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Our research topics

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Research Centres of the Galician University System

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GALICIA CALIDADE

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AI for Space Systems

Engineering & Technology

AI for Space Systems

Description

Application of Artificial Intelligence techniques to the design, operation and optimisation of next-generation space systems. The activities cover intelligent spacecraft subsystems such as attitude determination and control systems (ADCS), autonomous onboard decision-making, and in-orbit service capabilities, as well as AI-driven signal processing and communication technologies for satellite systems.

The line combines expertise in spacecraft engineering, autonomous operations, advanced signal processing and smart antenna systems to develop intelligent space infrastructures capable of adaptive operation, efficient resource management and enhanced mission autonomy. Research topics include machine learning for spacecraft control, AI-assisted satellite communications.

Infrastructures

Small satellite mission development facilities (CubeSat platforms), Satellite mission simulation and control laboratories, Space systems engineering and mission analysis tolos, Software frameworks for spacecraft dynamics and control, Signal processing and wireless communications laboratories.

Keywords

- Artificial Intelligence in Space
- Onboard Intelligence
- Satellite ADCS With AI
- Space Communications

Supervisors

- Fernando Aguado Agelet
- Carlos Mosquera Nartallo
- Pedro Orgeira Crespo

AI Methods for Adaptive Learning Systems

Engineering & Technology

AI Methods for Adaptive Learning Systems

Description

This research topic explores the convergence of artificial intelligence, cognitive ageing modelling, and privacy-preserving distributed ledger technologies to design next-generation e-learning systems that are adaptive, secure, and inclusive across the lifespan. It involves developing AI-driven platforms capable of personalizing learning experiences based on dynamically inferred cognitive profiles and ageing trajectories, enabling tailored educational interventions for diverse populations, including older adults.

At the same time, the research investigates how decentralized ledger technologies and advanced cryptographic methods can ensure the secure management of learning data, credentials, and user identities, preserving privacy while enabling trust, transparency, and interoperability across institutions. The work spans machine learning for longitudinal user modelling, human-centered adaptive system design, and secure distributed infrastructures, with the goal of creating robust, privacy-aware educational ecosystems that support lifelong learning and cognitive health.

Infrastructures

Access to the computing facilities of the Galician Supercomputing Center, including the FinisTerrae III with 4.36 PataFLOPS, High-availability, redundant, scalable and fault-tolerant Blockchain node, 8-node Blockchain prototyping network.

AI Methods for Adaptive Learning Systems

Keywords

- Interpretable AI
- Knowledge Representation and Management
- Large Language Models
- Machine Learning
- Multimodal Analysis

Supervisors

- Luis E. Anido Rifón
- Manuel J. Fernández Iglesias
- Manuel Caeiro Rodríguez
- Martín Llamas Nistal

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Engineering & Technology

Antenna Beamforming with AI

Engineering & Technology

Antenna Beamforming with AI

Description

Research on AI-assisted beamforming and antenna systems for aerospace and satellite scenarios, including array optimization, adaptive beam steering, propagation-aware control and intelligent integration of antenna subsystems in advanced communication architectures.

Infrastructures

The Antennas, Radar and Optical Communications environment at atlanTTic includes an anechoic chamber for antenna measurements and electromagnetic characterization, along with RF signal generation and frequency analysis equipment supporting experimental validation activities.

Antenna Beamforming with AI

Keywords

- Adaptive Arrays
- Aerospace Communications
- Antenna Beamforming
- Artificial Intelligence
- Beam Steering
- Propagation Modelling
- Satellite Antennas

Supervisors

- Marcos A. Arias Acuña
- Ana Vázquez Alejos

Design of Photonic Integrated Circuits for Communications

Engineering & Technology

Design of Photonic Integrated Circuits for Communications

Description

Research on development of integrated photonics devices for highly constrained optical communications, in underwater and free-space settings.

Infrastructures

State-of-the-arte equipment for experimental implementation and testing: software bundles for component and circuit simulation in RF and optical domains, optical sources, optical and electrical analyzers (vector network, spectrum, oscilloscopes), PIC characterization system.

