

Prior Knowledge-Guided Deep Learning-enabled Generative Antenna Design

Talk by Prof. Zhi Ning Chen, National University of Singapore, Singapore

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Antenna technology has a rich history dating back to the 19th century, with continuous advancements aimed at meeting the escalating demands of wireless systems development. Over the past two decades, metamaterial-based antenna technologies have emerged as a significant avenue for enhancing various antenna parameters such as bandwidth, size reduction, gain enhancement, and mutual coupling suppression. Concurrently, the rapid evolution of artificial intelligence (AI), particularly generative neural network methodologies, presents a promising frontier in antenna design innovation.

This speech explores the transformative potential of deep learning (DL), a subset of machine learning (ML) within AI, in revolutionizing antenna design. The presentation begins by outlining the prospective impact of DL on antenna innovation, followed by the introduction of two design exemplars employing generative adversarial networks (GANs). These examples illustrate novel approaches to metacell design within metasurfaces, achieved through pixelization techniques and DL-driven algorithms. Notably, the incorporation of prior knowledge (PK) in DL-enabled synthesis is elucidated, showcasing its efficacy in synthesizing metacells for metalens applications. Furthermore, the presentation showcases how metalenses synthesized using PK-DL techniques exhibit breakthrough performance and offer additional functionalities in metalens antenna design. The discourse concludes by contemplating the future trajectory of Antenna+AI integration, highlighting its potential to redefine the boundaries of antenna engineering.



Zhi Ning Chen got his two PhDs in 1993 and 2003 in China and Japan, respectively. He is working as a Provost's Chair and Professor of the Department of Electric and Computer Engineering, and the Director of Advanced Research and Technology Innovation Center at National University of Singapore. He has published and presented 718 papers in journals and at conferences as well as seven books. His current research interests include electromagnetic materials and metasurfaces, antenna engineering and applications, as well as algorithms for generative antenna design. He is the recipient of IEEE AP-S John Kraus Antenna Award (2021).

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