ISLANDS
MSCA DOCTORAL NETWORK

PROJECT NEWSLETTER

In this newsletter, we will keep you informed about our progress, milestones, and the people driving this project forward. From groundbreaking research to exciting real-world applications, we invite you to join us on this exciting venture as we shape the future of sensing communication and 6G wireless.

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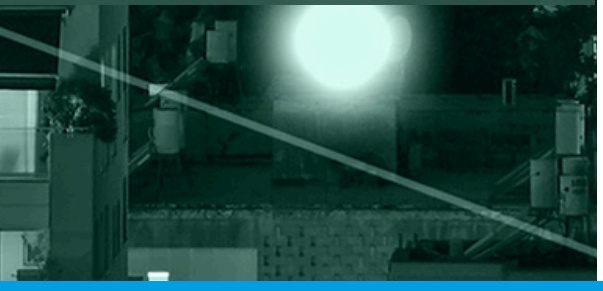


PROJECT DATA

This project has received funding from the European Union Horizon Europe (HORIZON) Marie Skłodowska-Curie Actions Doctoral Networks (MSCA-DN).

Project acronym: ISLANDS
Call: HORIZON-MSCA-2022-DN-01
Topic: HORIZON-MSCA-2022-DN-01-01
Type of action: HORIZON TMA MSCA Doctoral Networks
GA Number: 101120544
Coordinator: CNIT (Consorzio Nazionale Interuniversitario per le Telecomunicazioni)
Coordinator person: Dr. Stefano Buzzi
Project starting date: Jan 2024
Project duration: 48 months

Funded by the European Union

MEET THE DOCTORAL CANDIDATES

Here, you can learn more about the individuals driving cutting-edge research in our network, their backgrounds, and their contributions to advancing the goals of the project. Our diverse and dynamic team brings together expertise and innovation to address the challenges and opportunities of the future. Explore their profiles to discover the passion and dedication behind ISLANDS!

Nima Imani

Host Institution: ACG-RC
Ph.D. Enrollment: UCY
Supervisor: Prof. Constantinos Papadias and Prof. Ioannis Krikidis
Name: Nima
Surname: Imani
Nationality: Iranian
Birthday: 1994-02-20

Project Title

Shared spectrum access based on ISAC for automotive applications

Nima Imani was born in Iran. He received his B.Sc. degree in Electrical and Computer Engineering from the University of Mohaghegh Ardabili and his M.Sc. degree in Telecommunication Engineering from the University of Tabriz. His master's research focused on energy-efficient resource allocation in MIMO systems, with an emphasis on power allocation, antenna selection, and precoding techniques And His Master Thesis Was Mmwave Channel Modeling For Indoor Environments For 5g Applications.
Currently, Nima is a Ph.D. candidate in the ISLANDS Doctoral Network, hosted at the American College of Greece (ACG) and enrolled at the University of Cyprus. He is jointly supervised by Prof. Constantinos Papadias (ACG) and Prof. Ioannis Krikidis (University of Cyprus). His research focuses on spectrum sharing for Integrated Sensing and Communication (ISAC) in vehicular environments, with particular emphasis on waveform design, beamforming strategies, and spectrum coexistence techniques for next-generation automotive communication systems. His broader interests include wireless communications, optimization, and AI-assisted communication system design.

Mubashar Sarfraz

Host Institution: ACG-RC
Ph.D. Enrollment: UCY
Supervisor: Dr. Constantinos Papadias and Prof. Ioannis Krikidis
Name: Mubashar
Surname: Sarfraz
Nationality: Pakistani
Birthday: 1993-07-06

Project Title

Resource allocation for ISAC-enabled vehicular networks and system-level performance analysis

Mubashar Sarfraz was born in Pakistan. He completed his undergraduate degree in Electrical Engineering at NUML Islamabad in 2017 and his graduate degree in Electronics from ISRA University Islamabad. Currently, he is pursuing a Ph.D. under the Marie Skłodowska-Curie Actions (MSCA) ISLANDS project at the American College of Greece-Research Centre, supervised by Prof. Constantinos B. Papadias. His research focuses on resource allocation for Integrated Sensing and Communication (ISAC)-enabled vehicular networks and system-level performance analysis.

