ID: MSCA—22-Ferranti04

Title: Reconfigurable intelligent surfaces (RISs) for the 6G revolution

The demanding objectives for the future sixth generation (6G) of wireless communication networks have led to recent research efforts on novel materials and radio-frequency front-end architectures for wireless connectivity, as well as revolutionary communication and computing paradigms. Among the pioneering candidate technologies for 6G, the reconfigurable intelligent surfaces (RISs) have attracted a tremendous attention. RISs are engineered planar structures that can be programmed to manipulate the incoming electromagnetic field in a wide variety of functionalities. Incorporating RISs in wireless networks has been recently advocated as a revolutionary means to transform any wireless signal propagation environment to a dynamically programmable one, intended for various networking objectives, such as coverage extension and capacity boosting, spatiotemporal focusing with benefits in energy efficiency and secrecy, and low electromagnetic field exposure. RISs for 6G applications could operate in multiple bands, such as millimeter wave (mmWave) and THz frequency ranges.

In this project, we focus on developing machine learning techniques coupled with computational electromagnetics that can used for real-time prediction of the value of the internal reconfigurable parameters of the RIS in order to implement a desired behavioral functionality. Challenges as high-dimensional optimization spaces and real-time computation are to be tackled. The nature of the reconfigurable parameters is broad. Accurate and efficient system-level simulation and modeling (transmitter-channel-receiver) are also an important aspect of this project. Hardware and channel imperfections can be major performance limitations. Therefore, it is necessary to take these factors into account while evaluating the overall performance and investigate the performance loss caused by these imperfections. Simultaneous Wireless Information and Power Transfer (SWIPT) networks are also of interest in this project.

Advanced machine learning techniques, computational electromagnetics, and system level simulation and modeling will be the backbone of this groundbreaking multi-inter-disciplinary project. Validation of the simulation and modeling results by hardware fabrication and measurements is possible and supported**.** This project is embedded into a multi-inter-disciplinary research environment at Brussels Photonics (B-PHOT) of the Vrije Universiteit Brussel (VUB). A network of international collaborators is also involved in these research activities. The disruptive results of this project will pave the way towards a multitude of novel applications such as immersive virtual reality, high-fidelity holographic projections, digital twins, connected robotics and autonomous systems, internet of things/internet of everything, and intelligent transportation.

Supervisors: francesco.ferranti@vub.be

Research Group: https://www.b-phot.org/

To apply: https://www.vub.ac.be/en/european-liaison-office#apply-msca-if