INESC TEC INTERNATIONAL VISITING RESEARCHER PROGRAMME 2022 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 – 2022 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, we have organised this Programme, destined for researchers, including Master's and PhD students, affiliated with Universities and appropriate organisations outside of Portugal, who wish to spend **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 the 30th of November 2022**, unless all ten vacancies for these short-term research internships have been taken before that deadline.

Research internships may start any time from the 1st of September 2022 and must not extend beyond the 31st of July 2023.

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.

Candidates' Profiles and Eligibility Requirements

The Programme will accept applications from researchers, including Master's and PhD students, affiliated with Universities or other appropriate organisations outside of Portugal, regardless of nationality. Candidates admitted to this edition are expected to retain their affiliation to the home institution during their intake at INESC TEC.

How to Apply

Applicants meeting, in principle, the eligibility requirements and sought profiles need first to identify at least one topic and no more than three topics from the [list of available research topics proposed by INESC TEC](#) that aligns 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 if s/he is selected for the placement. 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 at the home institution on official letterhead, confirming his/her agreement to the applicant visiting INESC TEC under the Programme[1];

- Proof of Enrollment in Master's or PhD. Program *(only for applicants applying as Master's or PhD 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 mandatory documents missing will be rejected.

Applications moving forward will be analysed by a scientific panel appointed by the Board of Directors of INESC TEC. The host(s) of the topics picked by the applicant will also be required to indicate 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 raised by 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. Notification is sent by e-mail with a delivery receipt notification.

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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.

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: 1450 euros to cover living expenses for each month of the mobility period;

- Work accident insurance.[2]

Admitted applicants will sign the mobility contract before the commencement of the internship and receive an up-front instalment corresponding to 50% of the monthly allowance.

If admitted candidates fail to comply with any of the 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.

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 virtually meet 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.

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[2] 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.

Reporting and Acknowledgments

Admitted applicants are expected to write and submit, until the end of their visit, a report[3] 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 research visiting period and submitting their report, INESC TEC will issue a certificate of completion.

Publications or other scientific outputs resulting from the work plan must include an acknowledgement of 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.

Information about COVID-19

All admitted applicants coming to INESC TEC must comply with the Portuguese Government's rules applicable to immigration and border control regarding COVID-19. Please refer to this website for updated information: www.visitportugal.com/en/content/covid-19-measures-implemented-portugal

Contacts for Queries

International Relations Service – SRI

internationalrelations@inesctec.pt / + 351 22 209 40 00

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

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

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. Last update: 27 September 2022)

#	Research Topic	Topic Owner	Scientific Domain	Description
1	Echocardiography Image Quality Assessment and Artificial Enhancement	João Pedrosa	Networked Intelligent Systems	Cardiovascular diseases account for more deaths than any other cause and are projected to remain the single leading cause of death. Among the existing cardiac imaging modalities, echocardiography is especially attractive as it can be applied bedside, has a good temporal resolution, is of relatively low cost and does not make use of ionising radiation. As such, echocardiography has come to play a crucial role in clinical cardiology with diagnostic, prognostic and interventional value. However, echocardiography often suffers from poor image quality and artefacts, hampering image interpretation and the extraction of relevant clinical information. In this study, deep learning methods will be developed and validated towards the assessment of quality in 2D echocardiographic images. The artificial generation of enhanced quality images using GANs and inpainting networks will then be explored towards improving image quality and the extracted clinical information.
2	Automated Chest Radiography Curation and Quality Assessment	João Pedrosa	Networked Intelligent Systems	Chest radiography (CXR) is one of the most common imaging examinations globally, playing an essential role in screening, diagnosis and disease management. Nevertheless, CXR interpretation is a challenging and time-consuming task, representing a major burden for radiologists. As such, the development of automated tools for the detection of multiple pathologies can play an important role in reducing the burden on radiologists and decreasing variability in image interpretation. However, current deep learning models are extremely reliant on large and high-quality datasets for training and validation, which can be difficult to obtain and curate. In this work, semi- or unsupervised deep learning methods will be explored towards view detection (frontal vs lateral), exposure (AP vs PA), and compliance (correct patient position and exposure). These methods will then be deployed to curate large publicly available datasets, which can be used to train CXR pathology screening methodologies.

