IN THIS ISSUE

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.

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

ABOUT ISLANDS

Introduction

While deployment of fifth-generation (5G) wireless networks is progressing in many parts of the world, and 3GPP is working on advanced 5G New Radio (NR) releases, forward-looking research has started to focus on the design of the next generation (6G) of wireless networks, both in industry and in academia. Focusing on radio access technologies, 6G wireless networks will be based on the evolution of some key 5G technologies, – such as, to name a few, massive MIMO, the use of high carrier frequencies (in the millimeter and TeraHertz bands), the use of air interface solutions based on artificial intelligence (AI), – and on brand new technologies, such as reconfigurable intelligent surfaces, holographic communications, and integrated sensing and communications (ISAC). Of these, ISAC, also named "joint communication and sensing" (JC&S) or "dual-function radar-communication" (DFRC), is one of the most striking and promising.

ISAC a new paradigm aiming at integrating the sensing functionality into wireless networks.

One of the areas that will be strongly impacted and will benefit the most from the development of ISAC in future 6G networks is by no doubt the automotive sector. Indeed, moving people and goods is one of the fundamental needs of our modernized and global society, and we aspire that in the near future mobility will be more sustainable, more automated, more secure and more efficient than ever. These objectives can be reached by fully exploiting information technologies and in particular the potential of wireless networks. 5G wireless networks have been the first to have tried to provide extensive support for connected and automated mobility. As an example, the 5G advanced physical layer solutions, including new numerology and new channel codes to support low latency communications, network slicing and the localization capability, represent a first initial step towards the support of vehicle-to-everything (V2X) communications and Tele-operated Driving (ToD).
However, the technological advancement brought by 5G for connected and automated mobility (CAM) services are unanimously considered not enough. Further progress is expected for forthcoming 6G systems.

The unique capabilities brought by ISAC such as sensing-assisted communications and communication-assisted sensing, provide an unprecedented tool for the development and deployment of CAM services in terms of reliability, safety, localization accuracy and responsiveness.

How ISAC will revolutionize the wireless and connected/automated mobility landscape.

In the following, we list the key ISAC features that hold the potential to revolutionize the wireless communications landscape in general, and CAM services in particular.
Increased hardware, spectrum and energy efficiency. Resource pooling is a well-known way to increase efficiency and achieve a better use of available resources. Performing both the sensing and communication tasks by sharing significant portions of the transceiver hardware (antennas, RF chains, DSPs, chips, etc.), ISAC is such a key resource pooling mechanism. It allows to use a common power budget and spectrum, while saving hardware.
Better communication performance by using sensing information, i.e., sensing-assisted communications. Wireless communication relies on functions such as channel estimation, beam alignment, beam tracking, handover management, etc. These functionalities are currently implemented through ad-hoc protocols, exploiting suitable reference data signals. An ISAC network will help strengthen the performance of such functions and ultimately improve the performance of the communication system, with better support to CAM services.
Better sensing performance by using communication data, i.e., communication-assisted sensing. In CAM services, estimating and tracking the position of a vehicle with high accuracy is a crucial task. An ISAC network can improve this task by also exploiting the communication signals transmitted by the vehicles. Moreover, communication signals transmitted by some devices may be helpful to detect and locate nearby passive objects, and to create a map of the surrounding environment.
New use-cases and new business opportunities. A perceptive network can offer a much larger number of services than a traditional "communication only" network. All these new use-cases will naturally generate new business opportunities and the creation of new value-added services with high utility margins.

Why a Doctoral Network?

In order to realize ISAC-empowered wireless networks specifically tailored to the automotive sector, innovative training is to be conceived and realized. Developing ISAC technologies for the connected vehicle of the future is a highly inter-disciplinary effort.

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.

RESEARCH OBJECTIVES

The above overall objective is decomposed into the following four research objectives of ISLANDS:

Research Objective 1 – Theoretical framework for ISAC in vehicular environments. Develop new mathematical techniques for theoretical ISAC in high-mobility environments and unveil fundamental trade-offs for dual function radar-communication systems.

