ (e.g., roots, stem, leaves, and fruits) using the Finite Element Method and Computational Fluid Dynamics.			
17	Precision Fertilization Systems	Measurement of nutrients in agriculture is a critical aspect of proper crop production. In hydroponic systems, it plays an even more important role, as plants are entirely dependent on the nutrient feed provided, and their growth will reflect the degree of control of the system. In this internship, the intern will be able to participate in one of the biggest humanity challenges: precision fertilization technology. Such means, designing sophisticated sensor systems to measure nutrient uptake and fertilizer composition 'in-vivo', adjusting the fertilizer composition and dosage to the plant's need in real-time. Over-fertilization is the main cause of loss of soil and water pollution. The intern will also interact with the fertilizer complex chemical network, collect fertigation samples from an ongoing hydroponic setup, and analyze them using various laboratory techniques to assess the NPK concentration.	**Rui Martins**	rui.c.martins @inesctec.pt	**Robotics in Industry and Intelligent Systems**
18	Plant Wearables and Systems Biology for Precision agriculture	Plant Wearables are our latest innovation for real-time photosynthesis and central metabolism monitoring of the plant's vital signs. Metabolic fluxes obtained by wearables are used in Genome Scale Systems Biology models do re-construct and diagnose the plant's metabolic state, and control mechanisms and to diagnose plant physiology in both field and controlled environment agriculture. During this internship, the intern will work on developing a Systems Biology model for a metabolic network within a hydroponic system using our existing C3 plant model. This involves creating a high-resolution, holistic view of the hydroponic biochemical networks, constrained-based modelling, and managing control network mechanisms that are established under different scenarios of abiotic stress, such as light, temperature, water deficit, and nutrient imbalances.	**Rui Martins**	rui.c.martins @inesctec.pt nelson.machado@inesctec.pt	**Robotics in Industry and Intelligent Systems**

19	Management and Optimization Models to Support the Public Transport System	A transport system consists of a set of interrelated elements, including passengers and cargo, the vehicles that perform the journeys, and the infrastructure network that enables the system to function. Effective transport and maintenance management systems are essential to ensure the efficiency, safety, and reliability of operations across different modes—such as roads, railways, airports, ports, and urban public transportation. This research project proposes the application of Operational Research (OR) techniques to address challenges in Urban Mobility, with a particular focus on the optimization of operational capacity in the public transport system. The objective is to develop models that enhance the planning and operation of public transport services. By optimizing resource allocation, scheduling, and routing, these models can contribute to greater efficiency, reduced travel times, improved accessibility, and enhanced service quality for users.	Flávia Barbosa	flavia.barbosa@inesctec.pt	Industrial Engineering and Management
20	AI for Public Services	Population growth can put pressure on public services in many ways, including increased demand for services and budgetary pressures, highlighting the urgent need to improve the provision of services. For example, in the health system, prolonged waiting times for surgeries are associated with deterioration in patient well-being, increased mortality, and higher healthcare costs. The clinical pathways of surgeries are inherently complex, involving the dynamic and adaptive inclusion of multiple services and resources based on patients' conditions, test results and medical assessments. This project aims to apply AI to develop predictive decision support tools for the dynamic management of surgery pathways. The aim is to improve the service quality and the number of outcomes. The methodology can be extended to other public services, such as education and transportation. Combined with stochastic modelling, AI will drive the development of innovative tools, enhancing the development of society.	Flávia Barbosa	flavia.barbosa@inesctec.pt	Industrial Engineering and Management
21	Metaheuristics for scheduling problems	Scheduling problems arise when you need to organize tasks, appointments, or resources to meet deadlines or optimize performance. Through literature and real-world applications, we can	Flávia Barbosa	flavia.barbosa@inesctec.pt	Industrial Engineering and Management

		find different scheduling problems: • Job scheduling: Finding the best order for completing jobs with deadlines to maximize profit • Machine scheduling: Finding the best way to schedule machines to complete tasks efficiently • Open-shop scheduling: Scheduling jobs on machines where each machine can only process one operation at a time • Employee scheduling: Assigning employees to shifts while meeting constraints and staffing requirements • Workforce scheduling: Determining how many workers to assign to each work period These scheduling problems are NP-hard, making them computationally difficult to solve. This project addresses this challenge by developing a stochastic local search method to solve NP-hard optimization problems. Lower-bound formulations complement the proposed metaheuristics to provide optimal gaps for evaluating the quality of the heuristic results. The approach must produce high-quality solutions across diverse problem domains, underscoring its potential as a robust tool for combinatorial optimization.			
22	Deep Learning for Image-Based Cardiovascular Disease Screening	Cardiovascular diseases are the leading cause of death worldwide and a significant source of morbidity meaning that early detection of disease is of the utmost importance. Medical imaging plays a leading role in the detection, diagnosis and prognosis of cardiovascular diseases and several biomarkers are known to be associated to higher cardiovascular risk and cardiovascular diseases. The goal of this project is to develop artificial intelligence tools that can automatically interpret cardiovascular imaging, namely computed tomography images, to extract known (or hereto unknown) clinical biomarkers for cardiovascular risk prediction and diagnosis. This involves the segmentation/detection of structures, radiomic feature extraction and/or end-to-end risk prediction. The specific focus of the short stay will be defined depending on and in agreement with the applicants' interests and competences.	João Pedrosa	joao.m.pedrosa@inesctec.pt	Biomedical Engineering Research

23	System Identification and Robust Control for Underwater Robotics Applications	This research topic aims to develop new methodologies for system identification and robust control applied to underwater robotics, where both the vehicle dynamics and the underwater environment present high levels of uncertainty. The investigation focuses on: (1) Parsimonious modeling and identification of hybrid systems, leveraging noisy or sparse data from multiple sensors; (2) Advanced signal processing techniques to improve state and parameter estimation; (3) Robust predictive control that accounts for practical constraints, such as actuator limitations and temporary sensor or communication failures. By combining classical control engineering approaches with stochastic optimization and machine learning methods, this line of research seeks to enhance the autonomy and efficiency of underwater systems, preparing them for exploration, inspection, and intervention missions in complex underwater environments.	Paulo Jorge de Azevedo Lopes dos Santos & Bruno Miguel Mateus Ferreira	paulo.santos@inesctec.pt bruno.m.ferreira@inesctec.pt	Robotics and Autonomous Systems
24	Perception of Plants: A Robotic Sensing Perspective	This research focuses on how plants can be perceived by robotic platforms equipped with imaging, LiDAR, and radar sensors. It explores how these sensing technologies capture visual, structural, and material properties of plants to assess health, monitor growth stages, and detect environmental stress. The study aims to evaluate the state of the art in robotic perception systems that fuse multimodal data, with the goal of advancing precision agriculture applications such as crop mapping, stress detection, and autonomous farming operations (such spraying or fertilization).	Filipe Baptista Neves dos Santos	filipe.n.santos@inesctec.pt	Robotics in Industry and Intelligent Systems
25	Collaborative Ground and Aerial Robotics for Precision Agriculture	This research focuses on developing collaborative strategies between ground and aerial robots to enhance agricultural operations. By integrating the complementary capabilities of unmanned ground vehicles (UGVs) and unmanned aerial vehicles (UAVs), the study aims to improve crop monitoring, data collection, and field interventions with higher efficiency and precision. The work will explore coordinated sensing, task allocation, and navigation techniques that allow ground and aerial robots to operate autonomously and cooperatively in dynamic agricultural environments. This research contributes to advancing precision	Filipe Baptista Neves dos Santos	filipe.n.santos@inesctec.pt	Robotics in Industry and Intelligent Systems

