# INESC TEC INTERNATIONAL VISITING RESEARCHER PROGRAMME 2023 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 – 2023 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 2022 edition, 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 at the Institute on **topics of our community's interest** and aligned with the candidates' research goals.

We will be accepting applications on a _rolling basis_ until November 30, 2023, unless all fifteen vacancies for these short-term research internships have been taken before that deadline or all funds assigned to this Call are exhausted.

**Research internships may start any time from August 1, 2023, and must not extend beyond July 31, 2024.**

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 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 first edition are not excluded from submitting a new application for the current Call. However, priority will be given to new applicants. Therefore, former participants will be notified whether they have been admitted to the Programme only after the 30th of November (or earlier if the conditions to close the Call before that deadline are met).

# 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 that align with their interests and those of their home institution.

Each topic has 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 host for questions strictly related to the scope of the work underpinning the topic. However, at this stage, applicants are discouraged from sending any documents that make up 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;

- 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).*

Applications will be dealt with continuously, with INESC TEC's International Relations Service performing an eligibility check in the first instance. 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.

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[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.

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 will be notified of the panel decision and whether they will receive financial support under this Call, in principle, within one month after submitting their application. The notification time might **be extended in August due to our staff's summer holidays**. Notification is sent by e-mail with a delivery receipt notification.

## Financial Assistance and Mobility Contract

For the period of the visit, INESC TEC will confer upon admitted applicants the status of External 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.

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).

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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.

## 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. 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 implemented in 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

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

celebrates diversity and is committed to creating an inclusive environment for all its employees and visitors.

## 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

*(Interested individuals are encouraged to check this PDF regularly since topics may be added or withdrawn at any time.)*

| | Research topic | Description of the research topic | Topic Owner | Scientific Domain |
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| 1 | HumanAI | HumanAI aims to address the Human Factors in Artificial Intelligence, researching the cooperation between Humans and Machines from a human centred perspective. Under this research topic, Crowdsourcing, Citizen Science, Explainable AI and Federated Learning are currently hot topics. Crowdsourcing involves harnessing the power of a large group of people to accomplish a task being used to label data, verify the accuracy of AI models, and provide feedback on their performance. Similarly, citizen science involves engaging the public in scientific research, allowing them to contribute their time, knowledge, and resources to help solve complex problems. Federated learning and explainable AI are topics under the AI domain, where the impact of a human centered approach has the potential to create models that are more accurate, reliable, and trustworthy, while also empowering people to participate in AI research and development. | Hugo Paredes | **Human-Centered Computing and Information Science** |
| 2 | Wearables for Good: exploring opportunities for high societal impact with wearable technology | Wearables are a promising type of technology for many high impact societal scenarios. BRAINlab is approaching some of these scenarios and is welcoming researchers willing to join our lines of R&D. | João Paulo Cunha | **Biomedical Engineering Research** |
| 3 | Spatial temporal traffic flow prediction | Spatial temporal learning problems are problems very common in our everyday life. Meteorological prediction, yield crop prediction, pandemic prediction, trajectory prediction, and traffic flow prediction are all spatial temporal problems. Despite that, each of these problems has its own specificities. We are interested in the traffic flow prediction problem. Currently, deep learning approaches are state-of-the-art in this kind of problem. Namely, LSTM, CNN, and transformers are the approaches most well succeeded to deal with it. In this proposal, we intend to explore a bit more this kind of approach for traffic flow prediction. | João Mendes Moreira | **Artificial Intelligence and Decision Support** |
| 4 | Evolutionary game theory | Evolutionary Game Theory applied to various topics of social interest, such as caring for the environment, public goods, evolution of corruption in democratic countries, learning and adapting to new technologies, study of the role of companies and the government in the implementation of new | Alberto Adrego Pinto | **Artificial Intelligence and Decision Support** |

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| | | technologies.<br>Analysis of the evolution as a result of solutions of dynamic systems corresponding to the dynamics of the replicator, predator and prey and in general Lotak Volterra systems. | | |
| 5 | Optimising livestock farming and ethanol production for sustainable bioenergy and food production | Considering determining factors for the growth of the Brazilian ethanol industry, such as technological advances and the introduction of corn ethanol production, the demand emerges to optimise integrated ethanol production systems and livestock farming for sustainable bioenergy and food production. To this end, it is necessary to consider synergies between the production chains of ethanol from sugarcane and corn, livestock farming, and other crops such as soybean and peanut for animal feed supply, and eucalyptus as a renewable energy source for corn mills. In this project, a mixed integer linear optimization model will be developed to maximize the sustainability of the proposed systems considering economic (CAPEX and OPEX) and socio-environmental criteria. | **Flávia Barbosa** | **Industrial Engineering and Management** |
| 6 | Mining Web Usage Patterns to Automatically Generate Regression Tests | The goal is to build a framework to collect information on the use of web applications to extract all the data needed to build test cases from that. This framework collects information about sequences of actions performed by users, the data of the objects with which it interacts, and (if possible) information about the input data introduced. Then these sequences are converted to test cases that may be used in a regression testing scenario. The goal is to apply operators that allow us to select, for instance, the most common, the longest, and the shortest sequences and assess the code coverage. Afterwards, we aim to improve the test suite with variances of the sequences to improve coverage. | Ana Paiva | **Human-Centered Computing and Information Science** |
| 7 | Software Testing Education | The goal is to identify current software testing teaching practices and develop new teaching materials (games, quizzes, exercises, etc.) to teach software testing effectively. For that, we aim to conceptualize and characterize how the students learn how to test and develop teaching materials for teaching software testing. | Ana Paiva | **Human-Centered Computing and Information Science** |
| 8 | Mutation Testing for Android | The goal is to continue the work done in FEUP defining meta mutants for Android, contributing to diminishing the mutation testing overall effort. We want to have just one file containing the implementation of all mutants. Each mutant can be executed by introducing a parameter when invoking the program. This way, we only install the meta mutant once on the device or emulator, saving time and effort. Also, we aim to improve our testing environment so that testers can generate mutants and run test cases to kill them. | Ana Paiva | **Human-Centered Computing and Information Science** |

