

## SEMINAR ANNOUNCEMENT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING  
COLLEGE OF DESIGN AND ENGINEERING  
Website: <https://cde.nus.edu.sg/ece>

**Area: Communications and Networks (CN)**

**Host: Prof Zhang Rui**

<b>TOPIC</b>	:	<b>From Reconfigurable Intelligent Surfaces to Analog Computing for Communications and Signal Processing</b>
<b>SPEAKER</b>	:	<b>Prof Bruno Clerckx Professor, the Head of the Communications and Signal Processing Group, and the Head of the Wireless Communications and Signal Processing Lab, Electrical and Electronic Engineering Department, Imperial College London, London, U.K.</b>
<b>DATE</b>	:	<b>Friday, 12 September 2025</b>
<b>TIME</b>	:	<b>10:30AM-11:30AM</b>
<b>VENUE</b>	:	<b>E1-06-03</b>

### ABSTRACT

Wireless communications systems benefit from progress in the analog world of wave generation, analysis and manipulation and the digital world of information generation and processing. Nevertheless, the ever-increasing needs for larger data rate require growing use of multi-antenna technology with larger dimensions making the current technology not sustainable nor scalable for future requirements of wireless communications. New paradigm shifts in system architecture require new system-level modelling to integrate and bridge the physics-based wave manipulation approaches and the mathematical information theoretic advances shaping modern networks. The talk shows some avenues to devise new, faster, and more sustainable communication architectures that marry the communication theoretic principles of modern digital communications with analog domain processing and computing paradigms such that information transmission, processing and computing are conducted faster with much lower computational complexity. The talk is divided into two parts. First, we introduce Beyond Diagonal Reconfigurable Intelligent Surfaces (BD-RIS), a general framework of reconfigurable intelligent surfaces where elements are inter-connected via tunable impedances. This enables engineered coupling, allowing waves to propagate between elements, enhancing RIS-aided communications with greater signal manipulation flexibility. Next, we perform computation, e.g. matrix inversion, with low complexity directly in the analog domain and enable ultra-massive MIMO communications with  $10^4\times$  lower computational complexity than digital beamforming.

### BIOGRAPHY

Bruno Clerckx is a (Full) Professor, the Head of the Communications and Signal Processing Group, and the Head of the Wireless Communications and Signal Processing Lab, within the Electrical and Electronic Engineering Department, Imperial College London, London, U.K. He received the MSc and Ph.D. degrees in Electrical Engineering from Université Catholique de Louvain, Belgium, and the Doctor of Science (DSc) degree from Imperial College London, U.K. He spent many years in industry with Silicon Austria Labs (SAL), Austria, where he was the Chief Technology Officer (CTO) responsible for all research areas of Austria's top research center for electronic based systems and with Samsung Electronics, South Korea, where he actively contributed to 4G (3GPP LTE/LTE-A and IEEE 802.16m). He has authored two books on "MIMO Wireless Communications" and "MIMO Wireless Networks", over 350 peer-reviewed international research papers, and 150 standards contributions, and is the inventor of 80 issued or pending patents among which several have been adopted in the specifications of 4G standards and are used by billions of devices worldwide. His research spans the general area of wireless communications and signal processing for wireless networks. He received the prestigious Blondel Medal 2021 from France for exceptional work contributing to the progress of Science and Electrical and Electronic Industries, the 2021 Adolphe Wetrems Prize in mathematical and physical sciences and the 2024 Georges Vanderlinden Prize in Electromagnetism and Telecommunications from Royal Academy of Belgium, multiple awards from Samsung, IEEE best student paper award, and the EURASIP (European Association for Signal Processing) best paper award 2022. He is a Fellow of the IEEE and the IET. He is the vice-chair of ETSI Industry Specification Group (ISG) on Multiple Access Techniques (MAT).