		agriculture by enabling scalable, adaptive, and intelligent multi-robot systems capable of supporting sustainable farming practices.			
26	Digital Twin Prototyping for Protection and Control using FPGA-enabled Real-Time Simulation	This topic focuses on developing digital twin prototypes for power system protection using OPAL-RT's FPGA-based real-time simulator. The visiting researcher will implement protection functions (overcurrent, voltage, reclosing) in Simulink/FPGA, integrate these with MV network models, and validate them through hardware-in-the-loop testing. The work follows a structured approach: (1) familiarization with protection schemes already existent for OPAL-RT (hardware-in-the-loop related); (2) development of relay function models; (3) FPGA integration and HIL validation; and (4) creation of reusable frameworks. This initiative supports INESC TEC's strategic goals in adaptive protection systems while providing a platform for testing IEC 61850-based communication, DER integration, and digital substation concepts. The project leverages recently acquired infrastructure to create lasting value through modular, reusable digital protection models.	Everton Leandro Alves	everton.l.alves@inesctec.pt	Power and Energy Systems
27	Physiological profiling of hypopneas: a comparative study across patient groups	This project aims to analyze and compare hypopnea events across different patient groups, specifically focusing on individuals with cardiovascular diseases and without. The central question is whether patients with cardiovascular diseases experience more hypopneas followed by oxygen desaturation, in contrast to hypopneas followed solely by arousals. By exploring these differences, the study seeks to enhance the understanding of sleep-disordered breathing and its interaction with cardiovascular health, potentially informing more tailored clinical approaches for at-risk populations.	Daniela Ferreira-Santos	daniela.santos@inesctec.pt	Telecommunications and Multimedia
28	Towards Computational and Energy Efficient Federated Learning Algorithms	The applicability of federated learning (FL) algorithms to sensitive data has been expanding rapidly, driven by their inherent privacy-preserving nature and ability to manage heterogeneous data sources. However, current state-of-the-art FL research has largely focused on mitigating the challenges of data heterogeneity and safeguarding privacy, often neglecting the computational resource	Cláudia Brito	claudia.v.brito@inesctec.pt	High-Assurance Software

		demands and energy efficiency of these methods. This research aims to systematically evaluate the energy consumption profiles and computational bottlenecks of leading FL algorithms. By conducting a comparative analysis of the energy impact across different algorithmic families, this work seeks to identify critical inefficiencies and propose new guidelines for the development of energy-aware federated learning strategies. The findings of this study will contribute to the design of next-generation FL algorithms that are not only privacy-preserving and robust but also computationally sustainable, aligning with the growing need for greener AI technologies. Based on such findings, this work should end with the proposal of a novel federated learning algorithm that is energy-aware and resource efficient.			
29	Cutting and Packing	Cutting and Packing (C&P) is a research area within Operations Research and Combinatorial Optimisation that focuses on the efficient arrangement of objects within containers or stock materials. The goal is to maximise the use of available space or resources while minimising waste, cost, or other operational constraints. Problems in this area arise in various industrial applications such as manufacturing, logistics, and warehousing - where objects need to be cut from raw materials (such as wood, metal, or fabric) or packed into boxes, pallets, or storage units. C&P problems are typically complex and computationally challenging, often requiring exact methods, heuristics or metaheuristics to find high-quality solutions.	**José Fernando Oliveira**	jose.f.oliveira@inesctec.pt	**Industrial Engineering and Management**
30	FairFaces: Advancing Generative AI for Fair and Unbiased Face Biometrics	The widespread use of facial biometrics in authentication, surveillance, and identity verification has raised growing concerns about bias and fairness, particularly across ethnicity, gender, and age groups. This visitor programme explores how Generative AI—especially generative adversarial networks (GANs) and diffusion models—can be leveraged to design fairer, more robust facial recognition systems. The core idea is to use generative models to synthesize balanced, diverse, and privacy-preserving datasets, simulate	**Ana Sequeira**	ana.f.sequeira@inesctec.pt	**Telecommunications and Multimedia**

		underrepresented scenarios, and identify bias patterns in existing models. Visitors will collaborate with INESC TEC researchers on methods that enhance model interpretability, debias training pipelines, and ensure equitable performance across demographic groups. Additionally, work will focus on evaluating generative models for ethical risk, adversarial robustness, and compliance with evolving AI regulation frameworks, such as the EU AI Act. This programme combines advances in machine learning, ethics, and human-centered AI, and will contribute to building trustworthy biometric systems that promote inclusivity and fairness in high-stakes applications.			
31	Stable Feature Selection in Non-Linear Models	We will investigate the topic of feature selection in non-linear models, prioritizing the stability of feature importance rankings over raw magnitude. While traditional feature selection techniques often rely on absolute importance scores, they may overlook how consistently a feature contributes to the model across different data variations or training instances. We propose to estimate the distribution of importance ranks for each feature and develop a Feature Stability Score (FSS) to quantify the consistency of a feature's rank across data variations or model runs. Features identified as unstable according to this criterion will be considered unreliable and targeted for iterative removal. This strategy will be explored as a basis for a robust, stability-driven feature selection framework. Further, we will investigate the possibility of making the approach model agnostic for broader applicability. Our focus on rank stability ensures that selected features are relevant and robust to the inherent variability of data and initializations, thereby improving generalization and supporting more trustworthy model interpretations.	Ana Sequeira	ana.f.sequeira@inesctec.pt	Telecommunications and Multimedia
32	Bioinspired Visual Intelligence: Advancing Event-Based Perception, Neuromorphic Robotics	This study proposes a bioinspired visual attention system that integrates event-based sensing with neuromorphic computation to enhance real-time perception in autonomous robots. The approach draws inspiration from biological mechanisms of visual processing, particularly the principles of border ownership and perceptual	Ana Sequeira & Jaime Cardoso	ana.f.sequeira@inesctec.pt	Telecommunications and Multimedia

	and Spiking Neural Networks	grouping observed in the primate visual system. A hierarchical neural architecture will be developed to implement figure-ground segmentation, enabling the system to isolate behaviorally relevant foreground objects from cluttered backgrounds using minimal computational resources. To further improve dynamic scene understanding, the system incorporates object motion sensitivity (OMS) by detecting relative motion between objects and their surroundings. A fully spiking convolutional neural network (sCNN) will be employed to process event streams and highlight salient motion cues. This motion-enhanced saliency information is then used to trigger active gaze shifts—mimicking biological fixational and saccadic eye movements—allowing the robotic platform to center attention on the most relevant regions of the visual field. By leveraging the sparse and asynchronous output of event-based cameras, and deploying computations on neuromorphic hardware, the proposed system aims to achieve low-latency, power-efficient, and robust visual attention suitable for real-world environments.		jaime.cardoso@inesctec.pt	
33	Domain-Adaptive AI for Endoscopic Risk Stratification	Gastric cancer screening via endoscopic imaging suffers from inter-institution variability in image quality, equipment, and operator technique—limiting the generalizability of AI models. Building on recent work at INESC TEC that predicts gastric intestinal metaplasia (GIM) risk using small image patches, this topic aims to investigate domain-adaptive deep learning approaches that mitigate the need for annotated data from new clinical centers. We will develop and benchmark unsupervised adaptation strategies such as Domain-Adversarial Training (DANN), self-training with pseudo-labels, and feature alignment via CORAL/MMD losses. The goal is to create AI tools for optical diagnosis that generalize across geographies and healthcare systems.	Miguel Coimbra	miguel.coimbra@inesctec.pt	Biomedical Engineering Research
34	Immersive Media for an augmented human intervention in complex scenarios.	Our research group develops research in the triadic perspective of Immersion: Extended Reality, Interactive Narratives and Digital Games and Gamification. We are challenged through interdisciplinary research in Immersive	António Coelho	Antonio.coelho@inesctec.pt	Human-Centered Computing and Information Science