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| 9 | Real-Time Rust | The Rust programming language is emerging as a potential candidate for the programming of reliable cyber-physical systems, due to its type-safety and memory ownership model, which enforces memory safety and prevents concurrent data races, and system programming nature.<br><br>Nevertheless, Rust provides a very limited set of real-time capabilities, mostly based on thin libraries to the underlying real-time POSIX support in operating systems.<br><br>The goal of this research is therefore to analyse the existent real-time capabilities available in the language and libraries, proposing a high-level approach to enable concurrent and parallel real-time programming in Rust. | **Luis Miguel Pinho** | **Human-Centered Computing and Information Science** |
| 10 | Detection of Social Engineering Attacks using Machine Learning Algorithms over Continuous Data Streams | In recent years, online communication and data sharing channels have been vulnerable to security breaches, resulting in the leak of sensitive information. While efforts have been made to enhance channel security, social engineering attacks can still manipulate users into divulging valuable data to cybercriminals. Many machine learning-based mechanisms have been developed to detect malicious activity in such attacks, but most rely on supervised approaches that require labelled data for training and validation. However, labelled data for social engineering attacks is scarce, making it challenging to use supervised methods. To address this, we propose using an unsupervised approach treating the problem as an anomaly detection issue. We will employ a machine learning algorithm to create clusters of normal and anomalous behaviour, treating anomalies as malicious traffic to detect social engineering threats. We will also analyze the use of machine learning algorithms on continuous data streams, which are ideal for web traffic analysis and enable online training for detecting new attacks. Additionally, we will select a natural language processing technique for implementing an anomaly-based detection system. As a final deliverable, we will provide a security architecture and testing framework for future research in social engineering detection. This research project aims to enhance the detection of social engineering attacks and contribute to the field of cybersecurity. | **João Marco Silva** | **High-Assurance Software** |
| 11 | Detection of non-technical electricity losses using artificial neural networks | This topic encompasses the application of artificial neural networks for the detection of consumers' non-technical electricity losses, especially the losses caused by fraud, using customer invoice databases.<br>In specific: | **Tiago Manuel Campelos Ferreira Pinto** | **Human-Centered Computing and Information Science** |

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| | | • Analyze previous work developed in anti-fraud detection, especially in developing countries, where the percentage of non-technical losses is significant.<br>• Obtain a sufficiently large and secure database of consumer invoices for proper training of the artificial neural network models<br>• Analyze and discuss which neural network models are the most appropriate to perform the study.<br>• The system should classify consumers as fraudsters or not, and then generate a list of consumers classified as fraudsters to help perform focused inspections. The main goal being to improve the success rate of inspections to reduce unnecessary operational costs.<br>• Analyze the prediction results using different neural network models | | |
| 12 | 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** | **High-Assurance Software** |
| 13 | Resilient Software Configuration and Infrastructure Code Analysis | Modern and scalable applications use so-called infrastructure as code (IaC) scripts to provision servers and development environments. Commercial IaC tool vendors, such as Chef and Puppet, provide programming syntax and libraries so that programmers can specify configuration and dependency information as scripts.<br>The use of IaC scripts is essential to efficiently maintain servers and development environments. For example, the Fortune 500 company Intercontinental Exchange (ICE), which runs millions of financial transactions daily, maintains 75% of its 20,000 servers using IaC scripts. The use of IaC scripts has helped ICE decrease the time needed to provision development environments from 1~2 days to 21 minutes.<br><br>Despite the clear advantages, while developing IaC scripts, practitioners may inadvertently introduce security issues that can potentially lead to security breaches. In this project, we will contribute to our ongoing project GLITCH with new methods for automated analysis and repair of IaC scripts. | **Alexandra Sofia Ferreira Mendes** | **High-Assurance Software** |

