OUR ACTIVITY

SCIENTIFIC RESEARCH ACTIVITY

NETWORKED INTELLIGENT SYSTEMS

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

COORDINATED BY MANUEL RICARDO
ASSISTANT TO THE CLUSTER COORDINATOR: ANDRY PINTO

CAP Centre for Applied Photonics
C-BER Centre for Biomedical Engineering Research
CRAS Centre for Robotics and Autonomous Systems
CTM Centre for Telecommunications and Multimedia

The Cluster on Networked Intelligent Systems (NIS) envisions to work "towards autonomous networked intelligent hybrid systems enabled by ubiquitous sensing and processing of information". This cluster is formed by research centres working in complementary scientific domains: CAP addresses optical sensing, optical imaging, and microfabrication of devices; C-BER addresses bio-instrumentation, biomedical imaging, and neuro-engineering; CRAS addresses robotics and autonomous systems operating in complex environments for data gathering, mapping, inspection, surveillance, and intervention; CTM addresses electronics, radio and optical communications, communications networks, multimedia technologies, computer vision, and intelligent information processing.

Sensing aims to design multi-parameter sensing systems for capturing relevant information. Communications aims to create self-learning communications systems that can support different types of services and data in Immersive and extreme environments, taking advantage of state of the art heuristics including artificial intelligence (AI) and machine learning. Computer Vision aims to empower the next generation of intelligent systems with the capability of reasoning from visual data, approaching or even surpassing the human vision. Autonomous systems addresses the development of innovative robotics solutions for operation in complex environments; relevant examples are underwater environments, and particularly deep-sea water.

CENTRES OF THE NIS CLUSTER

CAP

Centre for Applied Photonics

Coordinator: Paulo Marques
Assistant Centre Coordinator: Ireneu Dias

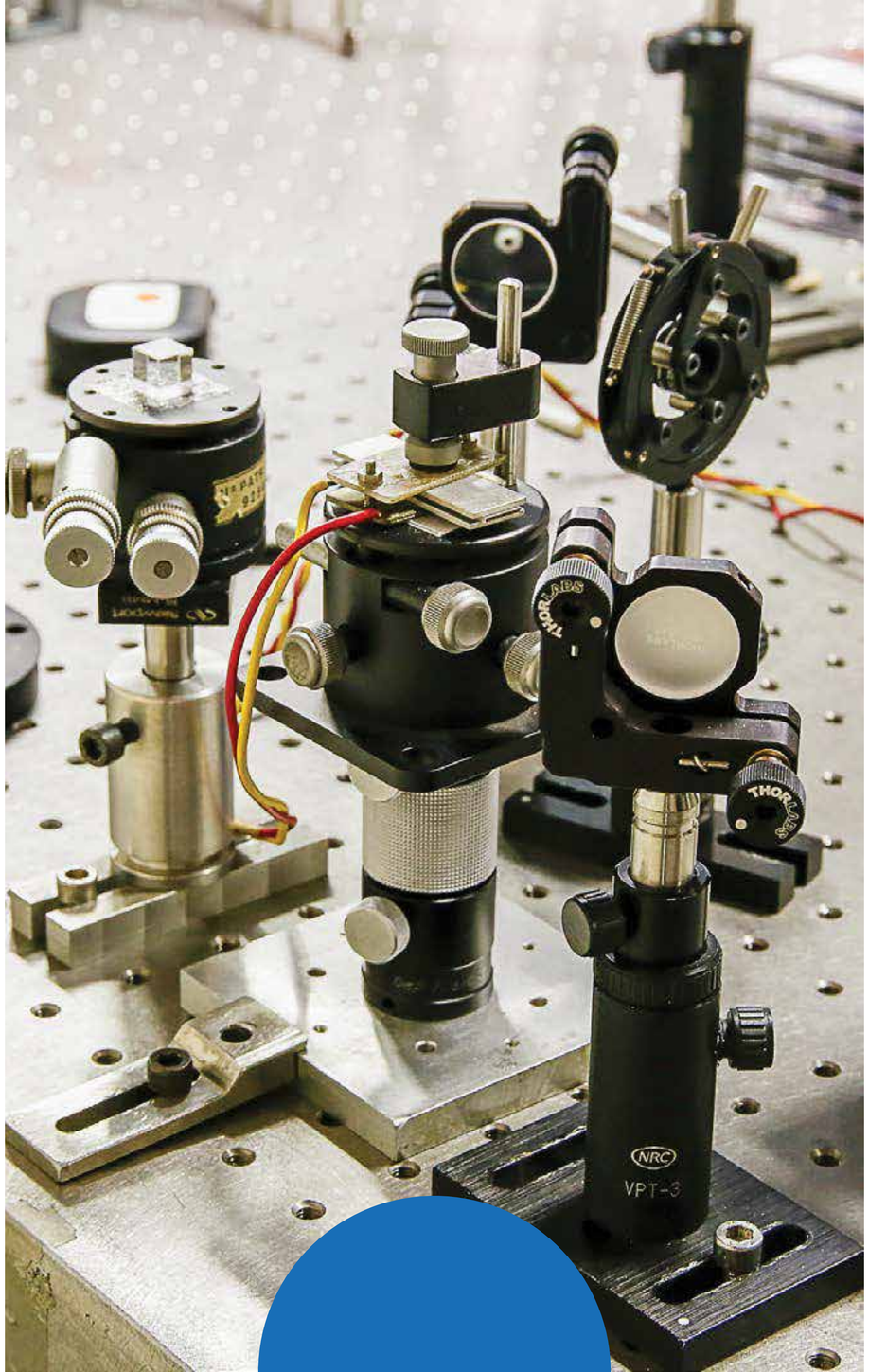
CAP accomplishes its mission within the Cluster NIS by directing its activities towards 4 main areas of research: integrated optics and microfabrication, advanced optical imaging, optical sensors, comprising chemical/biosensors and physical sensors, and high-performance simulations for nanophotonics. This organization is non-hermetic and the development of solutions implies multidisciplinarity and cooperative work from the different fields of the available expertise.

