INESC TEC INTERNATIONAL VISITING RESEARCHER PROGRAMME 2024 EDITION

The Institute for Systems and Computer Engineering, Technology and Science – INESC TEC is pleased to announce the opening of the INESC TEC International Visiting Researchers Programme – 2024 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 and is committed to promoting intercultural awareness and understanding in the research arena.

Therefore, building on the success of the previous editions, we are launching a new Call destined for researchers, including Master's and Ph.D. students affiliated with Universities or other research-performing organisations outside of Portugal, interested in spending **one up to three whole months in Portugal** working on **topics of our community's interest** and aligned with the candidates' research goals.

We will be accepting applications **from March 15 until May 15 (23:59 UTC+1), 2024.**

Research internships may start any time from July 15, 2024, and must not extend beyond July 31, 2025.

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 a presentation of their research to the community.

Candidate Profile and Eligibility Requirements

The Programme will accept applications from researchers, including Master's and Ph.D. students, 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.

Researchers who have already been visiting researchers in the previous editions are not excluded from submitting a new application for the current Call. However, priority will be given to new applicants.

How to Apply

Applicants meeting, in principle, the eligibility requirements and sought profiles must first identify at least one topic and no more than three topics 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 the applicant's scientific supervisor. Kindly note that topics can be removed or withdrawn from the list if there is a match between an applicant and the topic owner.

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 internship, applicants must fill out and submit this online application form with the following documents attached:

- Complete CV in English – the CV should 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;
- 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;
- Proof of Enrollment in Master's or Ph.D. Programme *(only for applicants applying as Master's or Ph.D. Students).*

After the application period closes, INESC TEC's International Relations Service will perform eligibility checks. Applications based on incomplete forms or with missing mandatory documents will be rejected.

A scientific 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.

At this stage, 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) **between June 18 and June 21, 2024**.

[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.

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 internship, 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 to the Programme:

- Monthly allowance[2]: net amount of 1600 Euros to cover living expenses for each month of the mobility period.
- 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. 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 will not be provided housing or accommodation but may contact INESC TEC's International Relations Service for guidance on these and other matters (such as visas, when applicable).

Work Plans

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

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[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 the double taxation in Portugal. More information: https://europa.eu/youreurope/citizens/work/taxes/double-taxation/index_en.htm.

[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.

The scientific host and the admitted applicant will work together to devise a realistic work plan ahead of the internship, with clear goals and outcomes.

Depending on the workplace of the host of the admitted applicant, the work plan can be carried outin one of INESC TEC's poles in Porto, Braga or Vila Real.

Reporting and Acknowledgments

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.

Publications or other scientific outputs resulting from the work plan must acknowledge INESC TEC and its International Visiting Researcher Programme.

Data Protection

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

Non-Discrimination Policy

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 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

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

other funds (e.g.: personal savings, grants). For more information on the cost of living in Portugal, consult this website.

- Suggested reading on 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.

Annex 1 – List of Available Research Topics

	Research topic	Description of the research topic	Topic Owner	Topic Owner Email	Centre/TEC4
1	Multi-energy systems	Modelling and optimisation of multi-energy resources and networks (electricity, gas and heat networks)	Filipe Joel Soares	filipe.j.soares@inesctec.pt	Power and Energy Systems
2	Novel Computer Vision Algorithms for Lesion Detection and Segmentation in Upper Gastrointestinal Endoscopy Images	The development of novel computer vision algorithms for lesion detection and segmentation in upper gastrointestinal (GI) endoscopy images represents a crucial advancement in the field of medical imaging and diagnostics. This research topic focuses on creating and refining algorithms that can accurately identify and delineate various types of lesions, namely intestinal metaplasia ones, within the upper GI tract from endoscopic images. The challenge lies in dealing with the diverse appearance of lesions, variations in lighting, and the presence of artifacts, such as bubbles and debris. Novel algorithms will be based on Deep Neural Networks and all its state-of-the-art variations, to enhance the accuracy and efficiency of lesion detection and segmentation. Researchers working on this topic are expected to contribute to the development of robust models that can generalize well across different endoscopic equipment and patient populations, thereby facilitating widespread clinical adoption. Additional information: https://uportomy.sharepoint.com/:b:/g/personal/up423346_up_pt/EdpoEBJNMUlCu_JRPGDLoPgBJ0JOp8eEmtnyGm1BduzTYA?e=MohGgG	Miguel Coimbra	miguel.coimbra@inesctec.pt	Biomedical Engineering Research
3	Pervasive Immersive Environments	We seek to empower users for pervasive use of immersive learning environments (ILE). ILE should be usable for individuals throughout their daily activities, year-round, not just for special occasions. Institutions should be able to deploy ILE as regular part of their activities. We tackle this challenge from the perspective of providing situational awareness to participants and empowering them to create and modify ILE content.	Leonel Morgado	Leonel.Morgado@uab.pt	Human-Centered Computing and Information Science

4	Intelligent Photonics Point-of-Care for Human and Veterinary medicine	Development of new materials, optics, and biochip sensors based on the new concept of 'information specificity,' breaking with the traditional approach of 'bio/chemical specificity'. New materials can separate or concentrate molecules without the need for reactions, allowing us to design optical systems that once coupled with our information processing and AI, can identify and quantify molecules at low concentrations. We want to establish partnerships with the best research groups in Europe, allowing us to be at the forefront of reagentless point-of-care research and development in both human and veterinary medicine. We have identified key researchers from these leading institutions.	Rui Costa Martins	rui.c.martins@inesctec.pt	Robotics in Industry and Intelligent Systems
5	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 genome-scale metabolism of plants, simulating in detail the physiological response of each plant organ (e.g., roots, stem, leaves, and fruits). We want to make partnerships with plant systems biology groups to fine-tune our models as cooperation efforts.	Rui Costa Martins	rui.c.martins@inesctec.pt	Robotics in Industry and Intelligent Systems
6	Human-AI symbioses in the power system control room	The topic covers the perspective of AI-based solutions addressing a high-stakes and high-risk system, the power system traditionally operated by humans, and where AI complements and augments human abilities. The power system operated by humans, often combining human expertise with control and supervision software and different levels of automation, will face additional complexities in handling increasing uncertainty (e.g., from weather, demand). This research topic will explore the interplay between the human operator, AI-based system, and the power grid, recognizing the need to integrate human aspects (e.g., cognitive load, attention budget) in AI algorithms. The work will consist of the following steps: 1- Improve and adapt the Grid2Game (https://github.com/BDonnot/grid2game) framework to a use case where an AI assistant interacts with a human operator in a control room. 2- Create interaction scenarios to derive useful conclusions to optimize the social-	Ricardo Bessa	ricardo.j.bessa@inesctec.pt	Power and Energy Systems

		technical system. 3- Release an enhanced version of Grid2Game. Additional information: This work will be conducted in the framework of the European Project AI4REALNET - AI for REAL-world NETwork operation (https://ai4realnet.eu/).			
7	Interactive learning for secure data-driven models for power system operation	In a high-risk sector like power systems, transparency, and interpretability are fundamental principles for the ethically aligned design of AI-based systems. This requires that human experts play a pivotal role in the learning and validation phases of AI-based systems, for instance, in the hyper-parameter tuning, generation of solutions, or formal verification of the robustness and resilience of these systems. The state-of-the-art focuses on deep learning strategies, but alternatives like neuro-symbolic learning are also emerging and cannot be designed by excluding the human role. Therefore, this research topic will be focused on studying the different levels of interactive learning between humans and AI, aiming to generate new methodologies that enhance the transparency of data-driven models for different use cases, in particular dynamic security assessment and/or remedial actions for congestion management. Additional information: This work will be conducted in the framework of the European Project ENFIELD - European Lighthouse to Manifest Trustworthy and Green AI (https://www.enfield-project.eu/).	Ricardo Bessa	ricardo.j.bessa@inesctec.pt	Power and Energy Systems
8	Narrative understanding	Develop methods, models and tools for extracting narrative elements from text, towards narrative structured representation, narrative understanding and narrative exploitation. The work involves using information extraction techniques as well as neural language models, training, fine-tuning, question answering, prompting and ontologies. Opening avenues to multimodal narrative understanding and structured narrative generation is also possible. On going applications to journalistic text and clinical text. Additional information: https://text2story.inesctec.pt; https://storysense.inesctec.pt.	Alípio Jorge	amjorge@inesctec.pt	Artificial Intelligence and Decision Support