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| 14 | Procedural Content Generation for Serious Games | Procedural content generation (PCG) is a technique used in digital games development to automatically create game content such as levels, scenarios, and challenges. This approach is especially useful in serious games as it can produce a large number of variations in content, allowing players to experience different scenarios and challenges that reflect real-world situations. PCG can also adapt the difficulty level to match the player's skill level, making the game more engaging and challenging.<br><br>With PCG we focus on generating learning scenarios that adapt to the needs of individual learners, making serious games more engaging, adaptive, and effective for learning and training. | **António Coelho** | **Human-Centered Computing and Information Science** |
| 15 | Visual processing of product labels | This topic is intended to research algorithms and deep learning models for the visual analysis of products and corresponding label information. Over product detection and recognition, the label should be processed to automatically extract a set of relevant information for a given use case (e.g., retailer, product placement). Focusing on shelf products, to extract information from the labels, it is necessary to take into account situations of visual clutter, occlusion and low resolution. | **Pedro Carvalho / Paula Viana** | **Telecommunications and Multimedia** |
| 16 | Automatic visual scene analysis for description and storage | The propose topics aims at the research of a set of image and video analysis models that enable the extraction of relevant elements present in the visual scene and of their relations. This includes spatial-temporal as well as depth information. The analysis can encompass low-level data, such as object ROI, position and pose, but also higher-level data like activity and actions. The extracted information should be stored in a flexible and efficient away to enable analysis, search and inference of additional knowledge. | **Pedro Carvalho / Paula Viana** | **Telecommunications and Multimedia** |
| 17 | Urban Art analytics with Computer-Based Methods | The aim of this internship is to explore Computer Vision approaches to extract information from street art paintings to find recurrences and variances of a motif, identify similarities between different images, patterns over time and space or artistic networks that can be revealed by the extracted visual feature. We will build on Google Arts and Culture or Facebook's Global Street Art datasets but want also to contribute to create a new dataset based on existing murals in the area of Porto town. | **Pedro Carvalho / Paula Viana** | **Telecommunications and Multimedia** |
| 18 | Probing quantum-like dynamics with paraxial fluids of light | The topic of paraxial fluids of light explores an analogy between the mathematical model for the propagation of light inside a nonlinear media and that for the time evolution of a quantum fluid. In this | **Nuno Azevedo Silva** | **Applied Photonics** |

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| | | topic, the researcher will get familiar with the quantum-like simulation platform of the Center for Applied Photonics, being integrated into the team and ongoing projects. | | |
| 19 | Cloud Robotics | With the emergence and growing popularity of cloud computing systems, there has been a transfer of processing power from local equipment to remote systems in various applications. In robotics, this transfer could potentially mean smaller robots with more efficient use of batteries. However, tasks such as control, security, or real-time execution make it impossible to fully transfer processing to the cloud. The research topic of Cloud Robotics focuses on bringing answers to the challenges associated with combining Cloud services with robotic software. | **Rafael Arrais** | **Robotics in Industry and Intelligent Systems** |
| 20 | Oil and Gas HPC Framework Project | The project is part of a research effort to develop a computational environment for academic studies to provide scalability to the new numerical methods developed in the oil and gas field, creating a scalable code to approach the solution of the advection problem using the well-known first-order finite volume method upwind. The project also plans to implement numerical methods of higher order in the code. In this system, an elliptical subsystem determines the velocity field. Additionally, a non-linear hyperbolic equation represents the transport of the flowing phases (saturation equation). The model applies a locally conservative finite element method for the mixing speed. Additionally, the model employs a high-order non-oscillatory finite volume method, based on central schemes, for the non-linear hyperbolic equation that governs phase saturation. | **João Barbosa** | **High-Assurance Software** |
| 21 | High-Performance Data Storage Infrastructure Performance Analysis | High-Performance Computing (HPC) platforms are required to solve the most diverse large-scale scientific problems in various research areas, such as biology, chemistry, physics, and health sciences. Researchers use a multitude of scientific software, which have different requirements. These include input and output operations, directly impacting performance due to the existing difference in processing and data access speeds. Thus, supercomputers must efficiently handle mixed workloads when storing data from the applications. Understanding the set of applications and their performance running in a supercomputer is paramount to understanding the storage system's usage, pinpointing possible bottlenecks, and guiding optimization techniques. This research topic  proposes a methodology and visualization tool to evaluate a supercomputer's data storage infrastructure's performance, taking into account the diverse workload and demands of the system over a long period of operation. | **Ricardo Vilaça** | **High-Assurance Software** |