RESEARCH ACTIVITIES

ISLANDS will lay the theoretical and algorithmic foundations of ISAC techniques for future vehicular applications, will develop the first experimental testbeds and simulators in the area, and will train the next generation of EU researchers with specialized interdisciplinary expertise on the topic.

To achieve its ambitious goals, the ISLANDS project has brought together eleven exceptional Doctoral Candidates — young researchers selected for their outstanding talent and expertise in the field of sustainable and intelligent communication systems. Together, they are driving forward the scientific vision of ISLANDS through ten integrated and interconnected research projects, each contributing to multiple objectives of the programme.

Their work spans four main research areas:

- **Theoretical Framework for ISAC in Vehicular Environments** – Developing new mathematical models to understand and optimize integrated sensing and communication (ISAC) systems in high-mobility scenarios, revealing fundamental trade-offs in dual radar-communication design.
- **Algorithmic Framework for ISAC in Vehicular Environments** – Designing advanced communication schemes, AI-driven algorithms, waveforms, and resource allocation methods to ensure robust ISAC performance under complex and dynamic channel conditions.
- **Developing ISAC Hardware** – Creating innovative antenna systems and vehicular radar transceivers capable of both sensing and communication, while contributing to the next generation of ISAC-enabled base stations.
- **Developing Testbeds, Demos, and an Open-Access Simulator** – Building demonstrators and over-the-air experiments to validate ISAC concepts in real vehicular settings, and providing an open-access software simulator for the research community.

In the following pages, we present the key role in shaping the future of ISAC technologies.

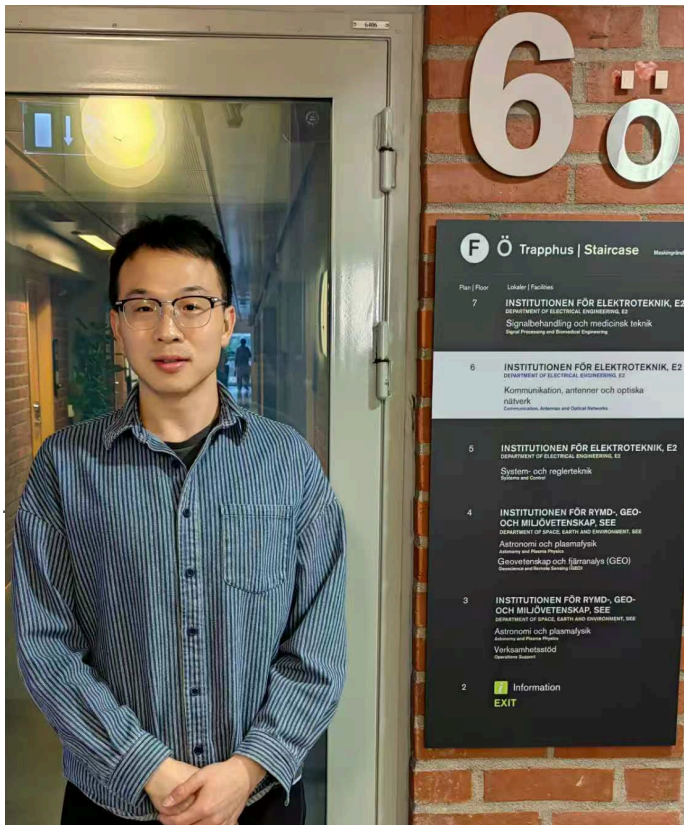
Yuhao Zhang

AI-based system design for integrating sensing and communications

Host institution: Chalmers University of Technology (Sweden)
Supervisor: Dr. Henk Wymeersch

Our current research focuses on advancing high-precision wireless localization for critical 5G/6G applications such as autonomous driving and navigation. The core objective is to develop intelligent positioning systems that overcome the fundamental limitations of existing methods.

Traditional model-based techniques perform well under direct Line-of-Sight (LOS) conditions but degrade significantly when signals are obstructed. On the other hand, machine learning (ML)-based approaches can handle complex Non-Line-of-Sight (NLOS) environments but typically require large volumes of manually labeled training data—an impractical demand at scale.