Design of Photonic Integrated Circuits for Communications

Keywords

- Design
- III-V Semiconductors
- Integrated Photonics
- Lasers
- Simulation
- Testing

Supervisors

- Francisco J. Díaz Otero
- Carlos Mosquera Nartallo

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Engineering & Technology

Efficient and Secure Intensive Distributed Computing for 6G and Non-Terrestrial Networks (NTN)

Engineering & Technology

Efficient and Secure Intensive Distributed Computing for 6G and Non-Terrestrial Networks (NTN)

Description

The evolution toward 6G networks is driving a transformative shift in mobile communications, enabling ultra-high-speed, intelligent, and globally connected systems. Additionally, non-terrestrial networks (NTN) extend connectivity beyond ground infrastructure by integrating satellites, high-altitude platforms, and airborne base stations with terrestrial systems to deliver seamless global coverage, especially in remote regions. AI-native networks embed artificial intelligence directly into network architecture to enable autonomous, self-configuring, self-healing, and self-optimizing systems.

Edge intelligence and Mobile Edge Computing (MEC) move computation, storage, and AI processing closer to users at the network edge to reduce latency and congestion, enabling real-time services through distributed AI processing, edge caching, task offloading, and cooperative edge-cloud architectures. This infrastructure addresses emerging challenges for compute-intensive distributed computing solutions, which must operate under conditions of intermittent connectivity, mobility, variable latency, interoperability, and limited energy availability.

Efficient and Secure Intensive Distributed Computing for 6G and Non-Terrestrial Networks (NTN)

Infrastructures

UVigo's cutting-edge, 7-million-euro 5G & 6G network provides an ideal platform for advanced 6G research. Its three independent network cores enable the emulation of complex roaming and interconnection scenarios. Twenty base stations are deployed across five locations, each equipped with edge computing servers, allowing support for real-time ultra-low-latency and AI-native applications. Flexible spectrum operation across the n40, n77, and n258 bands facilitates experimentation. Indoors, 40 nodes at the School of Telecommunication Engineering form one of the largest millimeter-wave deployments in Europe, making it ideal for studying high-density 6G scenarios. With software-defined radio equipment at all locations, researchers can fully customize signal processing, while the optical mesh backhaul and P4 programmable switches enable the emulation of extreme network conditions, including fiber cuts, dynamic topologies, and ultra-reliable low-latency communications. This infrastructure supports hands-on experimentation across all 6G research areas, from THz communications and edge intelligence to non-terrestrial networks and green networking.

Keywords

6G Networks | AI-Native Networking | Edge Intelligence | Green and Energy-Efficient Networking | Multi-access Edge Computing (MEC) | Non-Terrestrial Networks (NTN) | Self-Optimizing Networks

Supervisors

- Rebeca P. Díaz Redondo
- Felipe Gil Castiñeira

Resilient Networked Autonomous Sytems for Cyber-Physical Scenarios

Engineering & Technology

Resilient Networked Autonomous Sytems for Cyber-Physical Scenarios

Description

The rapid evolution of mobile networks is enabling a new generation of human-centric cyber-physical autonomous systems integrated with advanced mobile connectivity. By leveraging ultra-low latency, massive bandwidth, edge and cloud computing, and reliable network infrastructures, these systems support real-time, wide-area human–machine collaboration and remote operations. The research has strong relevance for dual-use technologies, as capabilities such as secure remote command, telepresence, autonomous swarms, and resilient cyber-physical systems (CPS) can support both defense operations and civilian sectors including emergency response, smart infrastructure, industrial automation, and advanced training platforms.

Key research directions include multi-robot and swarm systems, coordinated through mobile networks, including human–swarm interaction, distributed control algorithms, and ultra-reliable communications to enable real-time control and massive connectivity, situational awareness systems that combine mobile sensor networks, distributed analytics, and immersive visualization through sensor fusion, collaborative immersive telepresence that enables shared virtual environments where geographically distributed autonomous vehicles provide real-time information, and resilient CPS for mission-critical and military operations, focusing on robust operation in hostile or degraded environments, with autonomous network reconfiguration and fault-tolerant distributed control even under network disruptions. Such complex scenarios introduce a new frontier of complex vulnerabilities. At this particular respect, other relevant directions are agentic threats and protection from adversarial machine learning, quantum-safe scalable networks, cyber-physical resilience by dynamic decurity, and fail-safe protocols.