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| 22 | Energy Efficient BioInformatic Portal | Scientific gateways aim to integrate reusable data and processes, allowing research communities to access shared data, software, and computing services. In particular, bioinformatics portal can be a scientific gateway for parallel and distributed executions of bioinformatics programs coupled with supercomputers. Executions performed on supercomputer directly affect the gateway performance regarding speed, functionality, and job wait time for jobs when the cluster is at full load. Machine learning (ML) can support gateway functionality and performance optimization by constructing predictive mathematical models, offering the possibility to predict smart submissions through the gateway in the HPC environment. This project develops a framework supported by an ML model that aims to reduce the interference between HPC applications that share physical computer nodes and reduce the number of computer nodes that must be allocated. | **André Pereira** | **High-Assurance Software** |
| 23 | ChallengerAI: Generating worst case test traces for testing of systems and AI solutions | System-testing and hardware-in-the-loop testing is part of modern product development. Here a digital twin of an operational environment is used to mature and validate a solution during its development, and it can be used to integrate subsystems and project potential performance impact on the overall system operation. For smart grid/energy system solutions, due to the power network, the range of potential input combinations (scenarios) is humongous, even for a simple distribution network, especially if both static and dynamic operating conditions are considered. The available system models may allow to - in reverse, to also identify and generate test traces that are of particular importance to the defined test purposes. This project aims to build a machine-learning pipeline for deriving minimal representative sets of worst-case test input scenarios and sequences. | **Tiago André Soares** | **Power and Energy Systems** |
| 24 | Transfer learning for smart building load forecasting | Smart meters data is essential for the optimization of electricity consumption in buildings, as it can be used for forecasting electricity consumption and modeling synthetic profiles of building load curves. However, many buildings still not have smart meters installed, making it difficult to obtain accurate information on electricity consumption. In this way, machine learning techniques (such as transfer learning) can be used to apply models trained on consumption data from smart meters in buildings that do not have measurements. With this, it is possible to identify anomalies in the consumption of electricity, avoid energy waste and improve the energy management of the building. | **Tiago André Soares** | **Power and Energy Systems** |
| 25 | The role of batteries in community energy markets integrated to the distribution network | The continuous penetration of distributed energy resources (DER), namely, PV, wind, battery energy storage systems (BESS) and electric vehicles rises the importance of developing new methods for their integration in electricity markets, as well as in the operation of the distribution networks. Thus, | **Tiago André Soares** | **Power and Energy Systems** |

| | | community energy markets emerge as an approach to promote the integration of DERs into power systems, encouraging small energy consumers, producers, and prosumers to exchange energy in a competitive environment and balance energy supply and demand locally. However, the intermittence of renewable sources and their small scale may create serious challenges for distribution system operators. In this regard, ESSs can play a significant role both as traders in the market and as part of the solution to problems in the operation of the distribution system. Thus, they can be actively used to solve network issues related to line congestion and bus voltage. | | |
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| 26 | TwinConfidence: Probabilistic surrogate models for operation planning and sector coupling design | Surrogate models are simplified representations of complex systems, which can be used for accelerated simulation and optimisation. In context of thermal and sector coupling, a wide range of coupling concepts and operational strategies need to be evaluated, often under uncertain environmental conditions and limited physical knowledge of the plant. In sector coupling design, energy can be shifted between thermal and electrical storage media, so that a dynamic representation of the operational states, as well as of the control strategy must be included in the plant model. This project aims to develop an approach for the physics-informed simplified probabilistic representation of a sector coupling energy system. The model and approach aims to present a parametric surrogate model to evaluate system response under a wide large samples space and input scenarios. | **Tiago André Soares** | **Power and Energy Systems** |
| 27 | Embedded Domain Specific Languages | In the HASLab centre we have been developing the embedding of several programming language techniques using a powerful data structure called functional zippers. In fact, we define the embedding of both strategic programming and attribute grammars in the setting. They are powerful language engineering tools to express complex  transformation and analysis of (domain-specific) programming languages. For example, we use the embedding to efficiently and concisely express name analysis, program optimization, source code smells detection and elimination for several general purpose and domain specific languages. This work resulted in several relevant research results co-authored with researchers at Universidad de la Republica in Uruguai. Now, we would like to extend this work by considering memoization and tabulation techniques and to apply our tools in developing new languages and their compilers.<br>Thus,  we would like to use the INESC TEC International Visiting Research Programme to attract  a PhD student in that institution to visit our group and continue this fruitful collaboration. | **João Saraiva** | **High-Assurance Software** |
| 28 | End-to-end physical-layer security implementation | The goal of this project is to prepare physical-layer security for adoption in next-generation wireless communication standards by simulating and building an end-to-end physical-layer security system. To | **João Vilela** | **Robotics and Autonomous Systems** |