Research Objective 2 – Algorithmic framework for ISAC in vehicular environments. Develop new communication schemes, waveforms, beamforming algorithms, AI-based solutions, resource allocation schemes, to come up with effective ISAC schemes for vehicular environments and to cope with the harsh environment caused by doubly selective fading channels.

Research Objective 3 – Developing ISAC hardware. Bring to light novel antenna systems specifically designed for ISAC tasks in vehicles. Develop novel vehicular radar transceivers equipped with the communication functionality. Contribute to the definition and development of ISAC-enabled base station transceivers.

Research Objective 4 – Developing testbeds, demos and an open-access simulator. Develop demos and over-the-air experiments to showcase ISAC functionalities in vehicular environments, from both UE and network sides. Develop a unique and comprehensive open-access system-level software simulator.

To achieve the above research objectives, ISLANDS will hire eleven DCs, who will synergistically work on ten integrated and intertwined projects, each spanning at least two research objectives.

PROJECT PARTNERS

Beneficiaries

CONSORZIO NAZIONALE INTERUNIVERSITARIO PER LE TELECOMUNICAZIONI
CNIT - Coordinator (Italy)

AMERIKANIKO KOLLEGIO ELLADOS, KENTRO EREVNAS
ACG-RC - Beneficiary (Greece)

CHALMERS TEKNISKA HÖGSKOLA AB
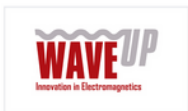CHAL - Beneficiary (Sweden)

TAMPEREEN KORKEAKOULUSÄÄTIÖ SR
TAU - Beneficiary (Finland)

ROBERT BOSCH GMBH
BOSCH - Beneficiary (Germany)

NOKIA SOLUTIONS AND NETWORKS GMBH & CO KG
NOKIA - Beneficiary (Germany)

WAVE UP SRL
WUP - Beneficiary (Italy)

UNIVERSITY COLLEGE LONDON
UCL - Beneficiary (UK)

Associated partners

UNIVERSITÀ DEGLI STUDI DI CASSINO E DEL LAZIO MERIDIONALE
UNICLAM - Associated Partner (Italy)

UNIVERSITÀ DEGLI STUDI DI SIENA
UNISI - Associated Partner (Italy)

UNIVERSITY OF CYPRUS
UCY - Associated Partner (Greece)

KARLSRUHER INSTITUT FÜR TECHNOLOGIE
KIT - Associated Partner (Germany)

ORANGE SA
ORAN - Associated Partner (France)

ORGANISMOS TILEPIKOINONION TIS ELLADOS OTE AE
OTE - Associated Partner (Greece)

SATELLITE APPLICATIONS CATAPULT LIMITED
SAC - Associated Partner (UK)

WEIZMANN INSTITUTE OF SCIENCE
WEIZ - Associated Partner (Israel)

SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY
SUSTECH - Associated Partner (China)

KO MEETING

On 22-23 January, 2024, took place in Italy, in the city of Cassino (FR), the KO Meeting for the Project Islands, organized by CNIT and coordinated by Dr. Stefano Buzzi, general coordinator of the project. The event served as a pivotal moment in the journey towards advancing research and innovation in the field of Integrated Sensing and Communications for the Vehicular Environment within future 6G Wireless Networks.

Hosted at the University of Cassino, the KO Meeting brought together key stakeholders, project partners, and experts from various domains. Over the course of two days, participants engaged in fruitful discussions, strategic planning sessions, and collaborative activities aimed at setting the foundation for the project's success.

Highlights of the KO Meeting include:

1. **Strategic Alignment: Participants** gained insights into the overarching objectives and strategic direction of Project Islands, ensuring coherence and alignment with the project's mission and goals.
2. **Collaborative Planning**: Project partners worked together to define key milestones, deliverables, and timelines, fostering a spirit of collaboration and collective ownership.
3. **Knowledge Exchange**: Experts and stakeholders shared valuable insights, best practices, and lessons learned from their respective fields, enriching the collective knowledge base of the project.
4. **Networking Opportunities**: The KO Meeting provided a platform for participants to network, establish new connections, and explore potential avenues for collaboration and partnership.

