Data-Driven Adaptive Modulation Classification Systems

Speaker: Professor Hen-Geul Yeh

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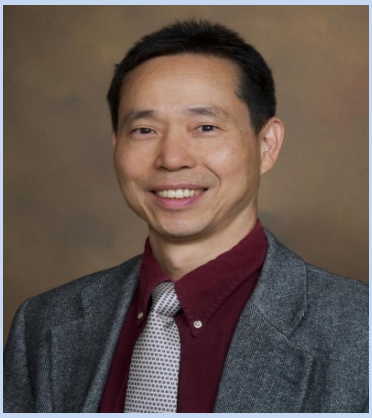

Date : June 3rd (Tuesday), 2025
Time : 10:30AM – 12:00AM
Place: Room EE-101, Department of Electrical Engineering, NCHU

Abstract:
The integration of machine learning into wireless communication systems has introduced innovative solutions for challenges such as modulation classification and interference mitigation. However, implementing deep learning models on edge devices with constrained computational capabilities poses significant obstacles. This study focuses on classifying Doppler velocities in Space-Time Orthogonal Frequency Division Multiplexing (ST-OFDM) systems using an adaptive approach enabled by 2D Convolutional Neural Networks (CNNs). By leveraging a realistic MATLAB-generated dataset, we simulate urban channel conditions with Doppler frequency ranging from 0 Hz to 500 Hz caused by relative velocity between mobile unit and base station. This Doppler frequency is considered as normalized frequency offsets at a 5 GHz carrier frequency. The dataset consists of QPSK-modulated signals transmitted across 512 subcarriers per OFDM block. Based on detected Doppler conditions, we introduce an adaptive mechanism to mitigate Doppler-induced intercarrier interference (ICI) by dynamically switching between two architectures: regular one-path Space-Time (ST)-OFDM with a higher data rate and two-path ST parallel cancellation (STPC)-OFDM with a lower bit error rate (BER) in mobile fading channels. The proposed model demonstrates high classification accuracy and robust performance, paving the way for real-world applications in dynamic and complex fading environments. By emphasizing adaptability and leveraging the efficiency of 2D CNNs, this work presents a novel framework for addressing Doppler-related challenges in ST-OFDM systems.

Bio:
Hen-Geul Yeh (葉先覺) received the B.S. degree in engineering science from National Chen Kung University, Taiwan, Republic of China in 1978, and the M.S. degree in mechanical engineering and the Ph.D. degree in electrical engineering from the University of California at Irvine, Irvine, in 1979 and 1982, respectively. Since 1983, he has been with the Electrical Engineering Department, California State University Long Beach (CSULB), USA, and the Department Chair, 2016 - 2022. He was selected as a NASA JPL Summer Faculty Fellow twice, in 1992 and 2003, respectively. His research interests include DSP/communication/control algorithms development and implementation using FPGA and digital signal processors with applications to communication systems, smart grids, optimization, controls, and electrical event detection. He is a Professional Engineer in Electrical and was a recipient of five NASA Technology Brief and New Technology Awards from the National Aeronautics and Space Administration (NASA), He has received eight U.S. patents in signal processing, communication, and controls. He is a senior member of the National Academy of Inventors and IEEE.