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| | | date, there exist channel sounding results for broadcast channels with eavesdroppers, but no end-to-end systems of which we are aware. Our system will encode real messages, transmit coded data over a wireless link using wiretap codes, and be evaluated for reliable communications for intended receivers and secure communications against eavesdroppers in the network. Various combinations of modulation schemes (e.g., MPSK, MQAM, etc.) and wiretap coding schemes (e.g., coset codes, lattice codes, etc.) will be analyzed. We will also implement phase synchronization and timing synchronization to deploy the entire system using PLUTO-ADALM software defined radios. The deliverables of the project are a successful implementation with understanding of tradeoffs between coding schemes and modulation schemes along with publications describing the main results. | | |
| 29 | I/O optimizations for Large Language Models | Large Language Models (LLMs) such as GPT-3 and BERT, are a new class of artificial intelligence models that can process and understand natural language at an unprecedented scale. As these new models continue to grow in size and complexity, I/O has become a significant bottleneck (e.g., transferring large amounts of data between nodes during the training process, storing parameters and intermediate results), hindering their ability to scale effectively. Therefore, the main goals of this research topic are to explore and evaluate existing techniques for addressing I/O bottlenecks in LLM training, as well as design and implement new I/O optimizations for improving the efficiency of network and storage during LLM training. | **Ricardo Macedo** | **High-Assurance Software** |
| 30 | 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.<br><br>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** | **High-Assurance Software** |
| 31 | Analyzing the energy consumption of highly configurable robots | Modern robotic systems are built modularly from heterogeneous components. This leads to easily configurable robots with various valid configurations for different applications. However, such high configurability poses a challenge in the analysis of desirable properties, requiring the interpretation of the various variants as a single family of products. | **Nuno Macedo** | **High-Assurance Software** |

| | | A critical non-functional property of robotic systems is energy consumption. However, ad hoc and manual techniques are still largely used to quantify the energy efficiency of robotic software. Moreover, such analyses still disregard the possible variability of the configurations. The goal of this project is to support roboticists in analyzing highly configurable robotic systems with concerns for energy consumption. This will require the combination of static-time techniques to extract architectures with variability, and runtime procedures to measure energy consumption of the individual components. A unified model is expected to be generated from this information, supported by automatic analysis procedures. | | |
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| 32 | Modeling attacks on privacy-preserving Machine Learning | Secure machine learning has been identified as one of the most important research challenges of the next decade. From a cryptographic standpoint, one can design privacy-preserving machine learning frameworks, i.e. systems that behave as black-boxes. However, attacks on such systems exist on a much wider spectrum, which significantly hinders security analysis. E.g., when discussing data poisoning, we may refer to threats that tamper with the dataset – and cryptographic techniques can be used to filter malicious inputs – or to threats that affect data collection – and thus the dataset must be sanitized. Another example are model inversion attacks: the threats can impersonate a user – and thus access control are effective – or threats can be legitimate users – and thus differential privacy techniques are necessary. The main goal of this work is to make an in-depth state-of-the-art analysis of ML attacks, and categorize in which circumstances standard/advanced cryptographic mechanisms can be effective countermeasures. | **Bernardo Portela** | **High-Assurance Software** |
| 33 | Combining Back-ends for Secure ML Computation in the Cloud | One of the most important practical advances towards the feasibility of Secure multi-party computation (MPC) lies in combining different MPC protocols, which has been shown to outperform standalone protocols in various settings. For instance, it is beneficial for an application that requires numerical and combinatorial/bitwise computation to use arithmetic-based protocols for the former and boolean-based MPC protocols for the latter. As such, to understand the realistic performance of MPC in practice, one must take into account the feasibility of protocols in different application contexts, as well as conversion costs to securely switch between protocols. Consequently, multiple existing MPC frameworks support various protocols and attempt to automate | **Bernardo Portela** | **High-Assurance Software** |

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| | | the process of choosing the most suitable MPC configuration for a given deployment scenario. This project aims to study various available MPC frameworks, and explore how to improve the practical deployment of privacy-enhanced ML applications by combining the best features of available frameworks. | | |
| 34 | Reinforcement Learning to optimize maintenance actions in renewable energy systems | Renewable energy systems have grown and become competitive in auctions in the electricity market. In the scope of asset management, the optimization of maintenance actions can be modeled as a Markov Decision Problem (MDP) and solved by Dynamic Programming (DP). Although DP has optimal solutions guaranteed to MDP, it is often a complex process when the solution spaces grow, becoming untreatable for large-scale problems. In this context, the project studies and applies RL to improve the solution method for the operation and maintenance cost problem. Reinforcement Learning (RL) is a machine learning that can avoid this issue since it does not need to calculate all the solutions possibilities, in addition to being solved in a suitable computational time. | **Eduardo Tadeu Bacalhau** | **Industrial Engineering and Management** |
| 35 | Secure Replicated Data Types | Conflict-free Replicated Data Types (CRDTs) [https://doi.org/10.1007/978-3-642-24550-3_29] are one of the most popular ways to achieve data replication with maximum availability. Nonetheless, their traditional abstraction still considers explicit coordination among replicas. Some CRDT frameworks [https://doi.org/10.1145/3360580,https://doi.org/10.1145/3341710,https://doi.org/10.1145/3485484] go further in isolating the programmer from such concurrency details.<br><br>However, none of these approaches considers the privacy of the data shared among the replicas. Ongoing work by the proposers [https://doi.org/10.1145/3427796.3427831] demonstrates that secure CRDTs can be implemented using general secure multi-party computation. However, integrating it with existing replication frameworks still poses important challenges, such as identifying which data is to be processed securely, and adapting replica-local secure computation and inter-replica communication of encrypted data. This topic plans to tackle these challenges towards building new secure replication frameworks. | **Hugo Pacheco** | **High-Assurance Software** |
| 36 | General-Purpose Certified MPC Compilation | Secure multi-party computation (MPC) allows two or more mutually distrusting parties to collaboratively compute over their private data. One key element for the practical success of MPC has been the emergence of domain-specific compilers [https://doi.org/10.1109/SP.2019.00028].<br><br>Certified compilers such as CompCert [http://compcert.inria.fr/] for C code provide rigorous guarantees that the generated executable code behaves exactly as prescribed in the original program, which is essential for critical software. However, most MPC compilers are not backed by a formal model offering formal correctness and security guarantees about the compilation process.<br><br>The goal of this project is to work towards the creation of a general-purpose certified MPC compiler, by | **Hugo Pacheco** | **High-Assurance Software** |

