Integrated Sensing and Communications: Link-Level, Network-Level Design and Security

Abstract: The future global cellular infrastructure will underpin a variety of applications, such as smart city solutions, urban security, infrastructure monitoring, and smart mobility, among others. These emerging applications require new network functionalities that go beyond traditional communication. Key network KPIs for 6G include Gb/s data rates, cm-level localization, µs-level latency, and Tb/Joule energy efficiency. Additionally, future networks must support the UN's Sustainable Development Goals to ensure sustainability, net-zero emissions, resilience, and inclusivity.

The multifunctionality and net-zero emissions agenda call for a redesign of multi-access technologies for 6G and beyond. In this talk, I focus on enabling multifunctionality in signals and wireless transmissions as a means of reducing hardware redundancy and minimizing carbon footprint. We will explore the emerging field of integrated sensing and communications (ISAC), which represents a paradigm shift towards combining sensing and communication functionalities within a single transmission, utilizing a single spectrum and ultimately sharing a common infrastructure. In this talk I briefly present the opportunities of ISAC as a natural evolution of the two technologies, with obvious gains in energy-, hardware- and cost- efficiency through the use of dual-functional hardware. I further explain that their co-design also offers opportunities in flexible trade-offs and new synergies between sensing and communication. I then discuss unprecedented security vulnerabilities that ISAC brings about, that need to be urgently addressed before its large scale deployment. I present some results from my team's work in the area, that underline the benefits of the co-design in offering a graceful trade-off between the communications, sensing and security, and some prototyping results. I conclude with some thoughts on research opportunities and the road ahead.