9	Human Motion Analysis for Neurological Diseases Diagnosis: AI & Computer Vision Approaches.	We are seeking 2-3 students to tackle core challenges in Human Motion Analysis, focusing on Wholebody 3D Human Pose Estimation (HPE), dynamic 3D scene reconstruction, and skeleton-based action & gesture recognition using AI and computer vision approaches. We will focus on the epileptic seizure classification use case of a neurological disease by analyzing movement patterns during seizures, called the semiology of the seizure, leveraging skeleton-based deep learning techniques proven effective in our prior studies. Essential to this effort is high-quality, whole-body 3D Human Pose Estimation that captures detailed hand and facial keypoints. Enriching the analysis with dynamic, high-fidelity 3D scene reconstructions would provide deeper insights for reviewing seizure episodes. The students can work on either of the pillars (HPE, scene reconstruction, action recognition), aligning the exact research problem according to their interests. This interdisciplinary project sits at the intersection of computational vision, medical research, and AI, offering students a unique opportunity to contribute to significant advancements in computer vision and epilepsy treatment and understanding. Additional information: Public code: https://gitlab.inesctec.pt/brain-lab/brain-lab-public/3d-uhdepil; https://gitlab.inesctec.pt/brain-lab/brain-lab-public/blanket-gen-releases. Selected publications: [1] Karacsony, T., Jeni, L. A., De la Torre, F., & Cunha, J. P. S. (2024). Deep learning methods for single camera based clinical in-bed movement action recognition. Image and Vision Computing, 104928. https://www.sciencedirect.com/science/article/pii/S0262885624000313 [2] Karácsony, T., Loesch-Biffar, A. M., Vollmar, C., Rémi, J., Noachtar, S., & Cunha, J. P. S. (2022). Novel 3D video action recognition deep learning approach for near real time epileptic seizure classification. Scientific Reports, 12(1), 19571. https://www.nature.com/articles/s41598-022-23133-9 [3] Carmona, J., Karácsony, T., & Cunha, J. P. S. (2023, June). BlanketGen-A Synthetic Blanket Occlusion Augmentation Pipeline for Motion Capture Datasets. In 2023 IEEE 7th Portuguese Meeting on Bioengineering (ENBENG) (pp. 112-115). IEEE. https://ieeexplore.ieee.org/abstract/document/10175320	Tamás Karácsony & João Paulo Silva Cunha	Tamas.karacsony@inesctec.pt joao.p.cunha@inesctec.pt	Biomedical Engineering Research

10	Sound based perception for agricultural/forestry robots	Agricultural and forestry robots require robust sensing capabilities for safety and reliability. While visual sensors are common, sound sensing presents an untapped opportunity. Sound sensors can detect humans, animals, and mechanical issues, akin to human tractor drivers. Integrating AI-based sound solutions enhances robots' auditory awareness. This enables them to respond to hazards, interact with humans, and identify mechanical anomalies more effectively. By analyzing sound data, robots become safer, more reliable, and better equipped for their tasks in dynamic environments.	Filipe Neves dos Santos	filipe.n.santos@inesctec.pt	Robotics in Industry and Intelligent Systems
11	Optimal Operation and Management of Cyber-Physical Power Systems	The topic is related to the interoperability of smart grids leveraging the contributions of prosumers in providing services for handling power balance in the local energy community, congestion management, power loss reduction, and voltage regulation for energy systems. These services can be incorporated into markets created under the transactive energy paradigm. Developing a novel competition-based enabling mechanism will empower the provision of demand-side services by engaging residential, commercial, and industrial consumers and will be designed to be scalable. Interoperable, active, and proactive operating strategies are predominant solutions for enhancing the microgrids' flexibility, reliability, and resiliency. Providing services in cyber-physical systems will aim to enable the proper environment with smart grid infrastructures and AI-based technologies for this challenge. - SCIENTIFIC CONTRIBUTIONS • Propose a modular and scalable open-source tool for the optimal control and management of smart grids. • Develop a decision support system using AI-based optimization models for active and proactive actions.	Mohammad Javadi	mohammad.javadi@inesctec.pt	Power and Energy Systems
12	Flexibility Provision in Digitalized Energy Systems	Flexibility provision in smart energy systems will reduce the overall cost of the energy supply chain. With the extensive deployment of smart devices and intelligent embedded systems, AI-based computing tools are expected to enable customers and grid operators to manage flexibility requirements transparently and efficiently. The topic is related to energy and flexibility transactions in a digitalized energy system with an interactive model. This will help to empower active	Mohammad Javadi	mohammad.javadi@inesctec.pt	Power and Energy Systems

		prosumers using the principles of transactive energy. A digitalized energy system will increase engagement in load management and provide the required flexibility. The interactions between clients and market operators should be addressed. The AI-based computing structure will aim to provide a robust environment with fast, flexible, and efficient functionality for this challenge. - SCIENTIFIC CONTRIBUTIONS • Develop innovative AI-based optimization models for boosting flexibility provision by smart homes in digitalized energy systems.			
13	Decentralized and Transactive Energy Model for Local Energy Communities	This topic is related to a multi-level energy management model using transactive models for automated energy trading within smart and sustainable energy systems. Transactive energy mechanisms can offer flexibility in market operations. State-of-the-art machine learning models, including deep reinforcement learning, will be applied to provide the interactions between different layers and sectors, while new techniques for maintaining the security and privacy of user data, such as differential privacy, will be applied. The privacy-preserving measures proposed within the transactive energy markets will provide the proper environment with robust, secure, and scalable functionality for this challenge. - SCIENTIFIC CONTRIBUTIONS • Develop a decarbonized and distributed transactive energy framework for energy management in smart grids. • Propose new privacy-preserving measures based on distributed ledger and IoT devices in transactive energy markets for consumer engagement.	Mohammad Javadi	mohammad.javadi@inesctec.pt	Power and Energy Systems
14	Study of coastal sea-level variability from the analysis of satellite altimetry data	Sea-level is an integrated indicator of the state of the climate system. Satellite measurements from radar altimetry provide regular sea-level observations at the global scale. Current continuous records of sea-level from satellite altimetry cover already the last 30 years, enabling the quantification of multi-decadal variability. Furthermore, recent improvements in the processing of the satellite altimetry measurements and the availability of new coastal products offer a good opportunity for using satellite altimetry data to quantify coastal sea-level variability. The proposed work focus on the assessment and quantification of trends, not only in the mean but also in extremes (doi: 10.1029/2008gl035182) as well as the analysis	Susana Barbosa	susana.a.barbosa@inesctec.pt	Human-Centered Computing and Information Science