3	How can prosumers distributed flexibility be provided to and managed by an aggregator?	José Villar	Power and Energy	Prosumers may have flexible resources (thermo accumulators, electric air conditioning, shiftable loads, etc.), that all together could be managed by an aggregator to offer larger amounts of flexibility to, for example, grid operators. This research aims to perform a literature review on the existing approaches to communicating and managing this flexibility. The result could be a research paper with a particular focus on practically implementable approaches.
4	Impact of automated equipment enabling appliance control on consumer consumption behaviour	Kamalanathan Ganesan	Power and Energy	Assessment of the impact the automation of equipment like smart plugs, mobile applications, etc. to enable their control can have on the consumer's behaviour and on their implicit flexibility to adapt to prices or demand response signals. Indeed, in recent years, consumers are adding more smart electronics to their homes. This increased automation could enable the easier integration of controlled appliances within houses and incentivise consumers to participate in DR and flexibility events more actively and consistently. The internship will consist of a comparative study on residential houses with and without automation and smart equipment under demand response or flexibility programs using the Causality Inference Model developed at INESCTEC under the InterConnect Project to assess the new customers' elasticity and the flexibility unlocked.
5	Long-term assessment of interconnected power systems	Leonel de Magalhães Carvalho	Power and Energy	The interconnection of power systems is a way to edge against the uncertainty associated with the massive integration of renewable generation. Accordingly, this topic aims at developing representative simulation-based models to emulate the operation of interconnected systems under different hydrologic, wind, and solar conditions and with multiple technologies for energy storage. The simulation process, based on the Sequential Monte Carlo Simulation method, quantifies the adequacy of the static and operational reserves under different agreements and/or policies for contracting and deploying reserves between different interconnected areas. The goal is to determine the effectiveness of reserve sharing procedures in mitigating capacity shortage events and whether there are important bottlenecks in tie-lines impeding power exchanges between interconnected areas.

6	Application of advanced simulation/optimisation techniques for analysis of active distribution systems	Leonel de Magalhães Carvalho	Power and Energy	An active distribution network can include a wide array of devices such as distributed generation, demand response, energy storage, electric vehicles, intelligent protection schemes, and centralised and/or decentralised control strategies. These new features must be properly coordinated to support not only the system but also the local operation of distributed resources. The development of representative simulation-based models for the distributed energy resources and associated uncertainties is extremely important to obtain an accurate assessment of the reliability of the active distribution system. Such models are embedded into reliability assessment techniques which quantify the impact of the new devices and operation strategies through performance indicators. In this context, this topic aims to implement advanced simulation/optimisation techniques, such as the Cross-Entropy Method, for the reliability analysis of active distribution systems, allowing a quantitative evaluation of design alternatives with less computational effort.
7	Communication of forecast uncertainty in electrical grid operation to human operators	Ricardo Bessa	Power and Energy	Communication of forecast uncertainty (e.g., from energy consumption and renewable energy) to human decision-makers remain a major challenge for both academic and industry communities and requires a multidisciplinary approach (social sciences, behavioural analysis, domain knowledge in electric power systems). The main objective of this research topic is to formulate and implement an experiment for electric grid operation where a human decision-maker must choose multiple options under uncertainty (and considering different levels of stakes), and extract conclusions/recommendations about how to communicate and integrate forecast uncertainty. Another goal is to design metrics and human-machine interfaces that enable a fast and concise assessment of the uncertainty level in grid operation, considering also aspects like cognitive flexibility from human operators. Reference to similar work: C. Möhrlen, N. Fleischhut, R. Bessa, "How do humans decide under wind power forecast uncertainty?," WindEurope Electric City 2021, Copenhagen, Denmark, 23-25 November 2021. https://www.smart4res.eu/

8	Study and development of fault diagnosis methods for battery systems.	Rui Esteves Araújo	Power and Energy	In recent years, batteries have become one of the leading energy storage solutions for different applications, and their market share continues to grow. Examples are electric mobility and smart grids. However, various faults in a Li-ion battery system can potentially cause performance degradation and severe safety issues. In order to enable the safe operation of these energy storage systems, it is necessary to improve fault diagnosis methods. Developing advanced fault diagnosis techniques is becoming increasingly critical for the safe operation of system and also to add features of fault tolerance. This internship will allow enrichment of fault mechanisms, characteristics and failure modes, including internal battery failures, sensor failures, etc. Algorithms will be developed and tested to enable fault diagnosis technology for a safer battery system.
9	The role of electric vehicles in future community energy markets	Tiago Soares	Power and Energy	Distributed energy resources, namely, PV, wind, ESSs and EVs are changing energy markets as they can help reduce emissions and meet carbon reduction targets. However, the intermittence of renewable sources and their small scale, associated with transport electrification may create serious challenges for systems operators. Thus, community energy markets emerged as an approach to promote the integration of DERs into the power system, encouraging small energy consumers, producers, and prosumers to exchange energy in a competitive market and balance energy supply and demand locally. In this particular, EVs will play a significant role, as they can be part of the solution. Recently, shared mobility business models may contribute to the system, as a fleet of EVs can take advantage of their high mobility to integrate different community markets. Furthermore, a controlled EV fleet could be more reliable to help shave the load peak, through V2G, than private EVs.
~~10~~	~~State Estimation for Power Systems~~	~~Jorge Correia Pereira & Eric Zanghi~~	~~Power and Energy~~	~~The research has been exploring the use of high-performance programming with GPU using to identify measurement criticalities in measurement plans. This analysis can be applied to critical system elements such as measurement units and branches. This project has already resulted in a congress article "GPU-Based Criticality Analysis Applied to Power System State Estimation" - ICCSA 2020.~~