C-BER

Centre for Biomedical Engineering Research

Coordinators: Aurélio Campilho and João Paulo Cunha

The mission of C-BER – Centre for Biomedical Engineering Research is "to promote scientific knowledge excellence through fundamental and applied research, advanced training and innovation in Biomedical Engineering". C-BER activities are aligned with the vision of the Cluster on Networked Intelligent Systems (NIS). To accomplish its mission, C-BER is organized in three Labs (Biomedical Imaging Lab, BioInstrumentation Lab and NeuroEngineering Lab).



CRAS

Centre for Robotics and Autonomous Systems

Coordinators: Eduardo Silva and Aníbal Matos
Assistant Centre Coordinators: Carlos Pinho

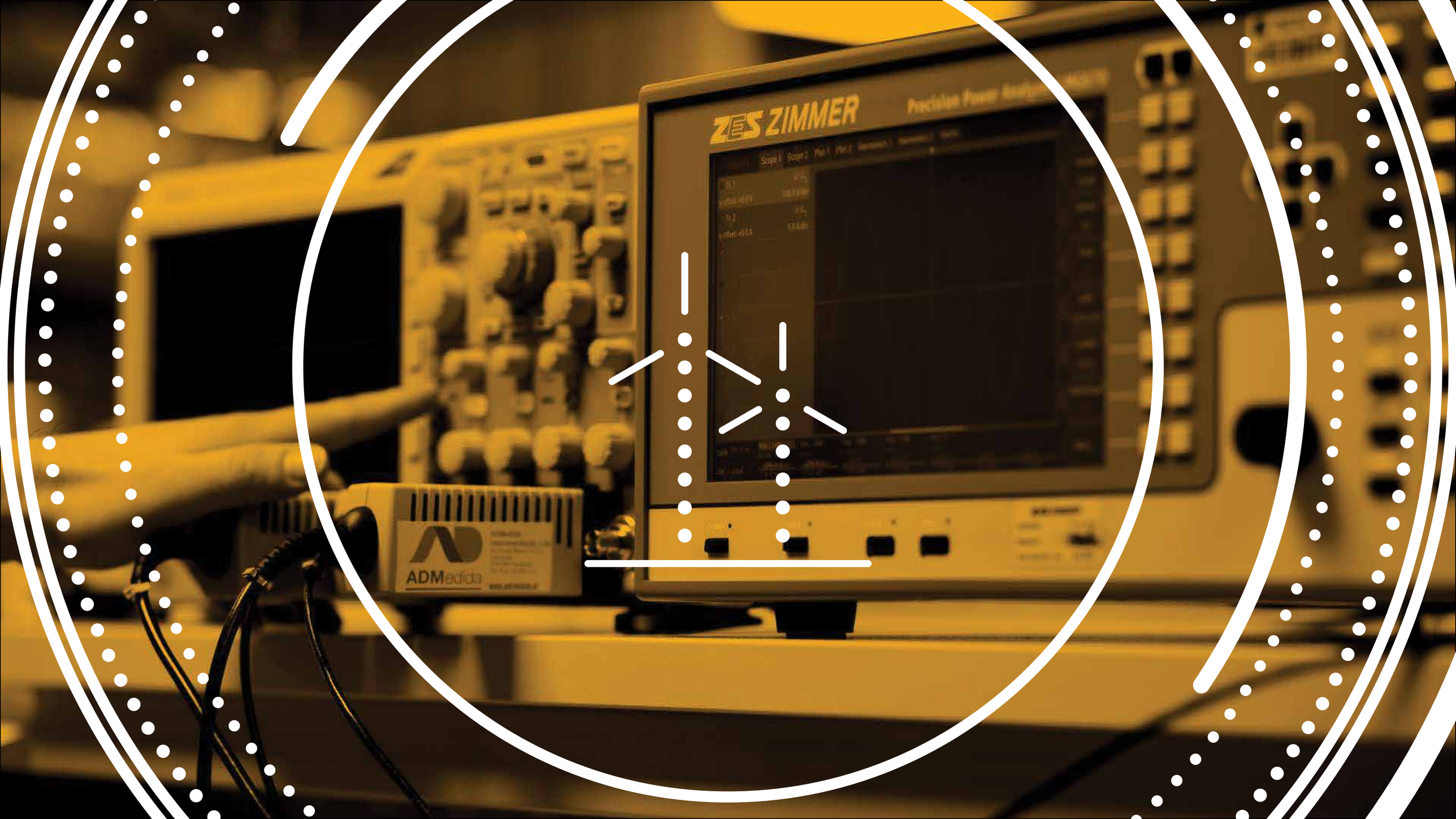
The Centre for Robotics and Autonomous Systems (CRAS) aggregates more than 40 researchers addressing scientific and technological topics associated to field robotics and autonomous systems. CRAS aims at becoming a worldwide reference in field robotics and autonomous systems and is already internationally recognised for its innovative robotics solutions for operation in complex environments – relevant examples are underwater environments, and particularly deep-sea water.

CTM

Centre for Telecommunications and Multimedia

Coordinator: Jaime Cardoso
Assistant Centre Coordinator: Filipe Ribeiro