Resilient Networked Autonomous Sytems for Cyber-Physical Scenarios

Infrastructures

UVigo has launched a cutting-edge, 7-million-euro, 5G/6G experimental network on the Lagoas-Marcosende campus as a premier, flexible testbed for validating advanced 6G, sub-terahertz (THz) communications, and Artificial Intelligence (AI) technologies in real-world scenarios. It is a unique, high-capacity European testbed, featuring extensive radio base stations, edge computing equipment, and optical communication systems designed to enable 6G research. This network provides an ideal environment for developing and testing human-centric autonomous systems. Its combination of ultra-low-latency connectivity, massive bandwidth, and edge computing resources directly supports real-time human-system collaboration and the complex immersive applications they will support. High-end edge computing support for 20 base stations across multiple locations will complement distributed onboard computing.The successful candidate will also have access to RETECH 5G/6G Cybersecurity Laboratory (https://iclab.uvigo.gal/retech/), an initiative supported (NextGenerationEU and INCIBE, with MEC deployments, dedicated C-V2X emulation and measurement equipment for for smart transportation scenarios. Furthermore, the lab is equipped with an OT cybersecurity layer, Deep Packet Inspection (DPI) firewalls, and specific hardware encryption devices for the practical integration of QKD and Post-Quantum Cryptography into conventional 5G/6G communications.

Keywords

Agentic AI Threats | Collaborative Immersive Telepresence | Cyber-Physical Neywork Resilience | Cyber-Physical Systems (CPS) | Dual-Use Autonomous Systems | Human–Swarm Interaction

Supervisors

- Ana Fernández Vilas
- F. Javier González Castaño

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Engineering & Technology

Theory and Experimental Research in Quantum Communications

Engineering & Technology

Theory and Experimental Research in Quantum Communications

Description

The research line "Theory and Experimental Research in Quantum Communications" focuses on the development, analysis, and experimental validation of quantum technologies for secure communications. It combines theoretical modeling, protocol design, and security analysis of quantum communication systems—particularly quantum key distribution (QKD)—with experimental implementations and demonstrations. Special emphasis is placed on implementation security, addressing vulnerabilities that may arise in practical realizations of quantum communication protocols.

Research activities include the development of mathematical techniques for the security analysis of real-world implementations, the design and experimental demonstration of fiber-based and free-space quantum communication links, and the investigation of quantum hacking attacks, together with the design and validation of effective countermeasures. The line also explores novel photonic approaches for quantum communications and quantum random number generation inter alia. These efforts aim to advance the security, performance, robustness, and scalability of practical quantum communication systems, while supporting the testing, standardization, and certification of these technologies for their secure deployment in future quantum communication networks.

Theory and Experimental Research in Quantum Communications

Infrastructures

For experimental research activities, the fellow will have access to three dedicated laboratories (approximately 90 m² each) equipped with state-of-the-art infrastructure for fiber-based quantum communications, free-space and satellite-based quantum links, as well as facilities for quantum hacking and certification of quantum communication systems. For theoretical research, the fellow will have access to high-performance computing facilities enabling large-scale simulations and advanced modeling of quantum communication protocols.

Keywords

Photonic Quantum Systems | Quantum Communication Quantum Cryptography | Quantum key Distribution | Quantum Networks | Quantum Technologies

Supervisors

- Marcos Curty
- Vadim Makarov
- Davide Rusca

Watermarking, Provenance Tracing, and Integrity of Generative AI and Multimedia Content

Engineering & Technology

Watermarking, Provenance Tracing, and Integrity of Generative AI and Multimedia Content

Description

This research develops comprehensive statistical and explainable AI (XAI) methodologies for multimedia forensics that are inherently robust against adversarial manipulation. Investigation will center on targeted research directions, which may include: 1) developing secure watermarking strategies and countering extraction techniques for generative models and their outputs, 2) advancing forgery detection utilizing both adversarially-trained models and robust hashing, 3) establishing tamper-resistant end-to-end content provenance tracing, and 4) achieving robust source and camera attribution, even when faced with sophisticated counter-forensic measures.

Infrastructures

The project will leverage the research group's on-site high-performance computing (HPC) infrastructure. Our computing resources consist of multi-core, high-memory servers with over 2 TB of aggregate RAM, optimized for intensive computational tasks. Crucially, this infrastructure includes a strong multi-GPU capability, featuring multiple distinct nodes equipped with a total of 32 high-performance NVIDIA GPUs. This specialized hardware is ideally suited for accelerating large-scale model training and inference.

Watermarking, Provenance Tracing, and Integrity of Generative AI and Multimedia Content

Keywords

- Adversarial Robustness
- Content Provenance Tracing
- Counter-Forensics
- Deepfake Detection
- Explainable AI (XAI)
- Generative AI Security
- Multimedia Forensics
- Robust Hashing
- Robust Watermarking

Supervisor

- Fernando Pérez González

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Deadline: 23 July 2026

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