To address these challenges, this project aims to propose a unified localization framework that synergistically combines model-based and data-driven methods. The central goal is to develop a versatile and adaptive localization system capable of dynamically detecting signal conditions (LOS/NLOS) and selecting the most appropriate technique accordingly. A key innovation lies in our unsupervised learning strategy, which eliminates the need for curated ground-truth data.

As an initial step, we introduced UNILoc, a unified localization framework that automatically adapts to varying propagation environments. Operating in a fully unsupervised manner, UNILoc generates its own training labels by fusing geometric estimates with environmental map information, leveraging advanced mathematical tools such as Optimal Transport. This approach has demonstrated strong generalization capabilities and achieves accuracy comparable to fully supervised methods, effectively bridging the gap between theoretical modeling and real-world deployment constraints.

Yuhao Zhang, Guangjin Pan, Musa Furkan Keskin, Ossi Kaltiokallio, Mikko Valkama, Henk Wymeersch, "UNILoc: Unified Localization Combining Model-Based Geometry and Unsupervised Learning". [Submitted on 24 Apr 2025 (v1), last revised 7 Sep 2025 (this version, v3)]

https://doi.org/10.48550/arXiv.2504.17676

Maryam Darabi

Distributed cell-free vehicle-centric architectures for joint communications and sensing

Host institution: CNIT (Italy)
Supervisor: Prof. Stefano Buzzi

My research focuses on distributed cell-free target-centric architectures for integrated sensing and communication (ISAC). Currently, I am developing a system model for a cell-free massive MIMO (CF-mMIMO) ISAC network using OFDM modulation, with particular attention to Doppler frequency effects. The model adopts a user-centric and target-centric approach to enhance scalability. Key components include the derivation of 3D Doppler frequency profiles, modeling of OFDM transmission and reception, uplink training, and downlink transmission procedures.
I have formulated the channel models, precoding and beamformers, and analyzed the achievable data rates. For sensing, in which our main focus is on detection task, I employ GLRT-based processing tailored to Doppler-aware single-target scenarios.

The system draft is complete and currently being implemented in MATLAB. Future work will extend the framework to support multi-target sensing and dynamic vehicular environments.

Arya Kanathil Meethal

Beam steering metasurface-based vehicular antenna with single reconfigurability parameter

Host institution: Wave Up srl. (Italy)
Supervisor: Dr. Cristian Della Giovampaola

As the initial phase of my research, a leaky-wave antenna based on a sinusoidally modulated reactance surface was designed to operate at 5.9 GHz, and its performance was analyzed. This work presents the design and analysis of a sinusoidally modulated corrugated leaky-wave antenna (SMRS-LWA) operating at 5.9 GHz, targeting vehicular communication and automotive radar systems that require compact, directive, and steerable antennas.
The corrugated surface supports slow-wave propagation, and sinusoidal modulation of its surface reactance facilitates the controlled coupling of guided energy into free space. The antenna was designed for a 30° beam angle with a 50 mm modulation period, ensuring efficient radiation through first spatial harmonic excitation. Periodic groove-depth variation was used to realize the reactance modulation, with depths optimized to achieve a smooth impedance transition along the aperture. Simulation results show S11 and S21 below −10

dB in the 5.85–6.0 GHz range, confirming effective power radiation with a realized gain of 14.61 dBi.

Separately, a Magnetic Field Integral Equation (MFIE) combined with the Method of Moments (MoM) was developed to model the magnetic surface current on a periodic corrugated structure. The formulation includes Floquet harmonics and transmission-line modal contributions, providing accurate characterization of field interactions within periodically loaded geometries.

Future work focuses on incorporating varactor-loaded metasurface (MTS) unit cells above the corrugated surface to achieve electronic reconfigurability. A transmission-line model and transverse resonance analysis have been carried out to study the dispersion characteristics of the composite structure. The next step is to extend the MoM framework to account for the nonlinear, tunable response of the varactor-loaded MTS. This will enable the realization of a fixed-frequency, electronically steerable LWA at 5.9 GHz. Such antennas are essential for vehicular communications, providing adaptive, high-gain, and dynamically steerable radiation for next-generation connected transport systems.

Mehri Nikzad

Automotive radar-centric ISAC system design

Host institution: CNIT (Italy)
Supervisor: Prof. Luca Venturino

I am currently working on automotive radar-centric Integrated Sensing and Communication (ISAC) systems, focusing on radar-enabled backscatter communication aided by Reconfigurable Intelligent Surfaces (RIS). The research explores how radar signals can be reused not only for target detection but also for enabling communication with passive or low-power devices.