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| | | extending CompCert with a new compilation step from its intermediate language (dubbed RTL) to popular MPC backends such as SCALE/MAMBA [https://homes.esat.kuleuven.be/~nsmart/SCALE/] or MP-SPDZ [https://github.com/data61/MP-SPDZ]. | | |
| 37 | Learning models for bone marrow edema characterization in radiological images | Bone marrow edema (BME) is a term used to describe the build-up of fluid (edema) in the bone marrow and can be identified in magnetic resonance imaging (MRI). Although pain is the major symptom, BME can be originated from multiple mechanisms. This complexity and the lack of evidence-based guidelines frequently make the identification and quantification a major challenge.<br><br>An automatic approach for BME detection and quantification aims at reducing the overload of the clinicians, decreasing human error, and accelerating the time to correct diagnosis.<br><br>Goals and expected results: This project will be dedicated to developing AI methods to support clinicians on early detection (using X-ray) and the BME quantification in late stages evaluation (using MRI); a) learning models to detect BME in the X-ray; b) quantitative methods to objectively assess BME in the MRI; c) novel visualization solutions for interpretations of decisions based on imaging data. | **Helder Oliveira & Tania Pereira** | **Telecommunications and Multimedia** |
| 38 | Automating the pre-operative planning of DIEP-based breast reconstruction | Breast conservative therapies have been allowing many women with breast cancer to avoid a mastectomy. Nevertheless, there are many scenarios where the latter is still conducted. Fortunately, breast reconstruction allows alleviating the loss of the breast(s) either by making use of an implant or tissue from the body of the patient. When a patient shows interest in this type of reconstruction, the surgical team requests a CTA. In the end, a report with a description of every perforator that was found is delivered to the surgeons. This process is very challenging for the radiological team, mainly because these blood vessels are very small (cross-sections of 1-2 pixels most of the time).<br><br>The objectives of this research topic are: to study blood vessel segmentation techniques, with a special focus on the fully automated ones; compare the time efficiency and accuracy of the existing solution with the automated methodology. | **Helder Oliveira & Tania Pereira** | **Telecommunications and Multimedia** |
| 39 | Generation of Artificial 3D Medical Data | Breast cancer (BC) is now the cancer with the highest incidence worldwide and a leading cause of cancer fatalities. Current standard treatment involves surgery combined with radiotherapy, however, 2/3 of early-detected BC tumors are clinically unpalpable. These require invasive, less accurate localization procedures for a conservative therapeutic approach. | **Helder Oliveira & Tania Pereira** | **Telecommunications and Multimedia** |

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| | | To succeed, a fundamental scientific problem must first be solved: how does the breast, a highly deformable organ, change shape when a patient is in different postures, while scanned using different medical imaging modalities?<br><br>In this project, we aim to develop a novel, hybrid in silico/physics-informed machine learning approaches, for generation of artificial data based on generative models and for multimodal data fusion. The result will be cutting-edge, high-fidelity digital breast models with breast magnetic resonance imaging pose transformation from prone to supine, to predict tumor location. | | |
| 40 | Design and Development of a clinical annotation and visualization tool | Developing prototypes for clinical evaluation is fundamental to implementing the new methods and algorithms developed. However, if the prototype developed is not suitable for the clinical environment, the validation of the methods can be conditioned.<br><br>Giving a brief overview, we may say that a CAD system has five independent modules for annotation, visualization, detection, segmentation/characterization, and classification.<br><br>For use in a clinical environment, an interface should be developed to allow user interaction among different options, user annotation, visualization, and navigation through images. Analysis and evaluation of results, such as Sensitivity, Sensibility, ROC and FROC curves, and other commonly used evaluation methodologies should be available, to produce comprehensive reports.<br><br>The objectives of this research topic are: to investigate software designs that have been employed for other clinical applications; find an appropriate computer programming language for developing the software; propose a software design satisfying the requisites of the clinicians. | **Helder Oliveira & Tania Pereira** | **Telecommunications and Multimedia** |
| 41 | Knowledge Boundaries affecting Circular Economy Integration | The new model of a Circular Economy presents significant opportunities and challenges for manufacturing companies. Information and knowledge exchanges are crucial to enable product circularity in a way that generates economic value throughout the product value chain and ensures positive environmental and social governance impacts. The main goal of this topic is to understand the role that boundary objects play in Circular Economy strategies and how to leverage them to drive better integrations between the different actors that enable the sharing of information to enhance repair and reuse, refurbishment, remanufacturing, and recycling processes. | **António Lucas Soares** | **Enterprise Systems Engineering** |
| 42 | Network Digital 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 6 years, namely in | **Rui Campos, Helder Fontes** | **Telecommunications and Multimedia** |