		Media that is transformative to the interplay between humans and technology. Either augmenting human perception and improving agency in the interaction with Intelligent systems, or engaging in immersive training and learning frameworks/tools. We also develop procedural content generation techniques for generating virtual and game worlds, and co-creation methodologies to provide more effective experiences in several application areas: Industry, Learning and Training, Health and Wellbeing, Culture and Creativity.			
35	Resilient underwater visible light communications	Underwater optical wireless communication (UOWC) offers high-speed, low-latency data transmission in the water environment but faces challenges, including signal attenuation, scattering, misalignment, and nonlinearities. This topic aims to significantly enhance UOWC by combining innovative techniques: constellation shaping (CS), digital subcarrier multiplexing (DSCM), RGB laser multiplexing, and entropy loading. CS, including probabilistic and geometric methods, improves spectral efficiency and noise resilience, while DSCM provides adaptive power and rate allocation. RGB multiplexing expands system capacity using multiple wavelengths, and entropy loading optimizes symbol distributions to mitigate nonlinear transmitter distortion. Research stages include numerical modeling, simulations, and experimental validation in clear, coastal, and turbid waters. Results will lead to robust, adaptive UOWC systems, advancing applications in environmental monitoring, autonomous underwater vehicles, subsea operations, offshore infrastructure inspection, defense systems, and critical maritime infrastructure security.	Joana dos Santos Tavares	joana.s.tavares@inesctec.pt	Telecommunications and Multimedia
36	Medical Imaging generation for lung cancer	The objective is to develop realistic and high-fidelity CT images and scans that can serve as effective training data for predictive models in medical imaging. By generating synthetic yet anatomically plausible CT data, this work aims to address the limitations of real-world datasets—such as data scarcity, class imbalance, and patient privacy concerns. The project will be focused on state-of-the-art techniques such as diffusion models and 3D generative adversarial networks (GANs), tailored specifically for volumetric medical data. These models will	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt helder.p.oliveira@inesctec.pt	Telecommunications and Multimedia

		be trained to learn the underlying anatomical structures and pathological variations from existing CT datasets, enabling the generation of diverse, realistic, and diagnostically meaningful synthetic scans. In parallel, object-centric learning frameworks will be integrated into the generative pipeline, allowing the models to understand and represent individual anatomical components—such as organs or lesions—as distinct, manipulable entities. This approach not only improves the interpretability of the generated data but also enables controlled synthesis, where specific clinical scenarios (e.g., presence of tumors, anatomical anomalies) can be modeled on demand.			
37	Synthetic Tabular Data Generation for Lung Cancer Prediction and Analysis	This project focuses on generating synthetic tabular data to enhance predictive models for lung cancer diagnosis and prognosis. Given the limited availability of high-quality, labeled medical data, particularly for rare cases, synthetic data generation provides a valuable alternative. By leveraging advanced machine learning techniques, such as generative adversarial networks (GANs) and other generative models, the project aims to create realistic, diverse, and representative tabular datasets that can supplement real-world data. These synthetic datasets will be used to train, validate, and test predictive models, helping improve the accuracy and robustness of lung cancer detection systems.	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt helder.p.oliveira@inesctec.pt	Telecommunications and Multimedia
38	Lung Cancer Prediction Using Tabular Data and Explainable AI (XAI) Techniques	This project aims to enhance the prediction and diagnosis of lung cancer using tabular data combined with Explainable AI (XAI) techniques. Lung cancer prediction models traditionally rely on complex machine learning algorithms, which often lack interpretability. By integrating XAI methods, this research seeks to provide transparent, human-understandable insights into model decision-making, ensuring clinicians can trust and act upon predictions. The project leverages diverse tabular data, such as patient demographics, clinical history, and biomarkers, to train robust predictive models. By emphasizing explainability, the research aims to improve model transparency, facilitate better	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt helder.p.oliveira@inesctec.pt	Telecommunications and Multimedia

		clinical decision-making, and ultimately lead to earlier and more accurate detection of lung cancer.			
39	Object-Centric Learning in Medical Imaging: Techniques, Applications, and Challenges	This research explores the application of object-centric learning techniques in medical imaging, aiming to enhance the accuracy and interpretability of diagnostic models. Object-centric learning focuses on learning representations of individual anatomical structures or lesions as distinct entities, enabling more precise segmentation, classification, and detection tasks. By leveraging advanced deep learning methods, such as Slot Attention and transformer-based architectures, this approach seeks to overcome challenges like occlusion, ambiguity, and scale variation in medical images. The research delves into key applications, including tumor detection, organ segmentation, and disease progression modeling, and highlights the unique challenges of applying object-centric models to complex medical data. The objective is to provide a comprehensive overview of existing work in this field, offering an in-depth characterization of current advancements, and to identify promising directions for future research in object-centric approaches for medical imaging.	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt helder.p.oliveira@inesctec.pt	Telecommunications and Multimedia
40	Sepsis Prediction Using Electronic Health Records: Approaches and Insights	This research focuses on developing predictive models for sepsis using electronic health records (EHRs). Sepsis, a life-threatening condition resulting from infection, requires early identification and timely intervention to improve patient outcomes. EHRs contain vast amounts of patient data, including vital signs, lab results, medications, and medical history, which can be leveraged to predict the onset of sepsis. By applying advanced machine learning techniques to this rich dataset, the goal is to develop accurate, real-time sepsis prediction models that can assist clinicians in identifying high-risk patients early. This research aims to not only enhance the predictive accuracy of sepsis detection but also improve clinical decision-making and patient management, ultimately reducing mortality rates and healthcare costs associated with delayed sepsis diagnosis.	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt helder.p.oliveira@inesctec.pt	Telecommunications and Multimedia

