Intelligent Metamaterials and Metamaterials Intelligence

Hongsheng Chen
Zhejiang University, China

Abstract— Metamaterials interacted with computer science have recently attracted immense interest to motivate scientists to revisit respective communities. These two seemly-unrelated fields are benefiting from each other in a complementary, detailed but less noticeable manner. Especially in the past five years, we have witnessed a proliferation of fruitful works on a scale not seen. In this talk, I stand from a unified perspective to review the recent advancements in these two nascent fields. For intelligent metamaterials, we discuss how artificial intelligence, exemplified by deep learning, streamline the photonic design, foster independent working manner, and unearth latent physics. For metamaterials intelligence, I particularly unfold three canonical categories, i.e., wave-based neural network, mathematical operation, and logic operation, all of which directly execute computation, detection, and inference task in physical space.

Hongsheng Chen (Fellow, IEEE) received the BSc and PhD degree from Zhejiang University, Hangzhou, China, in 2000 and 2005, respectively. In 2005, he joined the College of Information Science and Electronic Engineering, Zhejiang University, and was promoted to Full Professor in 2011. He was a visiting scientist (from 2006 to 2008) and a visiting professor (from 2013 to 2014) with the Research Laboratory of Electronics, Massachusetts Institute of Technology, USA. In 2014, he was honored with the distinguished Cheung-Kong Scholar award. Currently, he serves as the Dean of College of Information Science and Electronic Engineering, Zhejiang University. He received the National Science Foundation for Distinguished Young Scholars of China in 2016, and the Natural Science Award (first class) from the Ministry of Education, China, in 2020. His current research interests are in the areas of metamaterials, invisibility cloaking, transformation optics, and topological electromagnetics. He is the coauthor of more than 300 international refereed journal papers. His works have been highlighted by many scientific magazines and public media, including Nature, Scientific American, MIT Technology Review, The Guardian, and so on. He serves as topical editor at the Journal of Optics, deputy editor-in-chief at PIER, and editorial board member for Nature's Scientific Reports, Nanomaterials, and Electromagnetic Science. He served as the general co-chair of the Photonics & Electromagnetics Research Symposium in 2022, and the general co-chair of the International Applied Computational Electromagnetics Symposium in 2023.