		of changes in seasonality from satellite altimetry data (doi: 10.3402/tellusa.v68.30540).			
15	Study of the atmospheric electric field over the Atlantic Ocean from SAIL observations	The electrical properties of the atmosphere and the Earth's climate have a reciprocal influence, each impacting the other. Observations of the atmospheric electric field in the marine environment, unaffected by terrestrial ionisation sources, are scarce. The proposed work focus on the analysis of atmospheric electric field observations over the Atlantic Ocean collected in the frame of the SAIL campaign on board the Portuguese Navy ship NRP Sagres, focusing on the study of the daily variability of atmospheric electric field observations. Additional information: http://www.azul-infinito.net/SAIL.html.	Susana Barbosa	susana.a.barbosa@inesctec.pt	Robotics and Autonomous Systems
16	Symbolic Data Analysis	Symbolic Data Analysis is concerned with analysing data with intrinsic variability, which is to be taken into account. In Data Mining, Multivariate Data Analysis and classical Statistics, the elements under analysis are generally individual units for which a single value is recorded for each variable - e.g., individuals, described by age, salary, education level, etc. However, when the elements of interest are classes or groups of some kind - the citizens living in given towns; car models, rather than specific vehicles - then there is variability inherent to the data. Symbolic data goes beyond the usual data representation model, considering variables whose observed values for each unit are no longer necessarily single real values or categories, but may assume the form of sets, intervals, or, more generally, distributions. This complex data requires appropriate representation models, and analysis methodologies. Additional information: https://sda2018.wixsite.com/sda2023paris.	Paula Brito & Sónia Dias	mpbrito@fep.up.pt sdias@estg.ipvc.pt	Artificial Intelligence and Decision Support
17	Graph Neural Networks for Performance Prediction via Source Code Analysis	The increased need for custom computing solutions to achieve better performance at lower power cost has cause a rise in the use of High-Level Synthesis (HLS) tools. These tools enable the design of application-specific heterogeneous systems with hardware accelerators, using languages like C/C++. Part of a C/C++ program is converted to a hardware circuit, achieving performance benefits. However, HLS	Luís Miguel Mendes Pimentel Alves de Sousa	luis.m.sousa@inesctec.pt	Human-Centered Computing and Information Science

		compilers support only language subsets, require code to be written in particular ways for optimal designs, and the resulting performance is hard to predict. That is, which parts of an arbitrary application can benefit from hardware acceleration? This effort of identifying appropriate portions of code to accelerate, and then to re-write the application is currently done by expert developers, and the process is typically by trial-and-error. This topic aims to automate this process, by generating AI/ML models capable of analysing the source code of applications and identifying or classifying the suitability of certain regions of code for synthesis onto hardware. Specifically, it will address Graph Neural Network (GNN) based methods to analyse the input source code. Additional information: Aligned with on-going PhD work and research projects on compilation (https://www.aiqready.eu); Reference work: https://hdl.handle.net/10216/137152.			
18	AI Approaches for Mapping Dataflow Graphs to CGRAs	One promising approach to efficient heterogeneous computing on the edge are systems supported by Coarse Grain Reconfigurable Arrays (CGRAs) acting as co-processors for specific tasks. These architectures promise computing power greater than GPUs at a lower power cost, but a major issue is the compilation of operations onto CGRAs. This process is called mapping, and is essentially a placement and routing problem where operations, represented in a Dataflow Graph (DFG) are scheduled onto the CGRA. It is an NP-complete problem, where existing iterative or heuristic methods require long runtimes. This project aims to implement a machine learning (ML) based approach to mapping on CGRAs. The work will first determine the type of ML method to employ, gather a training/test set of CDFGs, and evaluate the effectiveness at producing mappings, especially vs. the runtime of conventional approaches. Additional information: Aligned with on-going European research project A-IQ Ready (https://www.aiqready.eu/).	Nuno Miguel Cardanha Paulino	nuno.m.paulino@inesctec.pt	Telecommunications and Multimedia
19	Mutual-benefit coordination of community energy markets and	Electricity market models focused on community organizations typically prioritize establishing transactions based on the availability and demand of existing energy resources within specified settlement periods. However, current decision-making	Tiago Soares	tiago.a.soares@inesctec.pt	Power and Energy Systems

	distribution grid management considering asset sharing	processes predominantly revolve around the financial preferences of prosumers associated with the community. Few models take into account non-financial aspects during settlement. Concerns such as local flexibility of market designs, electricity production and demand forecasting, and infrastructure limitations are prevalent in community energy markets and their distribution networks. Therefore, this project aims to evaluate the feasibility of incorporating forecasting and scheduling strategies into market designs. Additionally, it seeks to examine the impact of asset sharing strategies on local community markets, considering the physical and operational constraints of the distribution network. Additional information: https://www.inesctec.pt/en/projects/enpower.			
20	Towards a Catalog of Architectural Refactorings for Service-Based Systems	The processes of architectural refactoring and evolution involve a series of significant decisions. Such decisions have a lasting impact on various aspects of the software. However, architectural decisions are generally made in uncertain and ambiguous contexts due to a lack of knowledge about architectural characteristics, system requirements, and the solutions involved. Some strategies can help to better understand the architecture of a system, reduce uncertainties, and, consequently, facilitate more consistent architectural decision-making. Among these strategies are the adoption of architectural characterization models, techniques based on hypothesis engineering, and catalogs of architectural refactorings. Given this context, and considering the growing tendency to migrate monolithic systems to a microservices-based architecture, this project aims to refine the catalog of architectural refactorings proposed by Peixoto (2023). To achieve this goal, we intend to combine the adoption of the CharM, an architectural characterization model for service-based systems, with the hypothesis engineering technique called ArchHypo.	Filipe Figueiredo Correia	filipe.correia@inesctec.pt	Human-Centered Computing and Information Science
21	Responsible Research and Innovation Assessment	It is a work in progress in the construction of a Responsible Research and Innovation (RRI) assessment tool, where the dimensions were presented in a series of workshops within a Research and Innovation Action European Project where 35 Innovation Actions (IA) were developed. Focus-group methodology is being followed to generate discussion around the sixteen dimensions and the meanings of	Cristina Machado Guimarães	cristina.m.guimaraes@inesctec.pt	Innovation, Technology and Entrepreneurship

		the different grades of the Likert scale of an assessment tool to be applied to innovation processes and results.			
22	Optimizing Innovation Ecosystems: Enhancing Innovation Management and Supply Chain Performance	Industrial ecosystems represent dynamic networks of interconnected actors. Understanding the significance of these ecosystems, and its goals towards innovation, is an emerging topic in technology and supply chain management. While an Industrial ecosystem refers to a network of diverse industries and stakeholders operating within a geographic area, an innovation ecosystem is a fertile ground for the exchange of knowledge, ideas, and resources, essential for driving innovation. This upgrade might improve collaboration among diverse stakeholders, pooling expertise and resources necessary for tackling complex challenges and seizing emerging opportunities. Effective innovation management within these ecosystems involves orchestrating these interactions to maximize the generation and diffusion of novel ideas throughout the value chain. In that sense, our research objective is to investigate the interconnected dynamics of Industrial and Innovation ecosystems, focusing on their role in facilitating innovation management practices and reshaping supply chain strategies. Additional information: https://www.inesctec.pt/pt/projetos/risesme.	Gustavo Dalmarco	gustavo.dalmarco@inesctec.pt	Enterprise Systems Engineering
23	Biosignals wearable computing, embedded computer vision & edge-AI approaches towards Man-Machine Symbiosis.	"Man-machine symbiosis" refers to a future envisioned by J.C.R. Licklider in 1960, where humans and machines work together in a mutually beneficial way, achieving more than either could alone. Imagine humans and machines as partners, each contributing their strengths. Humans provide creativity, intuition, and judgment, while machines handle information processing, complex calculations, and repetitive tasks. This collaboration would lead to increased productivity, problem-solving effectiveness, and overall human progress. At our Neuroengineering lab we are perusing science-based with impact approaches to this disruptive concept through a combination of tiny wearable biosensors, advancements in artificial intelligence (namely edge-AI and hierarchical distributed computing), human-computer interfaces, and embedded computer vision. In this internship we will imerse the candidates into our current developments in various ways, depending on the student profile and interests.	João Paulo Cunha	jpcunha@ inesctec.pt	Biomedical Engineering Research