CTM accomplishes its mission, within the Cluster NIS, by directing its activities towards 4 main areas of research: Optical and Electronic Technologies (OET); Wireless Networks (WiN); Multimedia and Communications Technologies (MCT); Information Processing and Pattern Recognition (IPPR).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POWER AND ENERGY

A digital and decarbonized energy system.

COORDINATED BY LUÍS SECA.
ASSISTANT TO THE CLUSTER COORDINATOR: DAVID RUA

CPES Centre for Power and Energy Systems

The cluster is focused on traditional and emergent areas of power and energy systems, for planning and operation purposes, with an emphasis on renewable energy sources (RES) integration, electric vehicles (EV) deployment, distributed energy resources (DER) management, demand response (DR), smart grids and energy analytics, through steady-state and dynamic network analysis, reliability models and tools, optimization, soft computing and data science.

CPES is the core Centre of the Cluster, as it is clearly where the sector critical mass is concentrated, but the evolution of the energy system, particularly the electrical power system, has supported the involvement of other competences, held by associated Centres, due to the multidisciplinary nature of the problems and opportunities to address. There are already examples of this collaboration and joint projects, in the areas of information and communication technologies (CTM), data science (LIAAD), data platforms and hubs (HASLab), asset management (CEGI) and combined energy and process optimization in industry (CESE).

