Integrated Sensing, Communication and Computing for Cognitive Cities

Abstract: Future cities will require communication networks that go far beyond data connectivity, evolving into intelligent platforms capable of sensing, understanding, and interacting with the physical world in real time. This talk will explore the emerging convergence of integrated sensing, communication and computing as a foundational paradigm for enabling cognitive cities, where wireless infrastructure acts not only as a communication medium but also as a distributed perceptive and decision-making system.
A central focus of the talk will be on Reconfigurable Intelligent Surfaces (RIS), an emerging technology that enables programmable control of electromagnetic wave propagation through software-defined metasurfaces. RIS offers a transformative approach for next-generation 6G systems by dynamically manipulating the amplitude, phase, and polarization of radio waves to improve communication, sensing, and localisation performance. In communication networks, RIS enhances spectral and energy efficiency, extends coverage in Non-Line-of-Sight environments, and enables intelligent beamforming with very low hardware complexity and power consumption.

Beyond communications, the talk will highlight how RIS-enabled integrated sensing and communication (ISAC) systems can support high-accuracy environmental perception and human-centric sensing, including real-time monitoring of heartbeat and respiration in challenging indoor and obstructed environments. The integration of sensing and edge computing capabilities further enables context-aware and adaptive services for healthcare, mobility, smart homes, and urban infrastructure.

The talk will also discuss RIS-assisted localisation and machine-learning-driven indoor positioning, where programmable radio environments help mitigate multipath fading and improve positioning accuracy in dense and dynamic environments. Collectively, these technologies are paving the way toward sustainable, resilient, and intelligent wireless ecosystems capable of supporting the vision of cognitive cities.