		Additional information: https://www.inesctec.pt/en/laboratories/neuroengineering-and-advanced-human-sensing-laboratory.			
24	Wearables for good: Tackling high-impact social challenges with wearables	Following the 2015 UNICEF challenge "Wearables for Good" [1], our *Neuroengineering Lab* has been engaged on a mission into achieving "social impact" through technology and innovation. Being one of our key contributions to science the R&D of wearables for medical purposes with several well-known high-impact results, we have been tackling this mission in numerous ways. For example, we are presently developing wearable devices for better management of Parkinson's Disease motor symptoms that are the main quality of life-affecting problem of +10 million patients and another device for high-risk pregnancy monitoring. In this internship we will immerse the candidates into our current "Wearables for Good" developments in various ways, depending on the student profile and interests. [1] https://www.unicef.org/innovation/reports/wearables-good-challenge-use-case-handbook. Additional information: https://www.inesctec.pt/en/laboratories/neuroengineering-and-advanced-human-sensing-laboratory.	João Paulo Cunha	jpcunha@inesctec.pt	Biomedical Engineering Research
25	Speed-consumption optimisation in ASVs with battery/PV panel	Autonomy of electric autonomous vehicles depends on battery capacity, namely ASV or robotic vessels, and may be extended by adding solar panels to the boat structure. However, one also requires a precise management of the power consumption sinks, e.g. motors, lights, sensors, computing power - one of the main loads is related to motion and speed. The proposed research will address specifically the optimisation/management of speed in ASV equipped with solar panels. This might be achieved by developing a new approach to track the several power draining features and include prediction features in a way that autonomy is augmented, via an adaptive process running in real time. In the power systems domain there are several approaches dealing with consumption prediction in real time and, therefore, a cross-domain fertilization in envisaged.	Nuno Cruz & Vladimiro Miranda	nuno.cruz@inesctec.pt	Robotics and Autonomous Systems

		Additional information: This is a joint cooperation between Robotics and Power Systems and is sponsored by experts from both domains.			
26	New advances in real-time information fusion for robotic navigation	Information fusion is a necessary task to be performed by systems collecting environment data from several distinct sensor systems, e.g. optical, acoustic, electrical, etc. This is characteristic of robotic navigation in field robotics, such as in sea and sub-sea navigation, but also in power system monitoring, where state estimation may depend on conventional measurement devices and on PMU (phasor measurement units). Advances in this latter domain, using information theoretic learning concepts, correntropy Kalman filters and Bayesian approaches, coupled with experience in imaging, could well be adapted and adopted for robotic navigation. This demands cross-domain research but is likely to produce important results. Additional information: This is a joint cooperation between Robotics and Power Systems and is sponsored by experts from both domains.	Nuno Cruz & Vladimiro Miranda	nuno.cruz@inesctec.pt	Robotics and Autonomous Systems
27	Rethinking storage systems for emerging I/O devices	The ever-increasing need for improved performance, reliability, and storage capacity has led to the emergence of novel I/O technologies such as persistent memory, CXL memory, and computational storage. However, existing storage stacks and I/O subsystems are designed with the same assumptions and requirements as decades-old storage devices, being unable to fully reap the benefits of these new hardware technologies, or to comply with strict quality-of-service objectives imposed by applications. Therefore, this research topic aims to redesign storage systems of today's I/O infrastructures, such as cloud-based data centers and HPC supercomputers, including caches, file systems, and key-value stores, to better support these new hardware technologies.	Ricardo Macedo	ricardo.g.macedo@inesctec.pt	High-Assurance Software
28	CarbonAware HPC Data Centers - Techniques and Tools	In recent years, the demand for computing power to process large quantities of data has increased and there is a growing need for actions that enhance sustainability awareness and responsiveness in data centers due to increasing	Ricardo Vilaça	ricardo.p.vilaca@inesctec.pt	High-Assurance Software

		energy consumption, costs, and environmental impact concerns. A focus shift from costs to carbon emissions in data center creates a research and industry gap, in which innovations related to hardware, software and applications, resource management systems, user interaction, and novel business models have an opportunity to thrive. In this topic, we aim to study, develop, and apply methods and tools to analyze, understand, and optimize energy consumption in a high-performance computing setting. In detail, the topic focuses in research in carbon-aware job scheduling in HPC centers, leveraging renewable energy sources. This topic will use the Deucalion sustainable HPC infrastructure to experiment and validate the techniques and tools being developed during the project.			
29	Predictive algorithms to optimise isolated energy systems	Development of a multi-temporal predictive algorithm to optimise the operation of hydro, renewable and thermal generation, considering different storage technologies and dynamic security constraints. Additional information: https://istentore.eu/.	Filipe Tadeu Oliveira	filipe.oliveira@inesctec.pt	Power and Energy Systems
30	Optimal operation of hybrid refineries for H2 and bio-methanol production	Development of an algorithm to optimize the operation of hybrid refineries, including green hydrogen and bio-methanol production and storage.	Filipe Tadeu Oliveira	filipe.oliveira@inesctec.pt	Power and Energy Systems
31	Advanced Signal Processing for optical tweezer backscattering probes: Towards very-high sensitivity detection of micron and nano-sized bio-particles.	Our lab has been using optical tweezer sensing platforms for characterizing bio and other micron and nano-sized particles suspended in complex fluids [1]. We are currently exploring new nano-particles sensing detection technologies for very high-sensitivity detection of these particles using advanced signal processing and AI data analysis approaches. The present position will be embedded in our team's efforts in developing these next generation sensing technology for micron and nano-sized bio-particle detection with several scientific applications. [1] Paiva JS, Jorge PAS, Ribeiro RSR, Balmana M, Campos D, Mereiter S, Jin C, Karlsson NG, Sampaio P, Reis CA, Cunha JPS (2020) iLoF: An intelligent Lab on Fiber Approach for Human Cancer Single-Cell Type Identification. Nature/Sci Rep, vol. 10: 3171. doi: 10.1038/s41598-020-59661-5.	João Paulo Cunha	jpcunha@inesctec.pt	Biomedical Engineering Research

		Additional information: https://www.inesctec.pt/en/laboratories/neuroengineering-and-advanced-human-sensing-laboratory			
32	Active cooperative underwater localisation and mapping with natural landmarks	Cooperative localisation has proved effective in formations of autonomous underwater vehicles (AUVs) or combinations of AUVs and autonomous surface vessels (ASVs). Most works have focused on the cooperation of navigation-aids and survey vehicles. Still, landmarks can opportunistically serve as local references to these robots, improving localisation as long as they are in the range of sensors. By employing a shared map of features, the cooperative tasks and actions can be adjusted while taking the most advantage of the landmarks in the environment.	Bruno Ferreira	bruno.m.ferreira@inesctec.pt	Robotics and Autonomous Systems
33	Cooperation of marine robotic vehicles	In land and aerial robotics, cooperation is enabled by fast communications, either directly or using intermediate hopping locations. In marine robotics, particularly when integrating both surface and underwater vehicles, there is no equivalent to the performance of RF communications. Therefore, the cooperation mechanisms have to be redefined to reduce the dependency on communications. In this research topic, we want to explore new lines of research that enable the operation of teams of surface and underwater vehicles with swarm behaviours with minimum communication needs.	Nuno Cruz	nuno.cruz@inesctec.pt	Robotics and Autonomous Systems
34	Underwater adaptive sampling	Typical underwater missions with autonomous robots are defined as sequences of waypoints with local or global coordinates. In some cases, the efficiency in this sampling process may be low, for example if the robot is trying to find a pollution source or other local feature in a continuous scalar field. In this research topic, we want to explore the possibility of processing environmental data in real-time and adapting the robot trajectory to find the feature, for example, depending on the local gradient.	Nuno Cruz	nuno.cruz@inesctec.pt	Robotics and Autonomous Systems
35	Network Digital Models and Twins	Investigation of novel ML-based algorithms and models to evolve network simulator 3 (ns-3) – the most	Rui Campos & Helder Fontes	rui.l.campos@inesctec.pt	Telecommunications and Multimedia