Looking ahead, we are excited to announce that calls for applications to enroll in doctoral schools will be published shortly. These schools will provide aspiring scholars with the opportunity to engage in cutting-edge research, receive specialized training, and contribute to the advancement of knowledge in their respective fields.

We extend our sincere appreciation to the University of Cassino for graciously hosting the KO Meeting and to all participants for their active involvement and contributions. Together, we are committed to driving innovation, fostering collaboration, and making meaningful strides towards achieving the objectives of Project Islands.

Here is the list of the available Ph.D. Projects:

1. **ACG-RC-1** "Shared spectrum access based on ISAC for automotive applications" (Greece)
2. **ACG-RC-2** "Resource allocation for ISAC-enabled vehicular networks and system-level performance analysis" (Greece)
3. **BOSCH-1** "Sensor and data fusion techniques for vehicular communication performance enhancements" (Germany)
4. **CHAL-1** "AI-based system design for integrating sensing and communications" (Sweden)
5. **CNIT-1** "Distributed cell-free vehicle-centric architectures for joint communications and sensing" (Italy)
6. **CNIT-2** "ISAC in vehicular environments using holographic/XL-MIMO antennas" (Italy)
7. **CNIT-3** "Automotive radar-centric ISAC system design" (Italy)
8. **NOKIA-1** "Evolving wireless networks architectures to support ISAC" (Italy)
9. **TAU-1** "Advanced radio-based SLAM algorithms for vehicular systems" (Finland)
10. **UCL-1** "Signaling and waveform design for ISAC in vehicular environments" (UK)
11. **WUP-1** "Beam steering metasurface-based vehicular antenna with single reconfigurability parameter" (Italy)

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!

Paolo Tosi

Host Institution: NOKIA
Ph.D. Enrollment: KIT
Supervisor: Dr. Silvio Mandelli
Name: Paolo
Surname: Tosi
Nationality: Italian
Birthday: 1999-05-24

Project Title
Evolving wireless networks architectures to support ISAC

He was born in Italy, completed high school in Legnano, Italy in 2018 and later joined Politecnico di Milano for the Bachelor's degree in Computer Engineering. After successfully obtaining the degree, Mr. Tosi continued his studies in Milan, starting the Master's degree in Telecommunication engineering in 2021, where he specialized following the "Microwaves and Photonics" study track. Mandatory requirement for the completion of the degree was the production of an original Master's thesis. Under the supervision of Professor Maurizio Magarini, Mr. Tosi joined Nokia Bell Labs Stuttgart, where, advised by Dr. Silvio Mandelli and Dr. Marcus Henninger, he developed a project on "Feasibility of Non-Line-of-Sight Integrated Sensing and Communication at mmWave". An exerpt of his thesis was presented at SPAWC 2024 Conference in Lucca, Italy, and published in the conference proceedings. His software skills include, but are not limited to: Matlab, Python, Linux OS and LaTex. Mr. Tosi received his Master's degree in April, 2024, with an overall grade of 110/110.

Xi Zhang

Host Institution: TAU
Ph.D. Enrollment: TAU
Supervisor: Dr. Mikko Valkama
Name: Xi
Surname: Zhang
Nationality: Chinese
Birthday: 1999-10-12

Project Title
Advanced radio-based SLAM algorithms for vehicular systems

She was born in 1999 in China. She received her bachelor's degree from Xidian University in 2021 and completed her master's degree at Chalmers University of Technology in 2024. Currently, Xi is pursuing a Ph.D. degree at Tampere University, focusing on radio SLAM algorithms as part of the ISLAND project, funded by the European Union's Horizon Europe Marie Skłodowska-Curie Actions Doctoral Networks.

Yuhao Zhang

Host Institution: CHAL
Ph.D. Enrollment: CHAL
Supervisor: Dr. Henk Wymeersch
Name: Yuhau
Surname: Zhang
Nationality: Chinese
Birthday: 1993-01-24

Project Title
AI-based system design for integrating sensing and communications

He was born in Mianzhu, China. He received the B.E. degree in communication engineering and the M.S. degree in information and communication engineering from the Beijing University of Posts and Telecommunications, Beijing, China, in 2015 and 2018, respectively, and the M.Eng. degree in electrical and computer engineering from the University of Waterloo, Waterloo, ON, Canada in 2021. He is currently pursuing the Ph.D. degree with the Department of Electrical Engineering, Chalmers University of Technology, Sweden, where he is jointly supervised by Dr Musa Furkan Keskin and Dr. Henk Wymeersch. His research interests include integrated communication and sensing, machine learning and optimization for wireless systems.