41	Quantum Generative Learning with Parameterized Quantum Circuits	Parameterized Quantum Circuits (PQCs) offer promising avenues for generative modeling, allowing complex data distributions to be encoded in quantum states that are out of reach of classical systems. This topic examines whether commuting versus non-commuting PQCs yield different advantages in terms of learning expressiveness and training stability. We will also explore how kernels can couple these PQC-based generators to discriminative tasks, thereby enhancing classification performance. Building on our previous work in quantum reinforcement learning (e.g., Quantum Mach. Intell. 5, 18 (2023); Mach. Learn.: Sci. Technol. 5, 035037), we aim to deepen the theoretical foundations and practical implementations of quantum-assisted learning algorithms for generative modeling.	Luis Paulo Santos & Luis Soares Barbosa	luis.p.santos @inesctec.pt luis.s.barbosa @inesctec.pt	High-Assurance Software
42	Quantum Extreme Learning Machines for Fast Reinforcement Learning	Quantum Extreme Learning Machines (QELMs) adapt the concept of extreme learning—where most network parameters remain fixed—to quantum neural architectures. By leveraging randomized or partially fixed Parameterized Quantum Circuits (PQCs), QELMs can drastically reduce training complexity, accelerating policy convergence for reinforcement learning (RL) agents at the same it proposing solutions outside the classical realm. This project will design and test QELM-based RL methods, comparing their performance to classical extreme learning and fully trained quantum networks on standard RL benchmarks. Drawing on our prior investigations in quantum RL (Quantum Mach. Intell. 6, 53 (2024); IEEE TQE, 5, 2024), we aim to demonstrate a practical path toward quantum speedups in real-world decision-making tasks.	Luis Paulo Santos & Luis Soares Barbosa	luis.p.santos @inesctec.pt luis.s.barbosa @inesctec.pt	High-Assurance Software
43	Tensor Networks for the Design and Dequantization of Quantum Reinforcement Learning Agents	Tensor network techniques, such as Matrix Product States or Tree Tensor Networks, can encode large quantum states with reduced complexity. This project explores how these representations can inform the design of quantum reinforcement learning (RL) agents and also facilitate their partial or complete dequantization. By systematically translating PQC-based policies into classical tensor networks, we aim to pinpoint which quantum features genuinely enhance RL performance, which can be emulated classically, and if	Luis Paulo Santos & Luis Soares Barbosa	luis.p.santos @inesctec.pt luis.s.barbosa @inesctec.pt	High-Assurance Software

		these *quantum-inspired* models provide nonetheless better expressivity compared with standard classical RL models.			
44	Quantum Bayesian Reinforcement Learning	Quantum Bayesian Reinforcement Learning integrates quantum computing with Bayesian decision-making to manage uncertainty in complex environments more efficiently. Building on our prior demonstration of a quadratic speedup in near-optimal planning for partially observable Markov decision processes (POMDPs) (https://repositorium.sdum.uminho.pt/handle/1822/86205), this project explores how Parameterized Quantum Circuits (PQCs) can serve as policy generators within a Bayesian framework to introduce learning beyond planning. By updating quantum belief states in response to environmental feedback, we aim to achieve more efficient exploration and faster policy convergence.	Luis Paulo Santos & Luis Soares Barbosa	luis.p.santos@inesctec.pt luis.s.barbosa@inesctec.pt	High-Assurance Software
45	Trainability–Simulability-utility Trade-off in PQC-Based Reinforcement Learning Agents	Deep Parameterized Quantum Circuits (PQCs) enable quantum reinforcement learning (RL) agents to capture rich, entangled state spaces, yet they can be difficult to train due to issues like vanishing or exploding gradients. Conversely, shallow or constrained PQCs may be more trainable but risk being simulable by classical means, losing any distinct quantum advantage. Preliminary findings from HASLab indicate that there are indeed PQC-based architectures that circumvent typical gradient-related issues while maintaining quantum complexity beyond what is classically simulable (research article in preparation). Despite these promising traits, their tangible utility in solving RL problems remains an open question. This project aims to systematically investigate which families of PQC-based models strike the right balance between being trainable on practical hardware and offering genuine quantum advantages in challenging RL tasks.	Luis Paulo Santos & Luis Soares Barbosa	luis.p.santos@inesctec.pt luis.s.barbosa@inesctec.pt	High-Assurance Software
46	Semantic Narrative Extraction from Text	Narratives and stories are a part of our communication and world view and are used everyday in many different areas, such as culture, journalism, clinical records, legal decisions and financial reports. In our team we use NLP techniques, including LLM, to identify narrative elements in text, namely participants, events, temporal expressions,	Alípio Jorge	amjorge@inesctec.pt	Artificial Intelligence and Decision Support

		as well as the links between them (semantic roles, temporal relations, causal relations, etc.). We defined a semantic annotation framework in collaboration with linguists, and have some open challenges in using formal discourse representations for narratives and resolving semantic annotation that links to external databases. More info on our team in https://nlp.inesctec.pt.			
47	Exploring memory and storage technologies for data-centric systems	Data-centric systems, such as log-structured merge tree key-value stores, databases, and file systems, are foundational to modern computing infrastructures, serving millions of users with performance and reliability. Meanwhile, emerging memory and storage technologies — such as CXL, persistent memory, and disaggregated storage — are reshaping the hardware landscape. However, while recent research has been focused on integrating these technologies into general-purpose systems or at the operating system level, their full potential remains untapped for specialized data-centric workloads. This research topic proposes to explore new designs for core data-centric components, including caches, file systems, key-value stores, and databases, that are tailored to the unique capabilities of modern memory and storage technologies, maximizing their performance and efficiency.	Ricardo Macedo	ricardo.g.macedo@inesctec.pt	High-Assurance Software
48	Strategies for improving GPU energy efficiency	GPUs are at the core of modern compute-intensive applications, from AI training and inference to scientific simulations. Their massive computing power comes at the cost of substantial energy consumption, raising concerns about sustainability, operational costs, and thermal management, especially in large-scale infrastructures. While hardware vendors offer basic power management interfaces, current solutions are often coarse-grained and require manual tuning. This research topic aims to explore new strategies for improving the GPU energy efficiency of different workloads running in HPC infrastructures that can dynamically adapt power settings to workload characteristics without compromising performance.	Ricardo Macedo	ricardo.g.macedo@inesctec.pt	High-Assurance Software

49	Productive structure and innovation system: a regional analysis of strengths and challenges	There is a growing concern regarding national sovereignty and the development and recognition of capacities and resources to advance science, technology, and innovation across various countries. Specialization and differentiation within value chains have been employed as strategic approaches at regional and local scales to enhance the capabilities of productive systems, incorporate innovations into production processes, and introduce technological solutions into the market. However, this process requires a comprehensive understanding of the critical elements of a productive structure, technological development, and innovation and value chains. Identifying existing competencies, gaps within trade and innovation networks, and techno-economic and institutional challenges is essential. Analyzing the productive structure and regional innovation systems allows for the formulation of industry and science, technology, and innovation (STI) policies tailored to regional needs. Moreover, such analysis can guide stakeholders in directing efforts and resources toward well-defined and strategically justified opportunity windows and mission-oriented initiatives.	Manuel Victor Martins de Matos	manuel.v.matos@inesctec.pt	Innovation, Technology and Entrepreneurship
50	The role of Research, Development and Innovation organisations in a mission-oriented innovation policy approach	There is a global revival of science, technology, and innovation policies among academics and decision-makers to tackle and address grand societal and environmental challenges. The mission-oriented approach aims to handle the multifaceted and interrelated scientific, technological and socio-economic issues that require coherent measures and policy support across disciplinary, sectoral and regulatory silos. Beyond that, the mission-oriented innovation policy claims directionality, coordination, mobilisation, and entrepreneurial spirit to develop knowledge, practices, and integration towards behavioural and structural change. Different Research, Development and Innovation (RD&I) organisations worldwide have been dealing with how they should act to address the technical and institutional complexity of reaching market, societal, and environmental objectives. Given the current relevance of this approach in overcoming challenges from broad societal and	Manuel Victor Martins de Matos	manuel.v.matos@inesctec.pt	Innovation, Technology and Entrepreneurship

