



PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 39th cycle

Research Area n. 4 - Telecommunications

**PARTENARIATO PNRR Research Field: CHANNEL STATE ESTIMATION METHODS IN
SMART RADIO ENVIRONMENTS**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

**Motivation and objectives of the research
in this field**

This research project is in the framework of
RESTART
PARTENARIATO ESTESO RESEARCH AND
INNOVATION ON FUTURE TELECOMUNICATION
SYSTEMS AND NETWORKS TO MAKE ITALY MORE
SMART
CUP D43C22003080001
Decreto di Concessione D.D. 1549 del 11/10/2022

The main goal of this research activity consists in the development of channel estimation algorithms suitable to be implemented in the transceivers of future wireless communications systems that will operate in a smart radio environment (SRE). An SRE is an electromagnetic environment where it is possible to control and modify the propagation characteristics of the channel from the transmitter to the receiver. Key components in an SRE are reconfigurable intelligent surfaces (RISs), also known as intelligent reflecting surfaces (IRSs), which consist in metasurfaces with atomic elements able to modulate the behavior of the incident electromagnetic waves. This important feature of RISs has recently boosted the interest of the wireless communication community due to their potential to increase system capacity and improve



	coverage. The two main tasks to be completed during the research will consist in the definition of channel models for SRE and in the development of appropriate estimation techniques for scenarios involving RISs both considering the more traditional frequencies below 6 GHz (sub-6 GHz) and the portion of spectrum in the range between 30 GHz and 300 GHz, i.e., millimeter-waves (mmW) band. Because of the large number of RIS elements, conventional channel estimators necessitate an impractical pilot overhead. To address this issue, the study will concentrate on the development of low-complexity channel estimators that use the geometry of the array and of the resulting channel structure to reduce pilot overhead. In order to obtain realistic results, the effects of RIS imperfections will be also considered.
Methods and techniques that will be developed and used to carry out the research	The research methodology shall include: 1) Study of the literature about RIS, outline of the relevant SRE scenarios, and definition of KPIs and requirements. 2) Theoretical analysis and numerical simulations. 3) Development of novel algorithms. 4) Performance evaluation of designed algorithms and comparison with existing ones available in the literature.
Educational objectives	1) acquire an expertise in technologies for next generation of wireless cellular networks; 2) develop state-of-the-art skills concerning the application of signal processing techniques to improve the performance of wireless communication systems and to reduce power consumption; 3) disseminate research results (oral presentations/written publications); 4) ability to identify research problems and to conduct research in a highly focused fashion; 5) develop team working skills through the collaboration with the research groups on both theoretical and practical topics; and 6) develop skills for life-long learning and professional development.
Job opportunities	For the ambitious and disruptive objectives of the research, as well as for the reputation of the involved



	research groups, it is expected that after completion of the PhD program the candidate will be ready for being part of any research team in public and private institutions and centers, universities, and industry.
Composition of the research group	0 Full Professors 4 Associated Professors 2 Assistant Professors 0 PhD Students
Name of the research directors	Prof. Maurizio Magarini

Contacts	
E-mail: maurizio.magarini@polimi.it	

Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

Scholarship Increase for a period abroad	
Amount monthly	700.0 €
By number of months	6

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information
The funding for the scholarship comes from the project RESTART a comprehensive program, that aggregates and integrates the main stakeholders of the Italian Telecommunications sector. RESTART promotes TLC science and technologies advancement for both human and IoT users, applications and services in the most diverse sectors: agriculture, commerce, energy, finance, industry, media, health, safety/security, transportation. LIST OF UNIVERSITIES, COMPANIES, AGENCIES AND/OR NATIONAL OR INTERNATIONAL INSTITUTIONS THAT ARE COOPERATING IN THE RESEARCH: Politecnico di Milano; Politecnico di Torino; TIESSE. EDUCATIONAL ACTIVITIES (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student. TEACHING ASSISTANTSHIP: (availability of funding in recognition of supporting teaching activities by the PhD student) There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the



limits allowed by the regulations.

COMPUTER AVAILABILITY: individual use

DESK AVAILABILITY: individual use

D.D. 341 del 15/03/2022 Avviso pubblico per la presentazione di Proposte di intervento per la creazione di "Partenariati estesi alle università, ai centri di ricerca, alle aziende per il finanziamento di progetti di ricerca di base" - nell'ambito del Piano Nazionale di Ripresa e Resilienza, Missione 4 "Istruzione e ricerca" - Componente 2 "Dalla ricerca all'impresa" - Investimento 1.3, finanziato dall'Unione europea - NextGenerationEU