11	Enhanced Mobile Privacy Through an Adaptive Permission Manager Using Infrequent User Feedback	João P. Vilela	Computer Science	The high number of permission requests in mobile devices leads to cognitive overload if permission managers (PMs) are not automated. Previous work in the COP-MODE project focuses on fully automated PMs. To move forward, we aim to develop an adaptive PM using machine learning (ML) techniques which adapt itself to the user's responses to some permission requests which are asked in an infrequent manner. This adaptation is important from different perspectives: 1) It can yield a lower privacy violation rate than baseline PMs while avoiding cognitive overload of fully automated PMs. 2) The user preferences with respect to privacy may change over time, thus making adaptation imperative. 3) There is a correlation among user's decisions to subsequent requests. The goal is to develop ML mechanisms for adaptive PMs with a low privacy violation ratio that are suitable to run in real time on resource-constrained mobile devices. https://cop-mode.dei.uc.pt/
12	End-to-end physical-layer security	João P. Vilela	Computer Science	To date, there exist channel-sounding results for broadcast channels with eavesdroppers, but no end-to-end physical-layer security mechanisms. The goal of this project is to devise an end-to-end physical-layer security system. This 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 analysed resulting from and following from the IRES project. We will also implement phase synchronisation and timing synchronisation to deploy the entire system using PLUTO-ADALM software-defined radios. The project's goals are a successful implementation with an understanding of trade-offs between coding schemes and modulation schemes along with publications describing the main results. This topic builds on the work of a previous project in collaboration with colleagues from BYU, USA: https://nsf.gov/awardsearch/showAward?AWD_ID=1761280
13	Active cooperative underwater localisation and mapping with natural landmarks	Bruno Ferreira	Robotics and Autonomous Systems	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.

14	Cooperation of marine robotic vehicles	Nuno Cruz	Robotics and Autonomous Systems	Inland 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.
~~15~~	~~Test and validation of navigation stacks for agricultural robots - from cloud to ground robot~~	~~Filipe Neves dos Santos~~	~~Industrial and Systems Engineering~~	~~The communication/interaction between Agro Decision Support Systems (DSS) and agricultural robots is not well established. In robotics, we face several challenges. Most of the time, the coordinate system, mission description and communication standards are incompatible/non-interoperable between Agro DSS and robots. With this work, we aim to explore and study a modular robotic supervisor for interoperability between robotic navigation stack and Agro DSS.~~ ~~https://scorpion-h2020.eu/~~
16	Visual scene analysis and representation	Pedro Carvalho	Networked Intelligent Systems	Visual scenes can provide rich spatial-temporal information. The proposed research topic is two-fold: the use of computer vision techniques to extract information from visual scenes; explore data representation techniques for a richer visualisation of the information.
17	Network Digital Twins	Rui Campos & Helder Fontes	Networked Intelligent Systems	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. Instead of creating generalisable models, these data-driven models aim to create simulation models that are specialised for specific emerging scenarios, such as airborne networks or underwater networks, in which traditional simulation models fail to be accurate enough. 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 a research team working on this specific topic since 2017, including scientific publication and participation in projects focused on these topics, such as DECARBONIZE, FP7 SUNNY and H2020 Fed4FIRE+ (SIMBED, SIMBED+). https://www.nsnam.org

18	Underwater Communications	Rui Campos & Helder Fontes	Networked Intelligent Systems	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, and Under-Fi. https://grow.inesctec.pt
19	Airborne Communications	Rui Campos & Helder Fontes	Networked Intelligent Systems	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 10 years, namely within national and international projects such as FCT WISE, FLY.PT, 5Go, BLUECOM+, FP7 SUNNY, H2020 ResponDrone. https://wise.inesctec.pt
20	AI-based cancer characterisation using semi-supervised learning algorithms	Tania Pereira & Hélder Oliveira	Networked Intelligent Systems	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 personalised treatment plan assignments to increase survival chances. Medical images have been 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, motivating 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 complete dependence on the annotation process. https://vcmi.inesctec.pt/projects/lucas

