State Key Laboratory of Terahertz and Millimeter Waves
香港城市大學 City University of Hong Kong

Department of Electrical Engineering
香港城市大學 City University of Hong Kong

IEEE (HK) Section
AP/MTT

Seminar On

Machine Learning Assisted Surface Wave Antenna Radiation Pattern Shaping

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Date : **8 November 2023 (Wednesday)**

Time : **11:00 am – 12:00 noon**

Venue : **Room 15-202, 15/F, State Key Laboratory of Terahertz and Millimeter Waves, Lau Ming Wai Academic Building, City University of Hong Kong**

Abstract

Up to 40% of global crop production is lost to plant pests and diseases. Pests monitoring is vital since it provides ecologists and entomologists with migration information, which can be used to pest control strategies and reduce the use of pesticide. This aerial bio-flow has important implications for ecological, physiological and genetic studies of insects, with applications in pest management, conservation and environmental change programs. Millimetre-wave frequency modulated continuous wave vertical-looking radar systems are one of the feasible ways to monitor high-flying insects.

In this seminar, we would like to share our experience in using machine learning methods to design surface wave antennas providing the required radiation pattern. The proposed antennas are designed for the vertical-looking radar (VLR) systems for better pest monitoring. Wasserstein generative adversarial network (WGAN) and bidirectional gated recurrent unit (Bi-GRU) neural network prediction method were utilized to predict the distribution of the metallic cells on the low-profile surface wave antenna. The proposed neural network prediction method consists of two parts, which are i) from the far-field radiation pattern to the near-zone *E*-field and ii) from the near-zone *E*-field to the on-surface metallic cell pattern. In the first prediction part, the average prediction error among *Ex*, *Ey* and *Ez* components on the surface wave antenna of 50 test cases is 4.3%. And the average prediction accuracy achieves 99.54% in the prediction of the metallic cell pattern from the near-zone *E*-field. A dual-sided 30° cosecant-squared radiation pattern serves as the input for the neural network prediction model in the surface wave antenna design. The predicted antenna geometry shows less than 1 dBi variation in radiation pattern when compared to the input dual-sided 30° cosecant-squared radiation pattern. The fabricated surface wave antenna works in the frequency band 33.77 – 35.05 GHz, which covers the frequency band of the mmWave FMCW VLR system. With the help of the turntable of the mmWave VLR system, such antenna provides a circular observation area with a diameter of 9.8 m.

Biography

Professor Kin-Fai (Kenneth) Tong is a Professor of Antennas and Applied Electromagnetics and member of the Sensors, Systems and Circuits Group at the Department of Electronic and Electrical Engineering (EEE) in UCL. He has a track record in novel antenna design and microwave/millimetre-wave measurement in different applications such as radar, wireless communications, and medical related applications. During his PhD research, he has been credited to be one of the first who introduced the idea of embedding microstrip patch antennas into mobile phone handsets. He was an Expert Researcher in the Photonic and Millimetre-wave Devices Group of the National Institute of Information and Communications Technology, Japan. Professor Tong is a Fellow of IEEE, Chartered Engineer of UK Engineering Council, Fellow of Electromagnetic Academy USA and Fellow of Higher Education Academy UK.

***** ALL ARE WELCOME *****

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