Alexandra Chatzicharistou

Host Institution: UCL
Ph.D. Enrollment: UCL
Supervisor: Dr. Christos Masourous
Name: Alexandra
Surname: Chatzicharistou
Nationality: Greek
Birthday: 1997-07-10

Project Title
Signaling and waveform design for ISAC in vehicular environments

She graduated with an M.Eng. in Electrical and Computer Engineering from the Aristotle University of Thessaloniki in 2021, specializing in telecommunications. Her master's thesis focused on the use of Successive Interference Cancellation (SIC) for decoding received signals in LoRa networks. After graduation, she worked as a telecommunications engineer in Nokia's L1 organization, where she contributed to the research and development of baseband processing solutions for LTE/NR, with particular expertise in NB-IoT and URLLC. In this role, she was involved in algorithm development and performance assessment for Nokia's proprietary link-level simulator, further enhancing her knowledge of signal processing and next-generation radio access technologies. Currently, Alexandra is a PhD student in the ISLANDS doctoral network, where she is conducting research in joint communication and sensing technologies, leveraging her combined academic and industry expertise.

DISSEMINATION ACTIVITIES

Talk "Integrated Sensing and communications for future vehicuLAr systems (ISLANDS) – a Network of Doctoral Students"

Professor Constantinos Papadias, from The American College of Greece Research Center, Scientific Manager of the MSCA Doctoral Network Project ISLANDS, gave an overview talk about the project at the NextGCOM Research Colloquium (https://nextgcom.iee.ihu.gr/), which took place at the town of Litochoro in Northern Greece during August 28-30, 2024. The talk was entitled "**Integrated Sensing and communications for future vehicuLAr systems (ISLANDS) - a Network of Doctoral Students,**" and was given on Friday Aug. 30, 2024.

Online Women Workshop on Reconfigurable Intellingent Surfaces and Integrated Sensing and Communications

On November 25, 2024 the EU-funded META WIRELESS and ISLANDS projects hosted a highly engaging Online Women's Workshop on advancements in 6G wireless networks. The event brought together prominent female researchers and numerous participants to discuss two transformative technologies at the core of 6G innovation: Reconfigurable Intelligent Surfaces (RIS) and Integrated Sensing and Communications (ISAC).

Highlights of the Workshop

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These technologies represent essential building blocks for 6G networks, underscoring their transformative role in shaping the connectivity of the future.

Closing the Gender Gap in 6G Research

In addition to its technical focus, the workshop addressed the critical mission of increasing gender diversity in the 6G research community. By highlighting the contributions of female experts and creating opportunities for young women to connect with inspiring role models in wireless technology, the event reinforced the importance of inclusivity in STEM fields. This initiative reflects the broader commitment of META WIRELESS and ISLANDS to promote equity and innovation in advanced technology sectors.

Agenda of the workshop:

-14:30 - 14:45: Dr. Carmen D'Andrea - CNIT and UNICAS (Italy): "Introduction to METAWIRELESS AND ISLANDS MSCA Projects"

- 14:45 - 15:25: Prof. Sofie Pollin – KU Leuven (Belgium): "Massive Integrated Communication and Sensing"

-15:25 - 15:55: Dr. Özlem Tuğfe Demir - TOBB University of Economics and Technology (Turkey): "RIS-Assisted ISAC: Precoding and Phase-Shift Optimization for Mono-Static Target Detection"

-15:55 - 16:20: Dr. Anna Guerra – CNR and University of Bologna (Italy): "Wireless Localization and Sensing Empowered by Reconfigurable Intelligent Surfaces"

-16:20 - 16:50: Dr. Derya Malak – EURECOM (France): "Coding for distributed computation over networks"

Overall, the workshop was followed by 50+ participants from all over the world.

The workshop was organized by:

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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