Job Description

MetaWireless Early Stage Researchers
Laboratory of Signals and Systems (CNRS UMR 8506)
Paris-Saclay University, Paris, France

The Laboratory of Signals and Systems (CNRS UMR 8506), Paris-Saclay University, Paris, France is seeking to appoint two high-calibre Early Stage Researchers (ESRs) to join the Marie Skłodowska-Curie Innovative Training Network on **'Future Wireless Communications Empowered by Reconfigurable Intelligent Meta-Surfaces'** (MetaWireless).

Position	Early Stage Researcher - CNRS-1: Electromagnetic modelling of signal propagation in RIS-empowered wireless networks (RIS = reconfigurable intelligent surfaces) - CNRS-2: Modelling and optimization of large-scale RIS-based wireless networks (RIS = reconfigurable intelligent surfaces)
Location:	Laboratory of Signals and Systems (CNRS UMR 8506), CentraleSupelec, Paris-Saclay Campus, 3 Rue Joliot-Curie, 91192 Gif-sur-Yvette, France
Working time:	Full Time
Duration:	Fixed-Term (3 years)
Living, mobility, family, and research allowances:	In agreement with the MSCA-ITN financial regulations (http://ec.europa.eu/research/participants/data/ref/h2020/other/guides_for_applicants/h2020-guide-appl-msca-itn_en.pdf - Section 5, page 27)

About MetaWireless

Wireless connectivity has become a pillar of our society. The growth of wireless traffic is relentless, forecast to reach a staggering worldwide aggregate of 5,016 exabytes by 2030, along with bit rates of 1 Tb/s and new services related to sensing, localization, low-latency, and ultra-reliability. While the performance of wireless networks has improved phenomenally over the last decades, progress is by now pushing against fundamental limits and the mechanisms that have sustained these huge improvements are starting to falter. New evolutionary leaps are called for in order to ensure that the aforementioned forecasts can become a reality. To date, every wireless system has abided by the premise that the propagation radio channel is fixed by nature and cannot be tampered with, but only compensated through ever more sophisticated transmission/reception schemes. A potential evolutionary leap for 6G-and-beyond networks is to break free from the postulate that channels are uncontrollable factors. Serving such a vision, MetaWireless pursues the disruptive idea of designing wireless networks by treating the environment itself as a quantity to be controlled and optimized. Precisely, the manipulation of the wireless environment can be made possible by incorporating reconfigurable intelligent surfaces. These are planar structures, made of meta-materials and electromagnetically discontinuous, which do not adhere to conventional reflection and diffraction laws; rather, they can modify in a controllable fashion the phase and wavefront of impinging radio waves. If deployed to coat objects, walls, or building facades, they could allow customizing in real time the electromagnetic response of environments. Making this vision a reality requires the training of a new generation of researchers and a multidisciplinary effort involving wireless communications, physics, electromagnetic theory, and computational learning, which are the ingredients that define the MetaWireless project.

The Role

CNRS-1 and CNRS-2 will be hosted by the Laboratory of Signals and Systems (CNRS UMR 8506), which is located in CentraleSupelec, Paris-Saclay campus, Paris, France. Both ESRs will be enrolled on the PhD programme of Paris-Saclay University, Paris, France, and will write their thesis on a topic related to *"Electromagnetic modelling of signal propagation in RIS-empowered wireless networks"* (CNRS-1) and **"***Modelling and optimization of large-scale RIS-based wireless networks"* (CNRS-2), under the supervision of Dr. Marco Di Renzo for the entire duration of their Ph.D. programme. CNRS-1 and CNRS-2 will benefit, in addition, of a secondment period at other partners of the MetaWireless project.