		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 and HEUR SuperIoT. Additional information: https://www.nsnam.org.		helder.m.fontes@inesctec.pt	
36	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 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 and ACOUSTNET. Additional information: https://grow.inesctec.pt.	Rui Campos & Helder Fontes	rui.l.campos@inesctec.pt helder.m.fontes@inesctec.pt	Telecommunications and Multimedia
37	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 and HEUR OVERWATCH.	Rui Campos & Helder Fontes	rui.l.campos@inesctec.pt helder.m.fontes@inesctec.pt	Telecommunications and Multimedia

		Additional information: https://wise.inesctec.pt.			
38	Preserving Privacy in Federated Learning with Partial Cryptography	Federated learning allows users to jointly train a machine learning model without sharing their raw data, however it has been found that the data sent during training can leak information about the local client datasets. To address this issue, cryptography techniques like multiparty computation (MPC) and homomorphic encryption (HE) have been considered, albeit at a high computation and communication cost. This topic targets using partial cryptography, i.e. encrypting only a subset of parameters that provide more information about the client dataset, to make it difficult to recover data from the client-to-server parameters, while also reducing the amount of data clients need to send to the server. For that, it will explore the interplay of concealing specific parameters with the underlay network model, and propose methods to assess and identify parameters that are more relevant to conceal, namely through cryptographic mechanisms.	João Vilela	joao.p.vilela@inesctec.pt	Advanced Computing Systems
39	Physical-layer Security Enhancement for Spatial Modulation Based Communication	Data throughput and the number of connected nodes have increased dramatically over the past decade, and recent studies have predicted a significant increase in those for next-generation networks. How to ensure the security of data in the communication process has become a worthy concern. This topic targets the use of physical layer techniques to enhance the security of spatial modulation-based communication. The main goal is to enhance the reliability of communication by proposing a model-driven deep learning detection architecture for generalized spatial shift keying (a type of spatial modulation) communication. Moreover, based on our existing research on artificial noise to enhance the security, we will consider beamforming approaches to weight the signal part and the noise part, instead of using a single parameter, thus expanding the solution space and leading to significantly better secrecy rates.	João Vilela	joao.p.vilela@inesctec.pt	Advanced Computing Systems
40	Federated Learning: System Optimizations and Medical Applications	The research topic aims to explore storage and privacy optimizations for Federated Learning (FL), particularly in the context of its application in medical imaging. In this sense, the topic should focus on mechanisms to optimize storage efficiency in FL systems to handle large-scale medical imaging datasets while preserving data	João Tiago Paulo	joao.t.paulo@inesctec.pt	High-Assurance Software

		privacy. This research will investigate novel approaches to address these challenges, possibly leveraging techniques such as differential privacy, secure aggregation, model compression, sparse updates, or quantization methods. Ultimately, this research should promote more storage and compute-efficient FL systems without significant loss in model accuracy. Moreover, the findings should contribute to advancing FL systems tailored for medical imaging applications, fostering secure and collaborative learning across healthcare institutions while safeguarding patient privacy.			
41	Causal Discovery Methods in Machine Learning for Real-World Applications	This research topic focusses on the development of novel algorithms and methodologies for causal discovery in machine learning. Causal discovery is crucial to understanding complex systems and making informed decisions. The aim is to investigate methods for identifying causal relationships from observational data, utilising techniques such as Bayesian networks, structural equation modelling, and counterfactual reasoning. Researchers will explore advanced statistical methods to uncover causal structures in datasets, paving the way for more accurate predictions and interventions. Potential research areas include causal discovery from high-dimensional data, handling confounding variables, integrating domain knowledge into causal models, and applying causal discovery in various real-world applications such as healthcare, finance, and social sciences. Applicants will explore cutting-edge techniques to advance the field of causal discovery and contribute to developing more robust and interpretable machine learning models, ultimately leading to significant advances in artificial intelligence and data science.	Ana Rita Nogueira & Ricardo Sousa	ana.r.nogueira @inesctec.pt	Artificial Intelligence and Decision Support
42	Socio-technical approaches to digital transformation	Digital transformation is an intervention in a sociotechnical system (STS) of potentially profound scope. Classical STS theory emerged from analysis of individuals and work groups and principles have been defined for the design of work systems at that level. There is a need to explore how STS design principles may be applied to the enterprise-level challenges associated with digital transformation.	António Lucas Soares	antonio.l.soares @inesctec.pt	Enterprise Systems Engineering

43	Enterprise architectures as boundary objects	Boundary objects are abstract or physical artifacts that support knowledge sharing and coordination between different communities of practice by providing interfaces. We want to explore how a multiple disciplinary perspective enhanced during the STS design of digital-enabled enterprises by the use of system artifacts functioning in the role of boundary objects. The specific type of artifacts to be studied are Industrial Reference Architectures such as RAMI4.0, IDS-RAM3.0, and others.	António Lucas Soares	antonio.l.soares@inesctec.pt	Enterprise Systems Engineering
44	Exploring Large Language Models for enhanced Digital Twin management	The goal of the internship is to explore the potential for using generative AI to enhance the management of data and information in digital twins. The data and information managed in a digital twin is heterogeneous and includes data sets, text, images and video documents, several types of models - physical models, structural models, behavioural models, etc. Our goal is to use LLM combined with semantic techniques (e.g., knowledge graphs) to enable integrated vectorial and semantic search in a digital twin heterogeneous information.	António Lucas Soares	antonio.l.soares@inesctec.pt	Enterprise Systems Engineering
45	Pulmonary hypertension detection via heart sound analysis	Heart sounds are emerging as a promising biomarker for the detection and monitoring of a wide range of cardiovascular and respiratory diseases, such as Pulmonary Hypertension and Heart Failure. Currently, the detection of these diseases relies on expensive and invasive exams such as Right Heart Catheterization and Echocardiography. The recording of heart sounds is particularly appealing because of its noninvasiveness, low cost, and portability, which make it suitable for use in home monitoring applications and in underprivileged scenarios. The proposed research project focuses on the analysis of heart sounds for the prediction of Pulmonary Hypertension. Two main approaches will be explored, namely the use of Machine Learning and Deep Learning methods for the detection of the pathology, and the extraction of parameters of clinical interest from the signals to estimate the variations of the intracardiac pressures.	Francesco Renna	francesco.renna@inesctec.pt	Biomedical Engineering Research
46	Deep Learning for Image-Based		João Pedrosa	joao.m.pedrosa@inesctec.pt	TEC4HEALTH

	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.			
47	Intelligent Composite Indicators Systems for Energy Access Disparities and Environmental Sustainability	Many regions and communities lack reliable access to affordable energy sources, leading to socioeconomic disparities. Composite indicators can integrate data on energy access, affordability, and reliability to identify areas in need and guide targeted interventions, such as off-grid solutions or infrastructure investments. In addition, energy production and consumption contribute to environmental degradation, including air and water pollution and greenhouse gas emissions. Composite indicators can assess various environmental metrics, such as carbon emissions, pollution levels, and renewable energy penetration, to gauge the sector's sustainability performance and inform policies to mitigate environmental impacts. Integrating composite indicators with intelligent agent-based systems can enhance decision-making and resource allocation in the energy sector by leveraging real-time data, predictive analytics, and autonomous decision-making capabilities. We welcome proposals to develop intelligent agents to collect, process, and integrate data from diverse sources relevant to composite indicators to access and predict energy consumption patterns, infrastructure performance metrics, environmental monitoring data, and socioeconomic indicators.	Flávia Barbosa	flavia.barbosa@inesctec.pt	Industrial Engineering and Management
48	Integrating Event Simulations and Non-parametric Frontier Estimations for	This proposal aims to address prevalent operational reliability issues using advances in Discrete Event Simulations (DES) and non-parametric Data Envelopment Analysis (DEA). By combining non-parametric frontier estimations and event simulations, the proposal should facilitate the construction of dataset scenarios and comparisons	Flávia Barbosa	flavia.barbosa@inesctec.pt	Industrial Engineering and Management

