

JOB DESCRIPTION

ISLANDS – Doctoral Candidate (DC)

CHAL-1: AI-based system design for integrating sensing and communications

Chalmers University of Technology is seeking to appoint one Doctoral Candidate (DC) to join the Marie Skłodowska-Curie Doctoral Network on “**Integrated Sensing and communications for future vehicuLAr systems a Network of Doctoral Students**” (ISLANDS).

Position:	Doctoral Candidate (DC)
Location:	Gothenburg-Sweden
Working time:	Full-time
Duration:	Fixed term (3 years)
Living, mobility, family, and research allowances:	In agreement with the MSCA Doctoral Network financial regulations https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2023-2024/wp-2-msca-actions_horizon-2023-2024_en.pdf (Section 1. MSCA DOCTORAL NETWORKS, page 81)

About ISLANDS

For decades communication systems have been developed independently to radar systems, leading to a duplication of systems and devices that exploit the electromagnetic spectrum in common ways. Yet, the future wireless infrastructure will need to do more than just communications to support smart cities, intelligent mobility, infrastructure monitoring, security. It will need to perform multiple functions and will rely on high-reliability communication and sensing. The independent growth of radar and communication systems is no longer sustainable and will lead to a congestion of devices, emitters and sensors. There is a skills gap in the community to address this as communication engineers work isolated to radar engineers, and a new set of skills need to be developed. ISLANDS is a doctoral network that focuses on the theoretical and algorithmic foundations of integrated sensing and communication for the automotive sector, with the objective of developing new physical-layer and network-level solutions, to explore the fundamental limits of such technology, and to provide experimental validation and testing for the developed techniques. Specifically, ISLANDS will: 1) develop new transceiver algorithms, capable of integrating and leveraging the communication and sensing functionalities, with the purpose of achieving superior performance and energy and hardware efficiency; 2) investigate the ultimate network performance limits that

the integration of communication and sensing can achieve in environments with extreme mobility; and 3) provide experimental validations of the developed techniques with proof-of-concept testbeds and realistic system-level simulators. ISLANDS will train the next generation of EU experts and leaders with specific interdisciplinary expertise, combining sensing and communications, with the aim of reinforcing European leadership in the automotive sector of the next decades.

The Role

Supervised end-to-end learning approaches have recently been proposed to simultaneously design transmitters and receivers for ISAC and mmWave positioning systems. However, they often assume the existence of differentiable channel models for sensing and communications to be able to use them for joint transmitter-receiver training via neural networks. For the receiver side, the gradients can be computed from the output of the radar and communication channels, while access to the likelihood function for transmitter learning is not possible. Suitable alternative methods, such as reinforcement learning (RL) techniques (e.g., using policy gradient), or other methodologies, are thus needed to realize AI-based design of ISAC transmit waveforms.

The DC will reconsider the entire vehicular ISAC problem from a data-driven AI approach. This activity will enable the discovery of new transmitter and receiver structures that are optimized for scenarios for which no suitable model-based approaches exist (e.g., under severe compound hardware impairments common in resource constrained vehicular settings) or where model-based solutions are sub-optimal. The DC will also investigate supervised end-to-end learning solutions for cooperative and sidelink-based vehicular ISAC systems and the design of data-driven approaches to ISAC in cell-free massive MIMO networks.

Further information about the Ph.D. projects can be found in the following tables.

Position: CHAL-1
Title: AI-based system design for integrating sensing and communications
Scientific context: ISAC in vehicular environments
Objectives: Design data-driven ISAC transmitters and receivers for connected and automated mobility (CAM) services using reinforcement learning and supervised learning
Expected results: Novel transceivers schemes based on AI over differentiable channel models in automotive scenarios. OTA experiments
Acquire knowledge: ISAC, AI, statistical signal processing
Planned secondment(s): CNIT-3 months: design of data-driven approaches to ISAC in cell-free networks; BOSCH-3 months: investigate supervised end-to-end learning solutions for cooperative and sidelink-based vehicular ISAC systems
Ph.D. enrolment: Chalmers University of Technology

Duties and Responsibilities

1. Undertake postgraduate research in support of the agreed doctoral research project.
2. Work closely with the academic supervisors to ensure the compatibility of the individual project with the overall goals of ISLANDS.
3. Present and publish research in both academic and non-academic audiences.
4. Attend and participate to academic and non-academic conferences, events and seminars.
5. Attend and participate to all training events and supervisory meetings.
6. Be seconded to other network partners as necessary to fulfil the grant obligations.
7. Prepare progress reports and similar documents on research for funding bodies, as required.
8. Contribute to the delivery and management of the wider programme, including attending and participating in programme committee meetings.
9. Actively contribute to the public engagement and outreach activities as described in the grant agreement. As job descriptions cannot be exhaustive, the DC may be required to undertake other duties, which are broadly in line with the above duties and responsibilities.