21	AI-based cancer characterisation using multimodal data	Tania Pereira & Hélder Oliveira	Networked Intelligent Systems	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 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 the 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 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. https://vcmi.inesctec.pt/projects/lucas
22	Neuroblastoma Cancer Radiognomics	Tania Pereira & Hélder Oliveira	Networked Intelligent Systems	Neuroblastoma (NB) is the most common extracranial solid tumour in childhood. Genomic amplification of MYCN is associated with poor outcomes and is detected in 16% of all NB cases. CT scan or MRI are the imaging techniques recommended for diagnosis and disease staging. The assessment of imaging features such as tumour volume, shape, and local extension represent relevant prognostic information. Radiogenomics have shown powerful results in assessing the genotype based on imaging findings automatically extracted from the medical images. The main goal of this thesis is to develop predictive models for relating CT scans image features (phenotype) to genotype signatures based on retrospective Databases (radiogenomics approach).
23	AI-based models to predict the heart rate using PPG signal from wearables during physical exercise	Tania Pereira & Hélder Oliveira	Networked Intelligent Systems	Heart rate monitoring using wrist-type PPG signals during subjects' intensive exercise is a difficult problem since the signals are contaminated by extremely strong motion artefacts (MA) caused by subjects' hand movements. Accelerometers have been added to these wearables and can help reduce MA in the PPG signal. Strategies to remove noise will be used, from the traditional filters to deep learning approaches. Developing AI-based models to predict the heart rate during physical activity based on PPG signal and accelerometer signals. A multimodal approach will be compared with ones based only on PPG signals. Denoising approaches will be implemented in order to improve the HR predictions.

| 24 | ~~Source code transformations to automatically rejuvenate software systems~~ | ~~João Saraiva~~ | ~~Computer Science~~ | ~~Recent advances in information technology have had a great impact on the evolution of programming languages. Like software systems, programming languages evolve after technological innovations and/or according to the developers' needs. Language evolution can lead to improvements to existing features, include new features, or even support features from different language paradigms. In fact, software evolves. However, very much like with humans, software ages, and problems arise. Legacy systems tend to lose performance. Moreover, evolving such systems is error prone, thus, making the comprehensibility and maintainability of such systems more costly. The main objectives of this project are: firstly, to build a theory on the rejuvenation of software systems to explain the phenomena and factors that lead software developers to evolve the source code of their programs; secondly, to explore the use of advanced programming transformation techniques to support program rejuvenation activities.~~ |
| 25 | Foundations for quantum multiparty computation protocols | Luís Soares Barbosa | Computer Science | Strong correlations between objects at a distance that are impossible to replicate with classical analogues motivated new, quantum communications protocols. Furthermore, such correlations are also relevant to understanding the division between classical and quantum computing. Although proving the separation between BQP and BPP remains unsolved, it was proven that access to quantum correlations in specific restricted computational models would allow to solve efficiently some computational problems more – e.g. to compute deterministically non-linear Boolean functions, while a classical analogue would be restricted to linear Boolean functions. Motivated by this separation, secure and blind multiparty computation protocols were presented in several references. Multiparty computations concern problems for which various clients pretend to compute a result-based on their collected information, and blindness guarantees the privacy of their data is not compromised. Interestingly, no classical equivalent protocol can replicate or compute the intended results, providing the quantum-classical separation for an exciting problem. Unfortunately, the existent experiments concern particular Boolean functions for which the computational instructions were previously known. Therefore identifying efficient non-linear Boolean functions and their operational instruction stands as a relevant research question: Are there other, elementary non-linear functions that can be used as subroutines for larger computation protocols? More generally, what is the most efficient way to perform complex computations when we have access to limited quantum and classical resources? |

26	Energy-efficient production through optimal workload balancing and product sequencing in make-to-order manufacturing systems	Dalila Fontes	Computer Science	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 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 optimisation 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. Related Swedish projects in which I am collaborating, and the Visiting Researcher will be responsible for: • Agile ManufaCturing ConfigUration and OpeRAtions in The Era of Industry 4.0 (ACCURATE 4.0) • Digitalized and optimised production planning for energy-efficient production
27	Interpretable Machine Learning: an image analysis approach	Hélder Oliveira	Networked Intelligent Systems	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. http://vcmi.inesctec.pt/projects/lucas
28	Design and Development of a clinical annotation and visualization tool	Hélder Oliveira	Networked Intelligent Systems	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. Giving a brief overview, we may say that a CAD system has five independent modules for annotation, visualization, detection, segmentation/characterization, and classification. 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. 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. http://vcmi.inesctec.pt/projects/lucas
29	Automating the pre-operative planning of DIEP-based breast reconstruction	Hélder Oliveira	Networked Intelligent Systems	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). 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. http://vcmi.inesctec.pt/projects/ava
30	Learning models for bone marrow edema characterization in radiological images	Hélder Oliveira	Networked Intelligent Systems	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. 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. 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.