		research agendas, the role of RD&I organisations should be explored and investigated extensively in the mission-oriented approach.			
51	Geotechnologies and Planetary Geosciences	The development or the use of CRAS-INESCTEC geotechnologies is already available for the research of planetary geosciences and georobotics. Application of aerial drones or terrestrial robotics (UGVs) for lava tube assessment and the development of new tools for new characterizations.	Ana Pires	ana.c.pires@inesctec.pt	Robotics and Autonomous Systems
52	Distributed Sensing of long-haul transmission systems	Distributed sensing in long-haul coherent transmission systems offers promising capabilities for real-time infrastructure monitoring. INESC TEC has been actively integrating Distributed Acoustic Sensing (DAS) into electric grids, telecom networks, and submarine cables to remotely detect physical events. However, DAS is limited to a sensing range of about 100 km, restricting its effectiveness across the full length of optical cables. An emerging alternative is the State of Polarization (SOP), which shows potential for distributed sensing over the entire cable length without such range limitations. SOP-based methods can detect environmental and mechanical perturbations, but the interpretation of polarization fluctuations—caused by random birefringence—and their analysis remains insufficiently understood. This research aims to study the physical behaviour of SOP in long-haul fibres, evaluate SOP-based sensing techniques in the lab, enhance signal analysis models for geophysical detection, and assess the method's practical applicability in real-world systems.	Susana Silva & Henrique Salgado	susana.o.silva@inesctec.pt henrique.salgado@inesctec.pt	Applied Photonics
53	Human-Centered Smart Traffic Systems	This proposal explores embedding human values into urban traffic control systems. It examines methods, such as adaptive traffic control, as examples of how technology can improve efficiency while enhancing accessibility and community well-being. The focus is on integrating ethical principles into data-driven traffic management to support a more inclusive urban environment. By aligning traffic solutions with values such as equity, safety, and environmental sustainability, the research aims to shift the focus from purely performance-based metrics to a more holistic understanding of	Tânia Fontes	tania.d.fontes@inesctec.pt	Enterprise Systems Engineering

		urban mobility. This includes considering the needs of vulnerable populations, reducing traffic-related stress, and promoting healthier, more liveable cities. Ultimately, the goal is to contribute to the development of traffic systems that not only optimize flow but also reflect the diverse values and priorities of urban communities.			
54	Equitable Fleet Balancing in Shared Mobility	This research proposal focuses on strategies for managing shared transportation fleets—such as bicycles and scooters—with the aim of promoting equitable access to urban mobility. It explores how data analytics and responsive design can optimize fleet distribution based on real-time demand and social needs. By prioritizing human-centric values, the project seeks to ensure that shared mobility systems are accessible, inclusive, and responsive to diverse communities. The research also considers how these systems can contribute to environmental sustainability by reducing reliance on private vehicles and lowering urban emissions. Ultimately, the goal is to develop adaptive, ethical, and scalable solutions that improve the quality and fairness of urban transportation networks.	Tânia Fontes	tania.d.fontes@inesctec.pt	Enterprise Systems Engineering
55	Causal Representation Learning for Healthcare Applications	Causal AI uses advanced techniques in causal inference and causal discovery to model and understand cause-effect relationships in healthcare data. The aim is to develop models that not only predict outcomes, but also reason about interventions, treatment effects, and counterfactual scenarios. By learning causal representations, the goal is to create more robust, interpretable, and transferable AI systems that can inform clinical decision making. Key challenges include identifying causal structures from observational data, mitigating confounding bias, and ensuring generalisation in diverse patient populations. Applications range from personalised treatment planning to predictive analytics for disease progression and risk stratification.	Ana Rita Nogueira & Ricardo Sousa	ana.r.nogueira@inesctec.pt ricardo.t.sousa@inesctec.pt	Artificial Intelligence and Decision Support
56	An Analysis of the Characterization and Evaluation of Architectural Quality in	Architectural decisions define a system's foundation, influence its quality attributes, and may impact its lifecycle in the long term. Among the most widely adopted architectural styles is the microservices architecture, which structures systems as small,	Filipe Correia	filipe.correia@inesctec.pt	Human-Centered Computing and Information Science

	Microservices-based Systems	loosely coupled, and independently deployable services. This approach provides advantages such as agility, scalability, and maintainability. Despite the growing number of studies on microservices-based systems, challenges remain in characterizing architectures of this style and in evaluating their quality. This work aims to study the use of CharM, a model for architectural characterization of service-based systems. Namely, we aim to analyze and document the results of four empirical case studies—spanning academic, industrial, and financial domains—that sought to validate CharM's usability, ease of understanding, and perceived usefulness. As follow-up work, we will apply CharM to well-known open-source systems, like the Train Ticket application, to study its use in further real-world contexts and support research on microservice architecture characterization.			
57	Agentic AI in Economics and Social Sciences	Agentic AI enables the creation of adaptive, goal-driven systems that learn and evolve, making it a powerful tool in economics and social sciences. It allows for realistic simulations of markets and societies, where agents—such as consumers, firms, or policymakers—interact and respond dynamically to policy changes or economic shocks. In macroeconomics, agentic AI can model diverse households to study the impact of reforms like universal basic income. It also supports decision-making in public policy by monitoring data and suggesting targeted interventions.	Pedro Campos	pedro.campos@inesctec.pt	Artificial Intelligence and Decision Support
58	Advancing Interoperability in Grid-Forming Control Algorithms	This research focuses on developing and validating advanced algorithms to ensure interoperability among various grid-forming control strategies deployed in inverter-based power systems. As power systems transition toward higher shares of renewable energy, maintaining system stability, reliability, and performance becomes increasingly challenging. The goal is to create coordination mechanisms that allow heterogeneous grid-forming controllers—such as virtual synchronous machines, droop-based, and virtual oscillator control—to operate harmoniously within the same network. This includes addressing dynamic interactions, system-level stability, and fault response. Researchers with experience in control algorithm design, real-time hardware-in-the-loop simulation,	Ahmed Hussein & Justino Miguel Rodrigues	ahmed.hussein@inesctec.pt justino.m.rodrigues@inesctec.pt	Power and Energy Systems

		or the implementation of grid-forming inverters are encouraged to contribute to this collaborative effort. Their insights will help shape the next generation of resilient, inverter-dominated grids.			
59	Hardware Implementation of Grid-Forming Inverters for Hybrid AC/DC	This research targets the hardware implementation of grid-forming inverters in next-generation power systems, with a focus on hybrid AC/DC networks and islanded microgrids. As the grid evolves toward higher renewable integration and reduced inertia, there is a growing need to translate advanced grid-forming control strategies from simulation to real-world deployment. The work involves designing, testing, and validating these controllers on real-time platforms such as DSPs, FPGAs, or microcontrollers, with a strong focus on dynamic stability, smooth transitions between grid modes, fault handling, and coordinated operation of multiple inverters. Experimental setups, including hardware-in-the-loop (HIL) environments, will be used to evaluate performance under realistic conditions. We invite researchers with backgrounds in embedded control, digital implementation of power electronics, and experimental validation to contribute to this effort, aiming to enhance the reliability and resilience of decentralized, inverter-based grids.	Ahmed Hussein & Justino Miguel Rodrigues	ahmed.hussein@inesctec.pt justino.m.rodrigues@inesctec.pt	Power and Energy Systems
60	Photonic Assisted Integrated Sensing and Communications	The rapid evolution of autonomous systems, intelligent transportation, and next-generation wireless networks has intensified the demand for systems capable of simultaneous sensing and communication. Integrated Sensing and Communication (ISAC) is emerging as a transformative concept for applications such as autonomous vehicles, smart cities, and 6G wireless networks. While full Radio Frequency (RF)-based ISAC has been explored, its limitations in bandwidth and signal generation highlight the need for optical-assisted ISAC and seamless integration into fibre-wireless networks. This research seeks to enhance the capabilities of next-generation networks by utilizing the broad bandwidth of photonic devices, which facilitates high-resolution sensing and high-rate communications simultaneously. Moreover, the investigation of	Henrique Manuel de Castro Faria Salgado	hsalgado@inesctec.pt	Telecommunications and Multimedia