	Enhanced Reliable Operations	with simulated data, which will prove particularly beneficial to operational contexts where cross-sectional or time-series production occurrences are unavailable. Methodological developments include, but are not limited to: · Advancements that facilitate the optimization of preventive maintenance strategies, minimizing downtime and maximizing asset utilization; · Allocation of limited resources, such as workforce, spare parts, and maintenance budgets; · Expansion of current models and methodologies consistent with simulating different scenarios and process variations; · Modeling supply chain dynamics to identify vulnerabilities and formulate contingency plans; · Integration of complex systems interactions in production lines, transportation networks, and utility infrastructure; · Measuring performance trends and simulating maintenance interventions; · Measuring technical, scale or allocative operational efficiencies with multiple input scenarios and multiple simulated outputs; · New methodologies to identify bottlenecks, optimize resource utilization and improvements that lead to efficient and effective services.			
49	Composite Indicators for measuring sustainable transitions in the scope of UN's Sustainable Development Goals.	Sustainable transitions refer to societal, economic, and environmental shifts towards more sustainable practices and outcomes. These transitions are necessary to address global challenges such as climate change, resource degradation, and social inequality. Composite indicators are tools that combine multiple individual indicators or metrics into a single measure, providing a comprehensive assessment of complex phenomena. This proposal aims at holistic assessments of sustainable transitions in the scope of The United Nations Sustainable Development Goals (SDGs), integrating several dimensions, such as environmental, social, and economic factors, into a single measure. More specifically, this proposal focuses on global challenges such as poverty, gender disparities, resource efficiency and justice by constructing non-parametric indicators for measuring sustainable production capacity, performance, equality and comparative advantages to aid policymakers and stakeholders with a better understanding of the overall state of social development and identify areas that require attention and fair access to resources and opportunities.	Flávia Barbosa	flavia.barbosa@inesctec.pt	Industrial Engineering and Management

50	Performance evaluation of public security using DEA and ML	The project aims to contribute to improving efficiency in the management of Public Security based on the use of mathematical optimization models, frontier techniques, artificial intelligence and data science models, including time series analysis statistics, to support analyse the efficiency and effectiveness of Police Departments and thus monitoring strategies and allocation of police resources. Firstly, a mapping of the processes of the productive units will be carried out in order to diagnose the inputs used and outputs generated. Then, Data Envelopment Analysis will be used to measure the efficiency. Based on these estimates of the levels of efficiency, it is intended to optimize the allocation of resources to improve the performance and effectiveness of the units. Finally, this project is aligned with one of the Sustainable Development Goals (SDGs), which deals with building effective institutions to prevent violence, this project aims to contribute to improving efficiency in the management of Public Security.	Flávia Barbosa	flavia.barbosa@inesctec.pt	Industrial Engineering and Management
51	Analysis and proposition of management and optimization models to support the public transport system	A transport system is made up of a set of elements that comprise passengers and goods to be transported, the vehicles that carry out the journeys and the transport infrastructure network that allows the system to operate. Transport and maintenance management systems are essential to ensure the efficiency, safety and reliability of transport operations, whether on roads, railways, airports, ports or public transport systems. This research project proposes the application of Operational Research concepts to solve Urban Mobility problems. In fact, the development of operational research techniques that contribute to better planning of public transport systems tends to minimize problems arising from urban traffic, as well as helping to better serve the population. For modelling, real and random instances will be used.	Flávia Barbosa	flavia.barbosa@inesctec.pt	Industrial Engineering and Management
52	Explainable Artificial Intelligence for Face Presentation Attack Detection (xAI4FacePAD)	The face is one of the most advanced biometric traits, currently used for identification and identity verification in both high-security governmental systems, such as airports and border control, and mainstream technologies, such as smartphones and laptops. The information learnt by face recognition systems that rely on deep learning models is not transparent to humans. These highly complex systems learn correlations from non-causal events and infer potential causal relations. Hence, some of these systems, despite having extraordinary	Ana Sequeira	ana.f.sequeira@inesctec.pt	Telecommunications and Multimedia

		performance, are weak against adversarial attacks or unseen samples. This work will focus on applying AI explainability tools to face biometrics focusing in particular in face presentation attack detection (PAD) (aka, antispoofing). Additional information: Sequeira, AF; Gonçalves, T; Silva, W; Pinto, JR; Cardoso, JS, "An exploratory study of interpretability for face presentation attack detection", IET Biometrics, 2021 Sequeira, Ana F., João T. Pinto, Wilson Silva, Tiago Gonçalves and Cardoso, Jaime S., "Interpretable Biometrics: Should We Rethink How Presentation Attack Detection is Evaluated?", 8th IWBF2020 https://vcmi.inesctec.pt/projects/xaibio.			
53	Robust and Fair Lightweight Deep Learning Methods for Enabling Recognition in Embedded Domains	This research challenge focus on developing machine learning methods for neural networks complexity reduction including the development of methods for the evaluation of biases, fairness, overestimation and related metrics. In particular, the proposed work focuses on the development of on-board solutions that can be applied in real time. These solutions are agnostic to several distinct applications. The majority of the approaches for these systems, such as pruning, knowledge distillation or quantization rely on the development of less complex neural networks. However, less complexity can imply hidden sacrifices and drawbacks. As such, the expected work extends the development of efficient neural networks that are aware of fair and biases related problems. Additional information: https://vcmi.inesctec.pt/projects/new-space-portugal.	Ana Sequeira	ana.f.sequeira@inesctec.pt	Telecommunications and Multimedia
54	Enhancing Process Discovery in Process Mining with Deep Learning	Automatically discovering accurate process models remains a challenge in Process Mining. While existing heuristic techniques excel in scalability and workflow discovery from event logs, they struggle with noisy data. Event logs often contain inconsistencies like duplicate tasks, missing entries, or noise. These issues introduce uncertainty, hindering the creation of reliable process models and work flows. The recent success of Deep Learning algorithms adept at handling temporal sequences offers exciting possibilities for Process Mining. In this scenario, Deep learning could lead to the development of entirely new process discovery algorithms or significantly improve existing ones. Therefore, this research line proposes investigating how suitable Deep Learning techniques are and how to apply them to	Ricardo Sousa & Ahmed Fares	ricardo.t.sousa@inesctec.pt ahmed.a.fares@inesctec.pt	Artificial Intelligence and Decision Support

		Process Mining. The final goal is to enhance process discovery accuracy by leveraging Deep Learning's ability to handle complex and noisy event log data.			
55	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 data-driven approaches. The 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.	Jorge Pinho de Sousa	jorge.p.sousa@inesctec.pt	Enterprise Systems Engineering
56	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, 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 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