This concept is based on Symbiotic Radio — a novel paradigm where sensing and communication systems coexist and assist each other. In traditional SR systems, both networks are communication-based; however, in this work, the primary system is a radar whose electromagnetic waves are exploited by a secondary backscatter network for low-power data transmission.

The radar waveform thus serves a dual role, performing environmental sensing while simultaneously enabling backscatter communication. The goal of the research is to design and analyze signal processing techniques and system architectures that enhance communication reliability in realistic environments.

Ahmed Ellouimi

ISAC in vehicular environments using holographic/XL-MIMO antennas

Host institution: CNIT - Consorzio Nazionale Interuniversitario per le Telecomunicazioni (Italy)
Supervisor: Prof. Stefano Buzzi

I am currently working on cell-free m-MIMO, focusing on user prioritization using BiLSTM-based deep learning to optimize uplink spectral efficiency. At the same time, I

am also conducting research on Integrated Sensing and Communication (ISAC) systems, aiming to develop a specific system model that integrates communication and sensing functionalities.

My future research will primarily explore the use of holographic and XL-MIMO antennas in ISAC systems, specially in vehicular environments, where the far-field assumption no longer holds due to the large antenna size.

I plan to design novel near-field (Fresnel region) beamformers and transceivers for ISAC operations in such scenarios. Additionally, I will investigate holographic MIMO schemes for ultra-reliable communications during a secondment at Nokia, and study energy-efficient near-field beamforming for ISAC-enabled XL-MIMO architectures my expertise in machine learning,

I will also explore AI-driven design and optimization of ISAC algorithms for next-generation wireless networks. This work will be supervised by Prof. Stefano Buzzi, in collaboration with other researchers in a highly international research environment.

DISSEMINATION ACTIVITIES

The ISLANDS project continues to spread its scientific and technological results to a wide audience, fostering innovation and collaboration across academia, industry, and policy-making. Our dissemination strategy aims to maximize the project's impact on sustainable communication networks through publications in top-tier journals, presentations at major international conferences, workshops, and open-access sharing of research data and tools.

Beyond the scientific community, ISLANDS also reaches out to the public with Open Days and STEM activities for schools and families. These events, led by our Doctoral Candidates, feature hands-on experiments designed to inspire curiosity and enthusiasm for science and technology.

Alongside our website, social media channels (LinkedIn, X, and YouTube), and this Newsletter, these initiatives are key to promoting the project's achievements and engaging diverse audiences.

Below is a selection of ISLANDS dissemination activities and publications from recent months.

Alexandra Chatzicharistou presents her research at UCL events

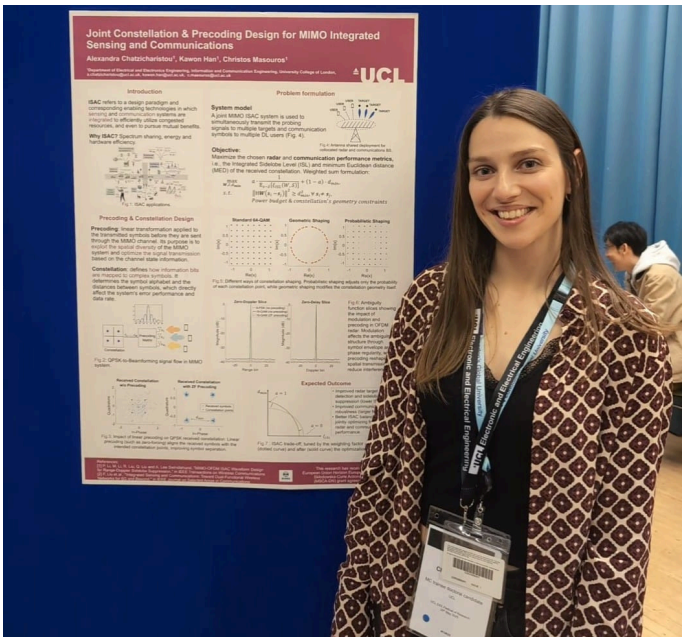
ISLANDS Doctoral Candidate Alexandra **Chatzicharistou**, hosted at University College London (UCL), had the opportunity to present her research at two important academic and industry events organised by UCL in spring 2025.