More than sharing projects, the goal is to foster a multidisciplinary approach to support current applied research and technology transfer, but most of all, to design the scientific strategy for this particular domain, distributed among the different Centres of the cluster, that will guarantee the creation of new knowledge to support the future challenges of a digital and decarbonized energy system.

RESEARCH LINES TOWARDS 100% RENEWABLE ENERGY SOURCES (RES)INTEGRATION AND MASSIVE INTEGRATION OF POWER ELECTRONIC-BASED INTERFACES | LARGE-SCALE MODELLING AND OPTIMIZATION OF ENERGY SYSTEMS | DATA-DRIVEN METHODOLOGIES FOR ENERGY SYSTEMS | ASSET MANAGEMENT AND PREDICTIVE MAINTENANCE | CYBERSECURITY AND IOT FOR ELECTRICAL INFRASTRUCTURES

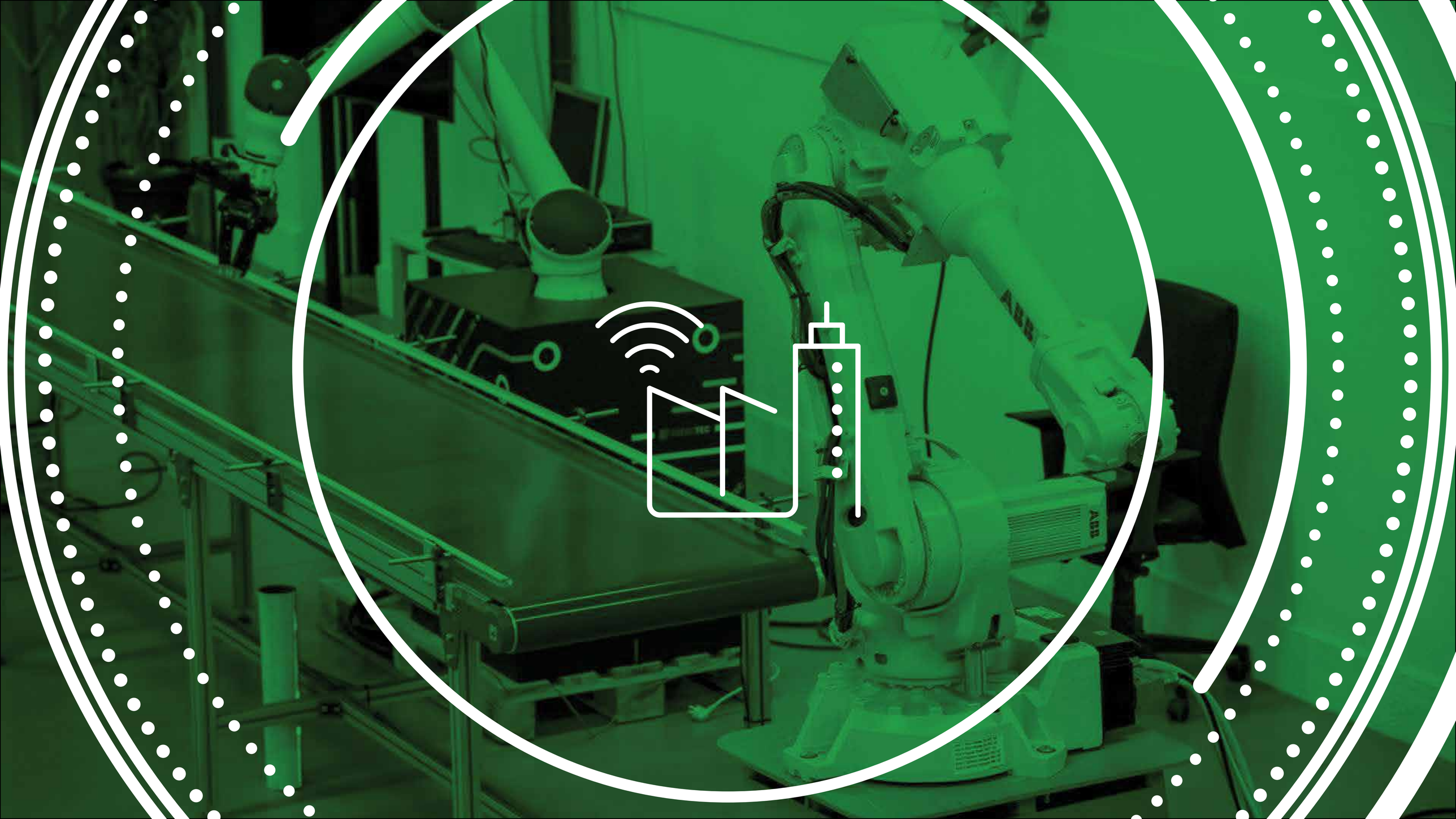
CENTRES OF THE PE CLUSTER

CPES

Centre for Power and Energy Systems

Coordinator: Manuel Matos
Assistant Centre Coordinator: Ricardo Bessa
Advisor Centre Coordinator: Jorge Pereira

The Centre for Power and Energy Systems (CPES) is the core Centre of the Cluster Power and Energy. Within this Cluster, CPES holds specific expertise in power systems analysis (steady-state and dynamic), probabilistic and fuzzy modelling, reliability, optimisation and decision-aid, computational intelligence, energy analytics and forecasting, with special focus on large scale integration of Renewable Energy Sources (RES), Distributed Energy Resources (DER) operation, Electric Vehicles (EV) deployment and Energy and Flexibility management, under the Smart Grid paradigm.



INDUSTRIAL AND SYSTEMS ENGINEERING

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

COORDINATED BY BERNARDO ALMADA LOBO
ASSISTANT TO THE CLUSTER COORDINATOR: ALEXANDRA MARQUES

CEGI Centre for Industrial Engineering Management
CESE Centre for Enterprise Systems Engineering
CITE Centre for Innovation, Technology and Entrepreneurship
CRIIS Centre for Robotics in Industry and Intelligent Systems

The Cluster on Industrial and Systems Engineering (C_ISE) aims to research and innovate in systems and services applied to the management of value streams. C_ISE envisions to lead complex decision-making in end-to-end, customer-centric, agile supply chains across different industries (e.g., manufacturing, process industries, retail, health and mobility).