		photonic based techniques for millimimeter-wave generation/distribution and beam steering suitable for ISAC systems combined with the development of waveform designs, will enable flexible trade-offs between data rate, range resolution, and detection distance, tailored to diverse application scenarios.			
61	Fine-Tuning a Large Language Model for Domain-Specific Language Understanding and Reasoning	Recent advancements in Large Language Models (LLMs) have led to significant improvements in natural language understanding and generation across general-purpose tasks. However, their performance often diminishes in specialized domains such as scientific literature, legal texts, and medical diagnostics, where domain-specific vocabulary, structure, and reasoning are required. Fine-tuning allows these models to adapt to domain-specific language, formats, and use cases, significantly improving accuracy and relevance. This project proposes a systematic investigation into the fine-tuning of LLMs to improve their applicability and reliability in specialized, high-stakes domains.	Shazia Tabassum	Shazia.tabassum@inesctec.pt	Artificial Intelligence and Decision Support
62	Network Digital Models and Twins	Investigation of novel ML-based algorithms and models to evolve network simulator 3 (ns-3) – the most used network simulator worldwide for wireless networks – towards a platform for supporting Digital Twins of wireless networks. This is a research topic with a long tradition at INESC TEC and increasing international visibility, namely within the ns-3 community. The visiting researcher will be integrated into the INESC TEC team that has been involved in the topic in the last 10+ years, namely in national and international projects such as DECARBONIZE, FP7 SUNNY and H2020 Fed4FIRE+ (SIMBED, SIMBED+, SMART), HEUR CONVERGE, HEUR OVERWATCH, HEUR SuperIoT, HEUR HURRICANE and HEUR REPLICA 6GS OC2.	Rui Campos & Helder Fontes	rui.l.campos@inesctec.pt helder.m.fontes@inesctec.pt	Telecommunications and Multimedia
63	Underwater Communications	Investigation of novel wireless underwater communications solutions, namely multimodal approaches combining radio, optical, and acoustics. Within this research topic, new ML-based algorithms and new communications paradigms such as semantic communications will be explored. This is a research topic with a long	Rui Campos & Helder Fontes	rui.l.campos@inesctec.pt	Telecommunications and Multimedia

		tradition at INESC TEC and increasing international visibility within the underwater communications community. The visiting researcher will be integrated into the INESC TEC team that has been involved in this research topic in the last 10+ years, namely within national and international projects such as FCT GROW, BLUECOM+, ENDURE, Under-Fi, ACOUSTNET and SEAGUARD.		helder.m.fontes@inesctec.pt	
64	On-demand 6G Communications using Robotic Platforms	Investigation of novel on-demand wireless communications solutions using robotic platforms such as drones, robot dogs and AGVs. Within this research topic, new ML-based algorithms and new communications approaches, such as LLM agents for Zero-Touch flying networks, will be explored for deploying wireless network infrastructures on-demand. The visiting researcher will be integrated into the INESC TEC team that has been involved in this research topic in the last 10+ years, namely within national and international projects such as FCT WISE, FLY.PT, 5Go, BLUECOM+, FP7 SUNNY, H2020 ResponDrone, NEXUS, HEUR CONVERGE, HEUR OVERWATCH HEUR HURRICANE.	Rui Campos & Helder Fontes	rui.l.campos@inesctec.pt helder.m.fontes@inesctec.pt	Telecommunications and Multimedia
65	3D_dampers - Three-dimensional tailored damping properties by additive manufacturing	The Green Deal will reshape industrial policies, especially in vehicle manufacturing, requiring new methods to reduce material dependency and raw material usage. Metals, due to their recyclability and performance, make metal-based additive manufacturing (AM) central to future vehicle components. While AM enables complex geometries and valuable end-of-life materials, challenges like anisotropy and fatigue remain. The 3D_dampers project takes a novel approach—rather than mitigating anisotropy, it aims to exploit it to create “vibration bottlenecks” that guide and damp vibrations, reducing fatigue-related failures. This involves two key steps: (i) studying direction-dependent properties, and (ii) applying these findings to real-time and in-situ control AM process with CRIIS. This approach could enable fully functionalized components with optimized three-dimensional vibration control, paving the way for a new generation of advanced mechanical parts and revolutionizing the future of manufacturing.	Vitor Carneiro	vitor.carneiro@inesctec.pt	Robotics in Industry and Intelligent Systems

66	Improving HPC Performance Evaluation Through Realistic Workload Modeling and Digital Twins	High-Performance Computing (HPC) plays a critical role in advancing science and innovation by enabling the execution of complex workloads at scale. However, HPC centers face persistent challenges in evaluating and optimizing system performance across both testing and production environments. Benchmarks used during the testing of HPC systems often fail to capture the complex and diverse I/O behaviors of real workloads, limiting their effectiveness. In production, tuning the performance of HPC systems without disrupting user experience is difficult, making live experimentation impractical. The goals of this research topic are to design benchmarking methods that more accurately reflect real HPC workloads and analyze their system-level impact while enhancing observability and predictability by developing a simulation model (i.e., digital twin) that mirrors the behavior of HPC supercomputers. This will enable the creation of a new generation of tools and methodologies for safely testing configurations and predicting performance without affecting HPC production environments.	João Paulo & Tânia Esteves	joao.t.paulo@inesctec.pt tania.c.araujo@inesctec.pt	High-Assurance Software
67	Where to Discount? Shelf Space Allocation Strategies to Promote Sales and Minimize Waste in Perishable Retail	Retailers frequently use price discounts to promote the sale of perishable products nearing expiration, aiming to reduce food waste and improve resource efficiency. However, the success of these strategies depends not only on discount value but also on shelf space allocation and product placement decisions. Placing discounted products near fresher items may increase visibility but can lead to cannibalization of regular sales; placing them separately demands additional operational effort and may limit exposure. This research seeks to develop quantitative models to support shelf allocation and discounting decisions that balance demand stimulation, operational constraints, and waste reduction. Additionally, discounting policies play a relevant social role by making food more accessible to price-sensitive consumers, particularly in vulnerable communities.	Sara Martins	sara.s.martins@inesctec.pt	Industrial Engineering and Management
68	Transactional techniques and	The concept of atomic transactions is key to the reliability of data-processing applications and contributes to simpler development. Thus, these technologies are increasingly relevant for data-intensive	José Orlando Pereira	jose.o.pereira@inesctec.pt	High-Assurance Software