| | | national and international projects such as CONVERGE, DECARBONIZE, FP7 SUNNY and H2020 Fed4FIRE+ (SIMBED, SIMBED+). | | |
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| 43 | 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 11 years, namely within national and international projects such as FCT GROW, BLUECOM+, ENDURE, and Under-Fi. | **Rui Campos, Helder Fontes** | **Telecommunications and Multimedia** |
| 44 | Airborne Communications | Investigation of novel on-demand wireless communications solutions using flying platforms such as drones. Within this research topic, new ML-based algorithms and new communications approaches 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 11 years, namely within national and international projects such as FCT WISE, FLY.PT, 5Go, BLUECOM+, FP7 SUNNY, H2020 ResponDrone, and HE OVERWATCH. | **Rui Campos, Helder Fontes** | **Telecommunications and Multimedia** |
| 45 | 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.<br>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. | **Tania Pereira / Hélder Oliveira** | **Telecommunications and Multimedia** |
| 46 | AI-based cancer characterisation using semi-supervised learning algorithms | The development of computer-aided systems for cancer characterization 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.<br>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 | **Tania Pereira / Hélder Oliveira** | **Telecommunications and Multimedia** |

| | | models. By not constraining the models to use only annotated data, this learning strategy avoids the fully dependence on the annotation process. | | |
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| 47 | AI-based cancer characterisation using multimodal data | The advances in AI methodologies have enabled the development of computer-aided systems capable to accurately provide assistance in several clinical tasks, reducing the effort, time-cost and the subjectivity factors inherent to completely manual tasks. However, considering the fact that 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 the benefits of multimodal data to provide more reliable decisions.<br><br>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 individual 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. | Tania Pereira / Hélder Oliveira | **Telecommunications and Multimedia** |
| 48 | AI-based models to predict the physiological events using PPG signal: diagnostic features and potential applications | The state-of-the-art studies suggest that in the years to come PPG wearables will become pervasive in many fields of medical practices, and the main domains include cardiology, respiratory, neurology, and fitness. The application field of photoplethysmogram has been extending from the clinical to the mobile environment and several new applications have emerged. In this study, novel hemodynamic parameters will be studied, and AI-based models will be developed to allow the early and accurate detection of the changes in the physiological states of the patients in the ICU. | Tania Pereira / Hélder Oliveira | **Telecommunications and Multimedia** |
| 49 | AI-based methods to characterize Glioblastoma patients through MRI analysis | Glioblastoma is a malignant brain cancer, of which first-line therapy includes surgical removal, radiation, and chemotherapy. Unfortunately, the tumor is usually identified in the late stages. Despite years of progress in understanding glioblastoma, survival rates have only slightly improved over the past two decades. Neurosurgeons and radiologists use magnetic resonance imaging (MRI) to assess the tumor. The purpose of this study is to improve the tissue characterization and determine the tumor grades of these highly heterogeneous tumors using the information from MRI. | Tania Pereira / Hélder Oliveira | **Telecommunications and Multimedia** |
| 50 | 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 | Nuno Cruz | **Robotics and Autonomous Systems** |

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| | | 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. | | |
| 51 | 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** | **Enterprise Systems Engineering** |
| 52 | 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** | **Enterprise Systems Engineering** |
| 53 | Design and evaluation of ultra-wide-band reconfigurable inteligente surfaces with few bits | The proposed research topic is aligned with the scientific strategy of the Communications scientific domain of INESC TEC, specifically the research challenge "Obstacle aware communications". As part of this research challenge we aim to design reconfigurable electronics transceiver architectures and signal processing algorithms for large antenna arrays up to 110 GHz, enabling wideband near and far field beamforming towards real-time digital control of antenna array radiation patterns suitable for environment sensing, localisation and obstacle-aware communications. We are especially interested in hosting a student/researcher working in the field of wideband antenna array design, targeting the improvement of the beamforming properties under the restriction of having 1 or 2 bits of control per unit cell. The antenna array performance should be estimated using 3D electromagnetic simulation software tools possibly in combination with numerical calculation tools such as Matlab. The prototyping of an antenna for demonstration purposes is in scope.

