Job Description
MetaWireless Early Stage Researchers
Wave Up s.r.l.
Siena, Italy

Wave Up s.r.l., based in Siena, Italy, is seeking to appoint one 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 - WUP-1: Meta-surfaces for low-complexity transmitter design in RIS-based wireless networks
Location:	Wave Up s.r.l., via Roma 77, 53100 Siena, Italy
Working Time:	Full Time
Duration:	Fixed-Term (3 years)
Salary:	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)

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

WUP-1 will be hosted by Wave Up, which is located in via Roma 77, 53100 Siena, Italy. The ESR will be enrolled on the Ph.D. programme of the Department of Information Engineering and Mathematics of the University of Siena, Siena, Italy, and will write their thesis on a topic related to *"Meta-surfaces for low-complexity transmitter design in RIS-based wireless networks",* under the supervision of Dr. Francesco Caminita (Wave Up) and Prof. Stefano Maci (University of Siena) for the entire duration of their Ph.D.

programme. WUP-1 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: WUP-1
Title: Meta-surfaces for low-complexity transmitter design in RIS-based 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 perception capability of RIS allows sensing the surrounding environment and capture the instantaneous 5G+ environmental status at electromagnetic level. This capability is enabled using a sensing device, consisting by a set of independent electromagnetic elements connected through a controlled electronic network, whose aim is to perceive the localization of the network players (e.g., access-points and users). The electromagnetic sensing is performed by several different devices able to interface with the electromagnetic environment and transduce the instantaneous amplitude and phase of the illuminating electromagnetic field into an electrical quantity, easily managed by the circuitry behind the sensor. The simplest electromagnetic receiving smart wave device is the *sensing metasurface*, i.e., a printed sub-wavelength elements properly emulating boundary conditions that convert electromagnetic a space wave from the environment into a surface wave, whose energy is collected by one or more feed points Two different architecture of the metasurface can be conceived to minimize the complexity of the electronics. The first one is based on a dynamic configuration with active control switches. The second one is based on a static configuration with overlapped holographies and multi-receiving points. In both cases, the metasurface intelligence will be able to perceive the localization of the network players (e.g., access-points and users). The two architectures are described next. A. *Uniform metasurface with controllable switches and single receiving points.* The metasurface is based on small elements in terms of wavelengths (e.g., one tenth of wavelength), each connected with a switch that allow to change the particle status with two bits (zero-one). The distribution of switches in status "on" are changed continuously maintaining a density of half-wavelength. The distribution is able to re-design a holography of "on" switches capable of sensing one direction of arrival at a time, so as the surface wave coupled energy will be maximized at the single collector point. B. *Multi-pinned overlapped holographies.* It has been demonstrated by actors of the University of Siena team that the metasurface can be designed in such a way to couple waves coming from more than one direction maximizing power at individual collector points. This is done by a proper optimization of overlapping contributions that maximize the power from different directions. This approach exhibits i) a low complexity since no active elements on the metasurface are needed, ii) it offers the possibility of coupling more directions of wave arrival, distinguishing them by ports. However, the main drawback with respect to the solution A is the less effective area of collection for each DoA, that translates in a reduction of the precision in the DoA detection. The final architecture will be selected depending on the specific system requirements.
Objectives: To design low-complexity single-RF multi-stream transmitters through metasurfaces that mimic conventional modulations.
Expected results: A new generation of low-complexity and low-power single-RF and metasurface-based multi-stream transmitters.
Acquire knowledge: Multi-stream transmitters with a single-RF chain, of low complexity and low power-consumption.

Planned secondment(s): National Centre for Scientific Research “Democritos” (Greece) for 3 months + Tsinghua University (China) for 3 months.
Ph.D. enrolment: University of Siena (Italy).

Duties & 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.
2. Excellent mathematical skills and background for the analysis of electromagnetic problems involving metasurfaces.
3. Solid background on antennas and propagation.
4. High proficiency in Matlab. Mathematica or Maple are a plus.
5. Desirable skills with commercial software for electromagnetic simulations (CST Microwave Studio).
6. Excellent written and verbal communication, including presentation skills.
7. Highly proficient English language skills.
8. Excellent organisational skills, attention to detail and the ability to meet deadlines.
9. Ability to think logically, create solutions and make informed decisions.
10. Willingness to work collaboratively in a research environment.
11. A strong commitment to his/her own continuous professional development.
12. 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. Cristian Della Giovampaola, 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/).

2) Parallel application and submission of the application material to be sent to jobs@wave-up.it.

Informal enquires for further information about the positions can be send to Dr. Cristian Della Giovampaola (cristian.dellagiovampaola@wave-up.it).

Note 1: Registrations and submissions need to be done both to the MetaWireless website and through Wave Up Job application email.

Note 2: By registering with both methods mentioned above, the applicants agree that the 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 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 Wave Up's level, the recruitment will be coordinated by both Wave Up and the University of Siena (Laboratory of Applied Electromagnetics). More precisely, the recruitment and selection of the ESRs will be executed by the Chief Technology Officer and Scientist-in-Charge of the MetaWireless project (Dr. Francesco Caminita) and by the Recruiting Committee Member (Dr. Cristian Della Giovampaola) for Wave Up, and also by Prof. Stefano Maci of the Laboratory of Applied Electromagnetics of the University of Siena.

The application deadline for the post is on **15 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 September 2021**. At the end of the selection process, all the applicants will be informed of the outcome of their application by return email. The selected candidate will start their activity on **1 November 2021**.

Further Information

For more information about the post WUP-1, please contact Dr. Cristian Della Giovampaola (cristian.dellagiovampaola@wave-up.it).

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.