	architectures for mutable data	systems and the data economy. Traditionally, transactional features are hard coded in the storage layer of database systems; however, cloud native database systems have made this harder to implement. Recent work by INESCTEC researchers [1,2] proposes a novel approach to isolation, recovery, and replication, using the query engine itself and aims at Hybrid Transactional Analytical Processing (HTAP) for fresh data analytics. In this context, this project welcomes researchers to focus on two complementary research questions: 1) How to take advantage of this approach to build customized transactional mechanisms for demanding large-scale applications, including for data processing graphs supporting AI applications? 2) How to re-architect existing data processing systems for optimal support of such approach? [1] https://dl.acm.org/doi/10.14778/3598581.3598598 [2] https://dl.acm.org/doi/10.1145/3709675			
69	Leveraging LLMs to handle diversity for Byzantine Fault Tolerant Heterogeneous Replication	Heterogeneous database replication is a way to overcome the lack of fault independence in database replication when the database engines are identical: a vulnerability in the common database engine (e.g. 0-day or an exploit) voids the fault tolerant effect of replication. This is particularly relevant for critical information systems. While there have been some attempts at heterogeneous database replication, the very diversity that creates value in the approach also poses its main obstacle, typically handled by limiting the diversity, by restring candidate replica database engines to the relational model) or restricting functionality by restricting a priori which queries can be performed. Having explored the use of LLMs for performing query translation and successfully performed BFT heterogeneous database replication among databases with different models (relational, document-based and graph-based, the goal of this collaboration is to further explore LLM-based online translation to generalize the approach and enable interactive workloads.	Ana Nunes Alonso & José Orlando Pereira	ana.n.alonso@inesctec.pt jose.o.pereira@inesctec.pt	High-Assurance Software
70	Fully-distributed Byzantine Fault Tolerant Machine Learning	Training machine learning models is a resource intensive task for which distribution has been proposed as different modalities of federated learning. These typically consist of a semi-centralized	Ana Nunes Alonso &	ana.n.alonso@inesctec.pt	High-Assurance Software

		architecture where a dataset is distributed among workers and a centralized parameter server decides on updates to the model. Most research on BFT in Machine Learning focuses on enabling the centralized parameter server to tolerate Byzantine workers. This setup is, however, unsuitable for scenarios where untrusted participants collaborate by training on private local datasets, which may be heterogeneous, to create a global model and, most importantly, do not trust a centralized parameter server to be honest. We proposed a distributed protocol that enables each participant to train a local model and benefit from the global dataset, empirically shown to tolerate even sporadic majorities of Byzantine participants. In this context we would like to explore novel correctness properties, useful for this specific task.	José Orlando Pereira	jose.o.pereira@inesctec.pt	
71	Using Zero Knowledge Proofs for Query Certification	Zero Knowledge proofs have been proposed to certify that SQL query results conform to the data in the database to clients without revealing the content of the database. The state of the art in this topic is to use Vector Oblivious Linear Evaluation to create interactive proofs that follow the step-by-step execution of the query plan. This results in considerable network usage between a verifier and a prover which has a markedly significant impact on the performance of each query. For this topic, the goal is to explore alternatives to provide better performance for verified queries: explore additional ZKP protocols, specific query optimization strategies that may leverage multiple protocols, etc.	Ana Nunes Alonso & José Orlando Pereira	ana.n.alonso@inesctec.pt jose.o.pereira@inesctec.pt	High-Assurance Software
72	Symbolic Data Analysis	Symbolic Data Analysis (SDA) aims at analysing complex data, that have inherent variability. The large amounts of available raw data often are not the researcher direct concern and only an analysis at a higher aggregated level puts in evidence relevant patterns. This is the case of data from social networks, large surveys, sensors, business and web-generated data. Data aggregation, however, leads to information loss; therefore variability across records should be kept	Paula Brito & Sónia Dias	paula.brito@inesctec.pt sdias@estg.ipvc.pt	Artificial Intelligence and Decision Support

		in the form of complex descriptions, e.g. sets of values, intervals, or distributions. SDA provides a framework for the representation and analysis of such complex data, considering their inherent variability. Methods for the (multivariate) analysis of symbolic data have been developed, following different approaches and criteria, taking the variability into account. SDA allows aggregating large datasets at a chosen degree of granularity while keeping the information on the intrinsic variability, and then analyse the resulting (symbolic) data arrays.			
73	Foundation Models for Multimodal Sensing: Toward General-Purpose Perception and Reasoning	Recent breakthroughs in large multimodal models have redefined AI's capabilities in reasoning across vision, text, and audio. Yet, real-world perception systems—especially in edge devices and autonomous environments—still struggle to integrate low-level sensor data like WiFi/5G CSI, RADAR, and LiDAR into generalizable frameworks. This research tackles the challenge of building a foundation model for multimodal sensing that can align and interpret heterogeneous sensor modalities in a scalable, zero-shot, and task-flexible manner. Drawing on principles from transformer architectures, modality alignment, and generative modelling, the goal is to develop a unified representation space that supports perception and semantic inference across domains such as human activity recognition, automatic wireless network reconfiguration, and driving assistance. The project aims to shift current paradigms from narrow, task-specific pipelines toward modular architectures for cross-domain sensor intelligence, enabling intelligent systems that adapt to new sensor configurations and tasks.	Luis Pessoa	Luis.m.pessoa@inesctec.pt	Telecommunications and Multimedia
74	Target Tracking Using FR2 RIS Assisted by Vision-Based Beamforming in Near-Field Conditions	This topic explores target tracking in near-field scenarios using Frequency Range 2 (FR2) Reconfigurable Intelligent Surfaces (RIS), assisted by real-time vision-based beamforming. Using the CONVERGE chamber infrastructure, stereo vision systems will estimate target distance and positioning to guide dynamic RIS beam steering, addressing the challenges of beam focus and control in non-far-field conditions. The integration of high-frequency RIS control with depth-aware visual input aims to improve tracking	Luis Pessoa	Luis.m.pessoa@inesctec.pt	Telecommunications and Multimedia

		accuracy, responsiveness, and energy efficiency. This research supports applications in robotic navigation, smart surveillance, and precision localization by combining multimodal sensing and programmable wireless environments.			
75	Sustainable Reconfigurable Intelligent Surfaces: From Material Development to Prototype Characterization	This research aims to pioneer the comprehensive development of sustainable Reconfigurable Intelligent Surfaces (RIS), encompassing material research, prototype design, simulation, fabrication, and thorough electromagnetic characterization. The project will identify, develop, and validate eco-friendly and recyclable materials that maintain high electromagnetic performance crucial for RIS, particularly at higher frequency bands. In addition to material synthesis, the project includes detailed RIS prototype design and simulation, precise fabrication processes, and extensive characterization in our state-of-the-art anechoic chamber facility. Outcomes will significantly advance eco-friendly wireless communications technology, offering viable alternatives to conventional materials without compromising operational excellence.	**Luis Pessoa**	Luis.m.pessoa@inesctec.pt	**Telecommunications and Multimedia**
76	Short-term operation tools for energy and flexibility markets with storage devices	Energy communities aim to meet customer needs by maximizing welfare, which may involve diverse objectives. These communities can also offer services like flexibility to better handle variations in load demand and renewable generation, thus improving real-time power system operations. Such variations introduce uncertainty, making short-term planning, particularly day-ahead decisions more complex. This topic focuses on developing stochastic and robust optimization methods to support energy and flexibility decisions in energy communities, particularly those with storage systems. It takes into account various scenarios of demand and renewable supply to model storage behavior and requirements accurately. A key goal is to evaluate how decision-making is influenced by using either stochastic or robust approaches. Furthermore, it is aimed create computational tools to support balancing customer goals with power system needs, enhancing decision-making in uncertain environments.	**Tiago Soares**	tiago.a.soares@inesctec.pt	**Power and Energy Systems**