In order to improve business performance and foster productivity, as well as to contribute to environmental and social sustainability, C_ISE intervention ranges from local optimization of individual organizations to complex system optimization of networks and chains. Its activities cover the design, implementation and improvement of systems for decision support, operations automation, management and intelligence, as well as the provision of innovation management & technology transfer consultancy services.
Clearly, the cluster helps companies to fully embrace the fourth industrial revolution by leveraging digital transformation, advanced analytics and the integration of advanced manufacturing technologies and new business models. Customer-centric and real-time supply chain optimisation, as well the decentralized decision-making, will only be possible with highly flexible, realocable, adaptable and intelligent automation, control and robotics.

RESEARCH LINES **OPERATIONS MANAGEMENT** | **OPERATIONS RESEARCH AND MANAGEMENT SCIENCE** | **ICT FOR DIGITIZATION** | **HUMAN-ROBOT COLLABORATIVE WORKSTATIONS** | **TECHNOLOGY ENABLED-INNOVATION**

CENTRES OF THE ISE CLUSTER

CEGI

Centre for Industrial Engineering and Management

Coordinators: Ana Viana and Pedro Amorim

This Research Group (RG) is an international reference in business analytics through decision support systems for service and operations management, contributing also in data science, service science, and other emerging topics (e.g., blockchain and asset management). The goal is to extract knowledge from data that can be leveraged to increase, for example, revenues of a business. The focus of the RG is on prescriptive analytics, particularly in addressing challenges related to dynamic optimization under uncertainty.

CESE

Centre for Entreprise Systems Engineering

Coordinators: Américo Azevedo and António Lucas Soares

CESE mission is to advance the scientific knowledge in enterprise systems engineering, providing unique expertise targeting complex industrial organisation challenges that foster high impact management and ICT systems and generate innovative services for industrial organisations. CESE wants to be positioned as a leading research Centre focused on connected, sustainable and customizable production systems through the engineering of innovative enterprise systems and as a first choice in helping industrial organisations to improve competitiveness and sustainability of their supply chains and achieve high-performance levels of their inner business processes.