On 20 May 2025, she took part in UCL's EEE Festival of Research, an annual event showcasing the latest research activities from the Department of Electronic and Electrical Engineering. Her poster and presentation titled "Joint Design of Precoding and Geometric Constellation Shaping for MIMO-OFDM Integrated Sensing and Communications Systems" introduced a novel framework for balancing sensing and communication performance in future wireless systems Integrated Sensing and Communications (ISAC) technologies aim to combine radar sensing and data transmission within the same platform, but they often face trade-offs between detection accuracy and communication reliability. Alexandra's work proposes a joint optimization method that minimizes the radar's Integrated Sidelobe Level (ISL) while maximizing the minimum Euclidean distance (MED) of the received signal constellation—enhancing both radar detection and communication robustness. Her approach employs an efficient alternating optimization algorithm with a tunable weighting factor to dynamically manage this trade-off..

Supervised by Prof. Christos Masouros, Alexandra's research attracted strong interest and valuable

feedback from peers and faculty during the event. Following this, the same poster was showcased again on 20 June 2025 during the BT Leaders Lab, an exclusive event hosted by UCL for manager-level staff from BT, one of the UK's leading telecommunications companies. This second presentation provided Alexandra with a valuable opportunity to share her findings with an industry audience, engage in discussions about potential real-world applications, and strengthen links between academic research and the telecommunications sector.

These events represented an excellent platform for Alexandra to disseminate her research, gain feedback from diverse audiences, and increase the visibility of the ISLANDS project within both academic and professional contexts.



ISLANDS showcased at at Major International Conferences

The ISLANDS project has recently been presented at three prestigious international events, confirming its growing visibility within the global radar and communications research community.

European Microwave Week (EuMW)

Prof. Christos Masouros from University College London (UCL) introduced ISLANDS during the European Microwave Week (EuMW), organized by the European Microwave Association (EuMA) in Utrecht, 21–26 September 2025. Together with his colleague Prof. Maria Sabrina Greco, he delivered a short course on Integrated Sensing and Communications (ISAC), guiding participants through cutting-edge research and recent advances in this rapidly evolving field, while highlighting the innovative objectives pursued within the ISLANDS Doctoral Network.

The 2025 IEEE Radar Conference

Shortly after, **Prof. Masouros also presented ISLANDS at The 2025 IEEE Radar Conference (RadarConf'25), held in Krakow, Poland, 4–9 October 2025**. The event, organized by the IEEE Aerospace & Electronic Systems Society (AESS), the IEEE Poland Section, and the Polish Joint Chapter AP/AES/MTT, was hosted in Poland for the first time under the inspiring theme "Communicating Radar Sense." During his invited talk titled "Integrated Sensing and Communication: New Opportunities Come with New Challenges," Prof. Masouros discussed the transformative potential of ISAC and the key role of ISLANDS in advancing research at the intersection of radar and communication technologies.

2025 EuCNC & 6G Summit

The ISLANDS project was presented at the 2025 EuCNC & 6G Summit, held in Poznań, Poland, from 3 to 6 June 2025. The event marked the 34th edition of one of the most prominent conferences in the field of telecommunications, sponsored by the IEEE Communications Society and supported by the European Commission and the Finnish 6G Flagship Programme.

Under the theme "6G: From Vision to Reality," the conference brought together leading experts and researchers from around the world to discuss the latest developments in 5G and 6G communication systems and networks, as well as advances in cloud and virtualization solutions, hardware design, and vertical applications. **Prof. Constantinos Papadias, from the American College of Greece Research Centre (ACG-RC) and Scientific Coordinator of the ISLANDS project, took part in the event**, presenting ISLANDS as a key European initiative contributing to the development of Integrated Sensing and Communication (ISAC) technologies for next-generation networks.

Through these high-profile appearances, ISLANDS continues to strengthen its presence in the international research landscape, promoting collaboration and innovation toward next-generation sustainable and intelligent wireless networks.

PHOTO GALLERY

In the next issue

The next issue will contain a description of the further training and dissemination activities carried out within the ISLANDS project.

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