77	Energy Valorization of Pulp and Paper Industry Sludge for Sustainable Electricity Generation	The energy transition and decarbonization goals are driving the adoption of innovative solutions for industrial waste valorization. The pulp and paper industry, due to its high resource and energy intensity, presents significant potential for implementing circular economy strategies. This project focuses on the energy valorization of sludge generated during the pulp production process, aiming to improve energy efficiency, reduce waste, and increase the electrical self-sufficiency of industrial units. The sludge, rich in organic matter and moisture, can be dried (e.g., using solar energy) and briquetted, enabling its use as an alternative fuel in industrial boilers for the production of thermal and electrical energy. The project includes a technical and economic assessment of this solution, evaluating its potential for continuous electricity generation, surplus injection into the grid, and participation in electricity and ancillary services markets.	Tiago Soares	tiago.a.soares@inesctec.pt	Power and Energy Systems
78	Automated Repair for Verification-Aware Programming Languages	The goal is to explore and develop techniques for the automated repair of programs written in a verification-aware programming language, preferably Dafny. The repair will be guided by the formal specification, i.e., the formal specification will be assumed to be correct and a program that does not meet the specification will be automatically repaired to satisfy it. The short-term vision is to build an open-source, proof-of-concept, tool that supports users in the correction of bugs in verification-aware programming languages. The overall goal is to encourage a wider adoption of verification-aware programming languages and to reduce the burden of repairing programs written using them.	Alexandra Mendes	alexandra.s.mendes@inesctec.pt	High-Assurance Software
79	Proof Generation for Dafny using Large Language Models	Formal verification tools like Dafny facilitate the construction of correct software by allowing developers to write specifications and automatically verify them. However, writing proofs in Dafny can still be time-consuming and challenging, particularly for complex properties. Inspired by recent advances in proof synthesis using large language models (LLMs), the goal of this proposal is to develop a novel proof generation system tailored for Dafny, that combines	Alexandra Mendes	alexandra.s.mendes@inesctec.pt	High-Assurance Software

		retrieval-augmented generation with fine-tuned LLMs to automatically synthesize proofs. The overall goal is to help improve the productitivy of Dafny users.			
80	Federated Generative Learning for Synthetic Immunological Data	This research investigates the feasibility of generating realistic immunological datasets using generative AI models, such as BERT or GPT, trained in a federated learning environment. Traditional federated learning approaches often struggle with challenges like data heterogeneity, communication inefficiency, and limited generalization across nodes. To address these shortcomings, the proposed study explores the integration of large-scale generative models capable of learning rich, contextual representations from distributed data without centralizing it. By training on local immunological datasets hosted at separate institutions, we aim to prove that these models can synthesize plausible and biologically meaningful data while preserving privacy. The focus is on evaluating the fidelity, utility, and privacy guarantees of the generated synthetic data, ensuring it reflects ground truth distributions. This approach aims to support secure, large-scale biomedical research collaboration by enabling the sharing of high-quality synthetic datasets. If successful, it could significantly enhance data availability and innovation in immunology and related biomedical fields.	Artur Rocha	artur.rocha@inesctec.pt	Human-Centered Computing and Information Science
81	Resilient and sustainable inter-modal logistics and global transportation networks	Inter-modal logistics and transportation systems play an important economic role, with significant positive impacts, but with many negative externalities. This is particularly true for inter-modal hubs, such as ports and airports. Moreover, the resiliency of the associated networks is critical, with high levels of uncertainty and disruptions. The research aims to support the design of more resilient and sustainable solutions for freight transportation and logistics, and is structured around: ports, airports, and other inter-modal hubs; synchro-modality in transportation networks; the circular economy; and global, complex supply-chains. Decision Support Systems will be developed grounded on optimization and simulation models, together with machine learning approaches. The	Jorge Pinho de Sousa	jorge.p.sousa@inesctec.pt	Enterprise Systems Engineering

		main goal is to explore different techniques and their hybridisation potential. This work is mainly directed to the operations of ports, and is strongly linked to the on-going MAGPIE European project and to NEXUS, a large-scale innovation agenda for the port, multimodal and transport sector in Portugal.			
82	Mobility as a Service for efficient, sustainable and socially inclusive urban transport of people and freight	MaaS (Mobility as a Service) may be viewed as a generic framework for the design and management of innovative (more resilient and sustainable) urban mobility services (both for people and logistics). In this context, research is naturally interdisciplinary, based on the co-creation of solutions and on digital platforms, addressing the current e-commerce challenges and environmental concerns, and providing more efficient, shared-connected and low-emission sustainable operations. The key drivers of our research are the current trends on: digitalisation; decarbonisation; social inclusion; citizen participation; the sharing economy; and the “smart city”. This work is also grounded on know-how in decision support systems, simulation, optimisation, machine learning, information and knowledge management, urban logistics and mobility, and Intelligent Transportation Systems. Strong links and collaborations with different key actors and stakeholders of these processes do feed our research in the area (mostly around doctoral projects), thus ensuring its practical relevance and impact in society.	Jorge Pinho de Sousa	jorge.p.sousa@inesctec.pt	Enterprise Systems Engineering
83	Planning sustainable urban mobility systems for metropolitan areas	Planning sustainable urban mobility systems is a challenging process, particularly at the scale of functional urban areas that encompass diverse and heterogeneous municipalities. Planning processes bring to the forefront not only financial constraints, technical capability, and access to reliable information about socio-spatial dynamics, but also power dynamics that significantly affect decision-making. In the context of the normative drive to decarbonise transport, while ensuring higher service levels and enhanced quality of life, social equity, and economic competitiveness of territories, there is a clear need of frameworks and tools to support structured and collaborative decision-making processes in designing innovative mobility services. This is	Jorge Pinho de Sousa	jorge.p.sousa@inesctec.pt	Enterprise Systems Engineering

		particularly relevant when considering the recent inclusion of metropolitan areas as urban nodes of the TEN-T network, underscoring the need for multi-level integration of decision-making processes. This research aims to address this challenge, by promoting an interdisciplinary approach, grounded on hybrid optimization and simulation models, together with AI techniques.			
84	Humans teaming with AI	We aim to explore how artificial intelligence can partner seamlessly with humans, enhancing human skills. This cutting-edge research topic aims to engage researchers on interactive and adaptive AI systems capable of understanding human intentions, providing explainable decisions, and ethically augmenting human performance. “Humans teaming with AI” represents an exciting frontier in interdisciplinary research, with focus in domain of Human-Centered AI, including topics as explainable, trustable, ethical and reliable AI. Researchers applying to this topic are challenged to shape innovative collaborations across fields like healthcare, active ageing, and beyond, transforming the potential of human-AI partnerships to tackle challenges previously beyond reach.	Hugo Paredes	hugo.paredes@inesctec.pt	Human-Centered Computing and Information Science
85	Federated active learning	Federated Active Learning (FAL) integrates federated learning and active learning to build robust, privacy-preserving AI systems, especially suited to sensitive fields such as healthcare. This research addresses key challenges of data privacy, system heterogeneity, and efficient computation at the network edge. By enabling AI models to actively query only the most informative data points from decentralized client devices, FAL minimizes labeling effort while respecting privacy constraints. Emphasizing Human-Centered and Responsible AI principles, this approach ensures transparency, accountability, and trustworthiness, essential for adoption in clinical settings. Leveraging edge computing capabilities further optimizes resource efficiency, reducing latency and enhancing scalability. Ultimately, Federated Active Learning paves the way for personalized, secure, and ethically-aligned healthcare AI solutions.	Hugo Paredes	hugo.paredes@inesctec.pt	Human-Centered Computing and Information Science