57	Design of Sub-THz Reconfigurable Intelligent Surfaces	INESC TEC has been coordinating the EU project TERRAMETA, which targets the development of Reconfigurable Intelligent Surfaces (RIS) in the 140 GHz and 300 GHz bands. The aim of this research topic, aligned with TERRAMETA, is to investigate novel sub-THz RIS spatial feeding architectures that are compatible with multiple RF chains (i.e. holographic architectures), while taking into account hardware limitations that arise at such high frequencies, such as the interconnection loss from the transceiver to the antenna structure, and addressing potential solutions such as waveguide/SIW-based feeding. The work entails simulation using 3D electromagnetic simulators (HFSS, CST), as well as prototyping and experimental characterization using a setup with a VNA and frequency extenders. Additional information: www.terrameta-project.eu.	Luis Pessoa	luis.m.pessoa@inesctec.pt	Telecommunications and Multimedia
58	Vision-aided communications and sensing empowered by RISs	INESC TEC has been coordinating the EU project CONVERGE, which targets the development of novel research tools integrating 5G FR2 radio equipment, RIS and computer vision towards a novel paradigm of integrated communications, localisation and sensing in 6G. The key objective of this research topic is to demonstrate vision-aided communications and sensing using RISs. This entails the identification and optimisation of ML methods for the processing of multiple video streams collected along a large RIS, as well as the study of ML methods to synthetize near-field RIS phase profiles with low computational complexity, while enabling the extraction of sensing/localisation/mapping/imaging data. The work will address the development of prototypes for testing and validation purposes and the preparation of test-setups and collection of vision and radio datasets for validating the developed algorithms. Additional information: www.converge-project.eu.	Luis Pessoa	luis.m.pessoa@inesctec.pt	Telecommunications and Multimedia
59	RF-aided computer vision	EU project CONVERGE aims at exploring how RF (Radio Frequency) can be used as a complementary to computer vision tasks as conventional cameras are subject to Line-of-sight (LoS) and lighting conditions and cannot capture occluded objects. The	Paula Viana & Luis Pessoa	paula.viana@inesctec.pt	Telecommunications and Multimedia

		key objective of this research topic is to study RF-Vision approaches capable of bypassing such difficulties. The work will address the research of multimodal datasets suitable for this scenario, identification and optimisation of ML methods for processing these data and the development of prototypes for testing and validation purposes. Additionally, the creation of a dataset comprising these modalities is also envisaged. Additional information: https://converge-project.eu/.		luis.m.pessoa@inesctec.pt	
60	How do product discount policies and shelf space allocation impact food waste?	Grocery retailers implement discounting policies for products near expiration to promote the product's sale before it is spoiled. The literature on discounting policies focuses on when the discount should be made and at what amount. Nevertheless, how and where the discounted product is presented to the customer can impact the potential demand. Retailers have different approaches to displaying discounted products, such as on the regular shelf with the no discounted/fresher products versus all the discounted products bundled in a box in a given shelf position. The distinct display settings require different operational efforts and account for different demand effects. This research aims to study how product discount policies and shelf space allocation impact demand and, therefore, the food waste generated by analyzing the different demand effects that play a role when near-expired products are discounted. Additional information: This topic can be related to the BeFresh project. Although this interconnection between discounting policies and shelf space allocation was not planned within the project, during the research, we identified it as an interesting topic to pursue, covering a gap in the literature.	Sara Martins	sara.s.martins@inesctec.pt	Industrial Engineering and Management
61	Planning sustainable urban mobility systems for functional urban 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	Jorge Pinho de Sousa	jorge.p.sousa@inesctec.pt	Enterprise Systems Engineering

		higher service levels and enhanced quality of life, social equality, and economic competitiveness of territories, there is a clear need of frameworks and tools to support structured and collaborative processes in designing innovative mobility services. This research aims to address this challenge. By promoting an interdisciplinary approach, the main goal is to produce actionable knowledge to support effective and participatory planning processes. This is 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.			
62	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 Sofia Ferreira Mendes	afmendes@fe.up.pt	High-Assurance Software
63	Large Language Models Trained on Dark Web Data to Support Decision Making	The main goal of this proposal is to investigate how to best develop a prototype software that makes use of an LLM trained on a comprehensive dataset from the dark web, and policies relevant to security and defense, aimed at enhancing policy formulation, defense strategies and policies, and law enforcement operations against cybercrime, illicit trade, and other dark web facilitated threats. Some expected tasks include: an analysis of dark web marketplaces and collection of data from those; fine-tuning an LLM with the data collected plus relevant policies for security and defense; comparative evaluation of prompting approaches/strategies to provide to the relevant parties suggestions on how to obtain better results from the model.	Alexandra Sofia Ferreira Mendes	afmendes@fe.up.pt	High-Assurance Software
	Smart-grid ready buildings: from		Hermano Bernardo	hermano.bernardo@inesctec.pt	Power and Energy Systems

64	building automation to demand-side energy flexibility.	Energy flexibility may address several challenges of societal transitions towards a low-carbon energy system with distributed and intermittent energy resources coupled with an increasing dynamic electrical energy demand in buildings. Controlling the time and amount of building energy consumption using advanced interoperable automation technologies will support the power grid in maintaining balance between supply and demand. This internship aims at exploring the challenges of building automation towards an effective management of demand-side energy flexibility in buildings, while keeping the comfort provided to occupants.			
65	The role of digital twins in smart building operation and management	Digital Twins are a promising tool towards a holistic digitalisation of the built environment. It has the potential to improve the building energy performance and management, increase power grid flexibility, improve the coordination of emerging technologies, such as renewable energy production and storage, heat-pumps, and electric vehicles, but there is still a significant potential to be explored. The aim of the internship is developing the foundations to the implementation of a scalable Digital Twin on a laboratory or building testbed.	Hermano Bernardo	hermano.bernardo@inesctec.pt	Power and Energy Systems
66	Identification and control of autonomous underwater vehicles (AUVs)	This research area focuses on developing algorithms and systems for identifying the dynamics and characteristics of AUVs. It also involves designing controllers to effectively navigate and maneuver these vehicles in underwater environments. Key aspects include system identification, structural design, parameter estimation, and control system design. Research in this field aims to enhance the autonomy, reliability, and efficiency of AUVs for various applications such as underwater exploration, surveillance, and environmental monitoring. Current trends involve advancements in localization, navigation techniques, and optimizing control strategies to improve AUV performance.	Paulo Lopes dos Santos	paulo.santos@inesctec.pt	Robotics and Autonomous Systems
67	Development of Battery Management Systems (BMS) for autonomous underwater vehicles (AUVs)	This research area focuses on designing and optimizing BMS specifically tailored for AUVs to ensure efficient and reliable power management. BMS for AUVs must address unique challenges such as limited space, harsh underwater conditions, and the need for prolonged battery life. Research in this field involves developing strategies for monitoring battery health, optimizing charging and discharging cycles, and implementing thermal management systems to prevent overheating. The goal	Paulo Lopes dos Santos	paulo.santos@inesctec.pt	Robotics and Autonomous Systems

		is to enhance the overall performance, endurance, and safety of AUVs by maximizing the utilization and longevity of onboard battery systems.			
68	Interpretable Machine Learning: an image analysis approach	With the widespread use of machine learning (ML), the importance of interpretability has become clear in avoiding catastrophic consequences. Black box predictive models, which by definition are inscrutable, have led to serious societal problems that deeply affect health, freedom, racial bias, and safety. Interpretable predictive models, which are constrained so that their reasoning processes are more understandable to humans, are much easier to troubleshoot and use in practice. It is universally agreed that interpretability is a key element of trust for AI models, and image analysis is a particular and special case. The objectives for this research topic are: study the state-of-the-art interpretable ML approaches for image analysis; compare the performance of such techniques; analyze whether any of the current modules can be adapted/modified in order to achieve a solution; compare the performance of our methodology with state-of-the-art ones. Additional information: https://www.ai4lungs.eu/.	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt	Telecommunications and Multimedia
69	AI-based cancer characterisation using semi-supervised learning algorithms	The development of computer aided systems for cancer characterisation has been an intense research field, considering the value of the outcomes for more adequate and personalized treatment plan assignments to increase survival chances. Medical images have shown to provide valuable information on the biological phenomena associated with cancer development, which can be used to design Artificial Intelligence (AI)-based predictive models for support in the clinical routine. From the clinical side, the imaging annotation process can be extremely difficult, subjective and time-consuming, which motivates the development of models that can benefit from labelled and non-labelled data. In this work, the use of semi-supervised methodologies is intended to be explored considering the large amount of non-labelled publicly available data that might enhance the predictive abilities of the models. By not constraining the models to use only annotated data, this learning strategy avoids the fully dependence on the annotation process.	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt	Telecommunications and Multimedia