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

Position: CNRS-1
Title: Electromagnetic modelling of signal propagation in RIS-empowered wireless networks.
Scientific context: Current wireless networks are designed based on communication-theoretic frameworks that ignore the electromagnetic characteristics of the objects, but in RIS-based networks the electromagnetic characteristics of the objects are to be optimized. To overcome this gap, a new mathematical+physics theory of communications will be developed, generalizing Shannon's theory of communications to account for Kirchhoff's theory of diffraction. The proposed approach consists of modelling transmitters and receivers as distributed sources of electrical/magnetic charges that emit waves, which interact with the objects, and are reflected, refracted, and scattered. By using the tool of Kirchhoff's theory of diffraction based on Green's functions, the objective is to devise new mathematical models for estimating the electromagnetic field scattered by large-size and small-size RISs. The objective is to identify so far unknown operating conditions under which RISs act as anomalous mirrors or diffusers, for multiple applications (e.g. beamforming, broadcasting). Exact analytical frameworks that can be efficiently computed numerically by system-level simulators, and closed-form approximations that are tractable for mathematical optimization will be devised. To this end, the stationary-phase methodology based on physics and geometric optics will be employed.
Objectives: Identifying fundamental conditions under which the RISs act as mirrors or diffusers in the near and far field.
Expected results: Electromagnetic-based framework for extracting the fundamental performance limits of RIS-based wireless networks.
Acquire knowledge: Electromagnetic tools for describing the interaction of electromagnetic waves with objects in the radio path.
Planned secondment(s): NEC (Germany) for 6 months.
Ph.D. enrolment: Paris-Saclay University (France).

Position: CNRS-2
Title: Modelling and optimization of large-scale RIS-based wireless networks.
Scientific context: Random spatial processes are the most suitable analytical tool to shed light on the ultimate performance limits of large-scale wireless networks, and to guide the design of optimal algorithms and protocols to attain them. Currently available analytical methods, however, are not capable of modeling RISs that shape the signals in unnatural ways. To overcome this gap, this ESR project is focused on developing a new analytical framework to quantify the system-level performance of wireless networks in the presence of RISs. The proposed approach will be based on modelling RIS-coated objects by means of spatial shapes whose locations, size, orientation, height are randomly distributed. The analytical tool of random shapes will be used, and the objective will be to formulate key performance indicators (e.g. coverage, spectral efficiency, energy efficiency, delay) in analytically-tractable forms, and, to optimize, the corresponding network, e.g., to identify the optimal number of RISs per unit area to be deployed.
Objectives: To develop analytical frameworks for assessing their performance in large-scale wireless networks using random spatial processes.
Expected results: Analytical models based on stochastic geometry for the deployment of large-scale RIS-based networks.
Acquire knowledge: Knowledge in stochastic geometry and random shape theory, for system-level analysis of large-scale networks.
Planned secondment(s): ERICSSON (Sweden) for 6 months.
Ph.D. enrolment: Paris-Saclay University (France).

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 MetaWireless.
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 ESR 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, 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) Early-Stage Researchers (ESRs) shall at the time of recruitment by the host organisation be in the first four years (full-time equivalent research experience) of their research careers and not yet have been awarded a doctoral degree. Full-time equivalent research experience is measured from the date when a researcher obtained the degree which would formally entitle him or her to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the researcher is recruited.

b) At the time of recruitment by the host organisation, ESRs 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 and/or short stays such as holidays are not taken into account.

How to Apply

Applications must be submitted, to the attention of Dr. Marco Di Renzo, according to the following procedure:

1) Registration and submission of the application material to the MetaWireless recruitment website (https://h2020-msca-itn-metawireless.cnit.it/jobs/).

Informal enquires for further information about the positions can be send to Dr. Marco Di Renzo (marco.di.renzo@gmail.com).

Note: By registering in the website mentioned above, the applicants agree that all members of the MetaWireless 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.
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 ESRs 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 ESRs 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 MetaWireless 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 CNRS's level, the recruitment will be coordinated by the host laboratory (Laboratory of Signals and Systems). More precisely, the recruitment and selection of the ESRs will executed by the Scientist-in-Charge of the MetaWireless project for the CNRS (Dr. Marco Di Renzo) and by at least another research scientist of the Laboratory of Signals and Systems. The entire process will be overseen and approved by the Administrator of the Laboratory of Signals and Systems and by the Responsible of the Human Resources of the Laboratory of Signals and Systems.

The application deadline for both posts is on **1 April 2021**. 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 period **1 May 2021 - 30 November 2021**. At the end of the selection process, all the applicants will be informed of the outcome of their application by return email. Applicants interested in joining the CNRS are invited to apply to both posts CNRS-1 and CNRS-2, and to express their preference for the most suitable post (if any).

Further Information

For more information about the posts CNRS-1 and CNRS-2, please contact Dr. Marco Di Renzo (marco.di.renzo@gmail.com).

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.