CITE

Centre for Innovation, Technology and Entrepreneursip

Coordinator: Alexandra Lobo Xavier

CITE accomplishes its mission, by carrying out R&D, advanced consulting and executive education bringing together expertise in Innovation & Technology Management and Technology Entrepreneurship fostering a cross-cutting approach to all INESC TEC's Clusters, and for Private and Public organizations. CITE aims at contributing for a better innovation and technology management with a sustainable and circular perspective of the entire knowledge value chain.

CRIIS

Centre for Robotics in Industry and Intelligent Systems

Coordinator: António Paulo Moreira
Assistant Centre Coordinator: Germano Veiga

The Robotics and Intelligent Systems Centre designs and implements innovative solutions within the areas of industrial robotics and intelligent systems. The Centre works in close cooperation with Companies, other INESC-TEC Centres and other Institutes and Universities, following the lemma from Research and Development to Innovation, passing through Design, Prototyping and Implementation.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COMPUTER SCIENCE

POWERING DEPENDABLE DIGITALIZATION.

COORDINATED BY RUI OLIVEIRA
ASSISTANT TO THE CLUSTER COORDINATOR: ANA ALONSO

CRACS Centre for Research in Advanced Computing Systems
CSIG Centre for Information Systems and Computer Graphics
HASLAB High-Assurance Software Laboratory
LIAAD Laboratory of Artificial Intelligence and Decision Support

The mission of the Computer Science Cluster is to achieve international excellence in both fundamental and applied research, with strong emphasis on technological innovation and transfer that benefits society at large.
Computing became fully decentralized, mobile, increasingly autonomous, and ubiquitous reaching all appliances, devices and living beings. As a result, current information and communications systems present many hard and intricate challenges associated to scalability, security and criticality. The ever-increasing amounts of generated data embody a wealth of information that needs to be properly and timely mined and analysed.
This challenges our capacity to filter, curate, store, process, query and visualise unprecedented volumes of data from diverse sources and formats. In addition, the economic value of the data, trade and state secrets, and individual rights require data manipulation to comply with demanding levels of privacy. Smarter and autonomous systems in critical realms such as utilities, health care, transportation and finance require dealing with new, and often unanticipated, sorts of risks that challenge the best practices of software engineering, network and information security and human-computer interaction.

RESEARCH LINES **ARTIFICIAL INTELLIGENCE** | **CYBER SECURITY** | **COMPUTER GRAPHICS AND VIRTUAL ENVIRONMENTS** | **INFORMATION MANAGEMENT SYSTEMS** | **DECISION SUPPORT METHODS** | **PARALLEL AND DISTRIBUTED SYSTEMS** | **SOFTWARE ENGINEERING**