		Additional information: https://www.ai4lungs.eu/.			
70	AI-based cancer characterisation using multimodal data	The advances in AI methodologies have enabled the development of computer-aided systems capable of accurately provide assistance in several clinical tasks, reducing the effort, time-cost and subjectivity factors inherent to completely manual tasks. However, because different modalities of medical data are generated over the multiple stages of the clinical routine, novel AI-based tools should also advance in this direction by exploring the aggregation and benefits of multimodal data to provide more reliable decisions. In this work, the aggregation of distinct types of features is intended to be explored, considering the potential to leverage the prognosis estimation ability and clinical decision-making. Developing learning models capable of dealing with the complexity of each data modality and also adequate to integrate distinct types of medical information will create a comprehensive and more robust understanding of the problem by capturing the implicit relationships between the different modalities. Additional information: https://www.ai4lungs.eu/.	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt	Telecommunications and Multimedia
71	Generation of Artificial Medical Imaging	Artificial intelligence (AI) enables data-driven innovations in health care. AI systems, which process vast amounts of data quickly and in detail, show promise both as a tool for preventive health care and clinical decision-making. However, the distributed storage and limited access to health data form a barrier to innovation, as developing trustworthy AI systems require large datasets for training and validation. Furthermore, the availability of anonymous datasets would increase the adoption of AI-powered tools by supporting health technology assessments. In this way, providing synthetic data will boost data-driven innovation without compromising the privacy of data subjects. In this proposal, we will advance the current state-of-the-art data synthesis methods towards a more generalized approach of synthetic data generation. We will also develop metrics for testing and validation, as well as protocols that enable synthetic data generation. Additional information: https://www.phase4ai-project.eu/.	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt	Telecommunications and Multimedia

72	Deep Learning for Image Super-Resolution	Image super-resolution (SR) is the process of recovering high-resolution (HR) images from low-resolution (LR) images. It is an important class of image processing techniques in computer vision and image processing and enjoys a wide range of real-world applications, such as medical imaging, satellite imaging, surveillance and security, astronomical imaging, amongst others. With the advancement in deep learning techniques in recent years, deep learning-based SR models have been actively explored and often achieve state-of-the-art performance on various benchmarks of SR. A variety of deep learning methods have been applied to solve SR tasks, ranging from the early Convolutional Neural Networks (CNN) based method to recent promising Generative Adversarial Nets based SR approaches. Additional information: https://www.phase4ai-project.eu/.	Tania Pereira & Hélder Oliveira	tania.pereira@inesctec.pt	Telecommunications and Multimedia
73	Verified Implementations of Replicated Data Types	Conflict-free Replicated Data Types (CRDTs) are a popular class of distributed data structures that provide strong eventual consistency guarantees for replicated data. An elegant framework is that of pure operation-based CRDTs, where the transmission of information is exclusively done through a reliable causal delivery protocol, and delivered messages are then incorporated into a partially ordered log. This however leaves some data-type-dependent reasoning to be manually crafted, and recent efforts propose more generic constructions on top of the pure op-based framework. As implementations of distributed objects are often complex, verification of their correctness is less common. For the case of CRDTs, a particularly interesting effort is their verified implementation in Liquid Haskell, including proofs of concrete state-based designs and of a reliable causal delivery protocol. The goal of this project is to explore how to combine recent efforts to develop a verified implementation of a pure op-based framework in Liquid Haskell.	Hugo Pacheco	hpacheco@fc.up.pt	High-Assurance Software
74	Research and development of new biomarkers derived from EEG and EMG of swallowing muscles	Research new biomarkers derived from EEG and EMG of swallowing muscles (non-invasive and “low cost” techniques that can provide objective and quantitative information compared to current techniques) for diagnosing and assessing post-stroke dysphagia and the possible effects of therapies, in collaboration with the	Miguel Coimbra	miguel.coimbra@inesctec.pt	Biomedical Engineering Research

		UPValência, and two international hospitals.The swallowing process is a complex physiological function that often goes unnoticed in our daily lives. However, for individuals with dysphagia, a swallowing disorder, this seemingly natural process can become a significant challenge. Dysphagia prevalence in the world population is around 6 %, but in the elderly population, this dysfunction increases to 22 %. Neurogenic dysphagia is one of the most common and at the same time most dangerous symptoms of many neurological diseases. Dysphagia is very frequent in stroke patients, with a prevalence between 28 and 73% [Lendinez-Mesa et al, 2014]. Affected patients have a 4 times higher risk of aspiration pneumonia, suffer more often from severe long-term disability, and also show significantly higher mortality [Joundi et al., 2017]. Conventional techniques have a very limited diagnostic capacity, leading to underdiagnosis [Sanchez-Sanchez et al., 2021] and a significant increase in mortality [Cocho et al., 2017]. The diagnosis and treatment of neurogenic dysphagia is a challenge and requires a joint effort of different medical professions and techniques [Dziewas et al., 2021]. While the evidence supporting the implementation of dysphagia screening is quite convincing, more refined techniques and methods for diagnosing dysphagia are needed, and in particular, the different treatment options for neurogenic dysphagia [Dziewas et al., 2021]. Currently, Videofluoroscopy (VFS) is the gold standard, followed by fiberoptic evaluation of swallowing (FEES). In the Uptodate (Martino et al., 2005), the review performed describes a detection of dysphagia by clinical screening techniques of 37 to 55%, compared to 64 to 78% if instrumental tests are included.			
75	Adaptive protection systems for Inverter-Based Resources dominated power systems	The increasing penetration of Inverter-Based Resources (IBRs) in power systems, such as renewable based energy sources and energy storage, presents new challenges for traditional protection schemes. These challenges arise due to the unique characteristics of IBRs compared to conventional generators, such as their low contribution to short-circuit currents and to the inertia of power system. This project focuses on understanding how adaptive protection systems can adapt their behavior in response to changing system conditions and IBR operation. Examining different adaptive protection techniques highlights the limitations of conventional protection schemes and how adaptive protection methods address them, including understanding their functionalities, advantages, and potential drawbacks to overcome. This project aims to conduct a critical evaluation of the current state of	Cleberton Reiz	cleberton.reiz@inestec.pt	Power and Energy Systems

		knowledge in this field and identify gaps for further research and development, contributing to a more reliable operation of IBR-integrated power grids.			
76	Exploring service design to leverage the role of living labs in sustainability transitions	Living labs can play a key role in sustainability transitions, as they create protected spaces for experimentation and learning in real-life environments, as well as a set of processes, methods and tools for developing and experimenting with solutions for societal challenges, such as energy transition. Living labs can be viewed as innovation infrastructures, bringing together various stakeholders for active collaboration in experimenting, developing, co-creating, and testing new products, services and systems , but less is known about how living labs can contribute to reconfigure societies, in their capacity to invent and experiment with more sustainable lifestyles. This topic explores how a multi-level service design approach can contribute to leverage the role of Living Labs. On the one hand, service design can contribute to understanding users and translating this understanding into new sustainable service solutions. On the other hand, service design can offer a multi-level perspective for designing the constellation and infrastructure required for value cocreation among multiple actors in service systems, for broader service ecosystem transformation toward sustainability. Research on this topic will be undertaken in collaboration with two projects exploring the application of service design in Living Labs for energy transition.	Lia Patrício	lpatric@fe.up.pt	Industrial Engineering and Management