Person Specification

1. An undergraduate degree and a postgraduate Master's degree (or equivalent) in electronic or electrical engineering, mathematics, electromagnetics, or a physical sciences subject.
2. Excellent mathematical skills and background.
3. High proficiency in Matlab, Python, Mathematica, Maple, R, or similar programming software.
4. Solid background on wireless communications (antennas, propagation, stochastic geometry is a plus).
5. Excellent written and verbal communication, including presentation skills.
6. Highly proficient English language skills.
7. Excellent organisational skills, attention to detail and the ability to meet deadlines.
8. Ability to think logically, create solutions and make informed decisions.
9. Willingness to work collaboratively in a research environment.
10. A strong commitment to his/her own continuous professional development.
11. Willingness to travel and work across Europe.

Eligibility Requirements

All candidates must meet the following requirements to be considered for this post:

- a) Doctoral Candidates (DC) must not have a doctoral degree at the date of the recruitment by the host organisation. A postgraduate Master's degree (or equivalent) is required at the time of recruitment to enrol in the doctoral program.
- b) At the time of recruitment by the host organisation, DCs must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organisation for more

than 12 months in the three years immediately prior to the recruitment date. Compulsory national service, short stays such as holidays, and time spent as part of a procedure for obtaining refugee status under the Geneva Convention are not taken into account.

How to Apply

Applications must be submitted, to the attention of Prof. Henk Wymeersch, according to the following procedure:

- 1) Registration and submission of the application material to the ISLANDS recruitment website: <https://www.islands-mscadoctoralnetwork.eu/jobs/>
- 2) Parallel application and submission of the application material at the Chalmers University of Technology website: <https://www.chalmers.se/en/about-chalmers/work-with-us/vacancies/>

Please note that it is essential that the candidate makes a double submission of his/her application by executing both the above steps 1) and 2).

Note 1: Informal enquiries for further information about the position can be sent to Prof. Henk Wymeersch (henkw@chalmers.se) and Dr. Musa Furkan Keskin (furkan@chalmers.se).

Note 2: By registering in the website mentioned above, the applicants agree that all members of the ISLANDS project can access their personal data and application material.

Each application must include the following material:

- a) A cover letter explaining the motivation for applying for the post.
- b) A curriculum vitae setting out the educational qualifications as well as any additional scientific achievements and publications.
- c) Evidence of English proficiency.
- d) Copy of Bachelor's and Master's certificates (if available at the time of application).
- e) Copy of Bachelor's and Master's transcripts.
- f) Any additional material useful for the assessment of the candidate (e.g., recommendation letters, research project/statement in agreement with the requirements specified in previous text).

Selection Process

The selection and recruitment processes of the DCs will be in accordance with the European Charter and Code of Conduct for the Recruitment of Researchers. The recruitment process will be open, transparent, impartial, equitable, and merit-based. There will be no overt/covert discrimination based on race, gender, sexual orientation, religion or belief, disability or age.

To this end, the following selection criteria for the recruitment of the DCs will be considered:

1. Curriculum vitae

2. Academic performance (diplomas, university transcripts, etc.)
3. Research and industrial experience
4. Awards and fellowships
5. Publications and patents
6. Research, leadership, and creativity potential
7. English knowledge
8. Other relevant items based on the specific candidate

The recruitment process will adhere to the guidelines described in the Grant Agreement of the ISLANDS project. At the network's level, the recruitment will be coordinated by the Recruitment Committee of the project in order to guarantee gender- and sector-balance.

At the Chalmers University of Technology, the recruitment will be coordinated by Prof. Henk Wymeersch. More precisely, the recruitment and selection of the DCs will be executed by Dr. Musa Furkan Keskin. The entire process will be overseen and approved by the Recruiting Committee of the ISLANDS Doctoral Network.

The application deadline for the post is on April 7, 2024. Each application will be acknowledged electronically (e.g., by return email) and a unique ID number will be assigned to it.

The applications will be analysed after the application deadline, and the shortlisted candidates will be invited to a teleconference interview. The selected candidates are expected to be recruited during the course of the current year (2024). At the end of the selection process, all the applicants will be informed of the outcome of their application by return email.

Further Information

For more information about the Doctoral Candidate position on AI-based system design for integrating sensing and communications, please contact Prof. Henk Wymeersch (henkw@chalmers.se) and Dr. Musa Furkan Keskin (furkan@chalmers.se).

Disclaimer

By applying for this position, the applicants give their consent to circulate their application and personal data within the members of the consortium.

By applying for this position, the applicants declare to fulfil the eligibility requirements defined by the MSCA.

By applying for this position, the applicants agree that they will comply with the secondment plan.

By applying for this position, the applicants agree that they will comply with the planned Ph.D. enrolment.