This research topic is related with the ongoing Horizon Europe research project TERRAMETA. | **Luis M. Pessoa** | **Telecommunications and Multimedia** |

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| 54 | Process mining: automatic process discovery and enhancing using machine learning techniques. | Automatic process design methods, such as discovery in process mining, have been developed that extract workflow models representing the behavior recorded in an event log. Process mining techniques presented efficient and highly scalable applications in process design/discovery tasks and all other tasks related to process workflow.<br>Domain knowledge includes procedural knowledge, which contains rules that determine how a process is executed, and contextual knowledge, which refers to the business environment in which a given process is integrated.<br>With domain knowledge, it is possible to improve the accuracy and interpretability of the process model. It should also be noted that it reduces the amount of noise in the data by eliminating irrelevant information. Finally, it allows identifying patterns not seen by traditional techniques. | **Ricardo Teixeira Sousa, and Ahmed Adel Fares** | **Artificial Intelligence and Decision Support** |
| 55 | Streaming Process Mining | Process data often comes in streams that belong to time-evolving processes. Traditional process mining techniques require all data to be available to extract the process model, which is challenging for evolving processes. One solution is to learn the process model as new data is received, but this approach is not well-defined in the literature.<br>Combining process mining with other techniques, such as machine learning and artificial intelligence, shows promise for improving process analysis and optimization in the context of streaming process mining. Machine learning can identify patterns and anomalies in the data streams to inform the process model, while deep learning can automatically learn the process model from the data streams. These approaches hold the potential for discovering complex and evolving processes.<br>In summary, we can expect new methodologies and techniques to emerge designed explicitly for treating streaming process mining by combining process mining with other techniques. | **Ricardo Teixeira Sousa, and Ahmed Adel Fares** | **Artificial Intelligence and Decision Support** |
| 56 | Evolving Processes and Process Mining | Evolving processes can be challenging to analyze with process mining, but by combining process mining with machine learning and data analytics techniques, organizations can effectively identify patterns, predict outcomes, and improve processes over time. Process mining can also support process innovation by identifying new ways of performing tasks and improving processes. By analyzing bottlenecks and areas of high variability, organizations can improve the efficiency and effectiveness of their evolving processes to better meet the needs of stakeholders. In summary, process mining offers a powerful approach for organizations to analyze and enhance their evolving processes, supporting decision-making, process innovation, and continuous improvement. | **Ricardo Teixeira Sousa, and Ahmed Adel Fares** | **Artificial Intelligence and Decision Support** |

| 57 | Explainable Artificial Intelligence – Towards Interpretable/Explainable Deep Learning Models for Face Biometrics (xAI4DLFB) | 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 performance, are weak against adversarial attacks or unseen samples. For instance, these systems can be biased against gender or biases. Thus, the main goal of this research plan will be to introduce domain and semantic information in the model's learning process. For instance, eye colour and face symmetry are usually useful, but not necessarily leveraged by current models.<br>This work will focus on applying AI explainability tools to face biometrics focusing in particular in detecting and mitigating biases. | Ana F. Sequeira | **Telecommunications and Multimedia** |
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| 58 | 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. | Ana F. Sequeira | **Telecommunications and Multimedia** |
| 59 | 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 performance, are weak against adversarial attacks or unseen samples.<br><br>This work will focus on applying AI explainability tools to face biometrics focusing in particular in face presentation attack detection (PAD) (aka, antispoofing). | Ana F. Sequeira | **Telecommunications and Multimedia** |
| 60 | Active cooperative underwater localisation | 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 | Bruno Ferreira | **Robotics and Autonomous Systems** |

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| | and mapping with natural landmarks | 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. | | |
| 61 | More resilient and sustainable inter-modal logistics and global transportation systems | Inter-modal logistics and transportation systems play an important economic role, with significant positive impacts, but with different types of negative externalities. This is particularly true for different types of inter-modal hubs, such as ports and airports, that have strong and widespread interactions with the hinterland and their metropolitan areas. Moreover, the resiliency of the associated networks is quite critical, having to deal with high levels of uncertainty.<br>Our research is strongly interdisciplinary, and aims at developing methodological frameworks and tools to support the design of more resilient and sustainable solutions for freight transportation and logistics. This research is structured around: ports, airports, and other inter-modal hubs; synchro-modality in transportation networks; the circular economy; and global, complex supply-chains.<br>Currently this work is mainly directed to the operations in "ports", and is linked to the on-going MAGPIE European project, involving key actors and stakeholders that ensure its practical relevance and impact. | **Jorge Pinho de Sousa** | **Enterprise Systems Engineering** |
| 62 | Mobility as a Service for enhanced, more 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).<br>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.<br>The key drivers of the work 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.<br>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** | **Enterprise Systems Engineering** |
| 63 | Energy-efficient production through optimal workload | Among many challenges manufacturers face while dealing with high product variants, optimal workload balancing and product sequencing to achieve the highest energy-efficient and throughput are | **Dalila Fontes** | **Artificial Intelligence and Decision Support** |

| balancing and product sequencing in make-to-order manufacturing systems | among the most time-consuming and challenging tasks for many production experts. This challenge is mainly due to the mixed-production sequence and introduction of new product variants, which force the production managers/planners to continually reconfigure and rebalance the lines in terms of workload and resources (e.g., equipment, operator, and machine) and re-sequence the production orders. This research aims to develop an optimization approach to simultaneously deal with the workload balancing and sequencing problems while seeking an energy-efficient solution. This research is connected to two applied research projects collaborating with world-leading industries such as Volvo Trucks and Volvo Penta. | | |