CENTRES OF THE CS CLUSTER

CRACS

Centre for Research in Advanced Computing Systems

Coordinator: Luís Antunes
Assistant Centre Coordinator: Ricardo Rocha

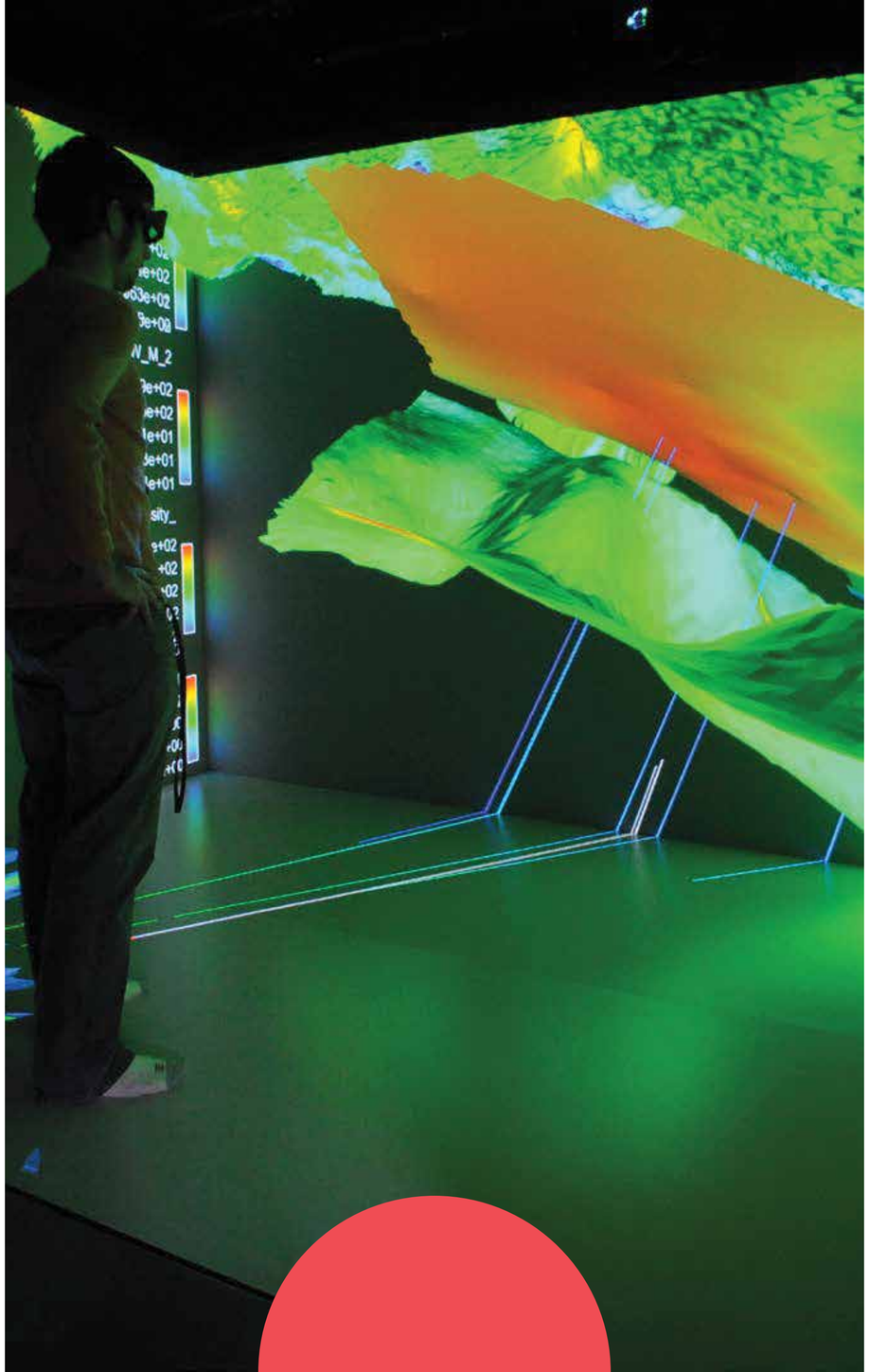
CRACS integrates the Computer Science Cluster with the mission of pursuing scientific excellence in the areas of programming languages, parallel and distributed computing, information mining, security and privacy, with a focus on scalable software systems for challenging multidisciplinary applications in Engineering, Life Sciences, Social Networks and the Internet of Things.

CSIG

Centre for Information Systems and Computer Graphics

Coordinators: António Gaspar and Ângelo Martins

The Centre for Information Systems and Computer Graphics (CSIG) is integrated in the Computer Science Cluster. Its mission is to pursue high quality research, strongly linked to industrial partnerships, consultancy and technology transfer, in five main areas: Computer Graphics and Virtual Environments, Information Management and Information Systems, Software Engineering, Accessibility and Assistive Technologies and Embedded/Special Purpose Computing Systems.



HASLAB

High-Assurance Software Laboratory

Coordinators: Alcino Cunha and António Luís Sousa

HASLab is focused on the design and implementation of high-assurance software systems: software that is correct by design and resilient to environment faults and malicious attacks. HASLab accomplishes its mission within the Computer Science Cluster, anchoring its research on a rigorous approach to three areas of Computer Science: Software Engineering, Distributed Systems, and Cryptography and Information Security.

LIAAD

Artificial Intelligence and Decision Support Laboratory

Coordinator: Alípio Jorge

LIAAD aims to produce high quality cutting-edge research in the international forefront of our research areas and promoting transfer of knowledge and technology. This Centre has been working in the area of Machine Learning and Data Science since 1991. The huge amounts of collected data (Big Data) and the ubiquity of devices with sensors and/or processing power offer opportunities and challenges to scientists and engineers. On the other hand, the demand for complex models for objective decision support is spreading in business, health, science and e-government, motivating our investment in different approaches to modeling.