Title: Certain Investigations on Machine Learning Applications in Wireless Communication

Abstract

In recent years, the integration of machine learning in wireless communication has become an area of increasing interest and potential. Despite this, investigations in this domain have remained relatively scarce. As wireless networks continue to evolve and handle ever-growing data traffic, the application of machine learning holds promise in enhancing efficiency, performance, and adaptability. Leveraging machine learning algorithms can optimize resource allocation, predict network behaviour, and enable intelligent decision-making in real time, paving the way for more resilient and self-organizing wireless systems. In this regard, several applications of machine learning have been explored to address various problems in the wireless communication domain. Among these, the first one is the development of a data-driven approach for mm Wave channel characteristics prediction using a deep neural network. The work proposes a methodology to predict the mm Wave channel characteristics using limited data. For this, the work effectively develops two deep learning models where model 1 is an auto encoder for the creation of new data from the limited data, and model 2 is a Deep Convolutional Neural Network (DCNN) for channel characteristic prediction. Simulation results show that the proposed model 1 is able to generate more data in the desired direction and model 2 can accurately determine the path power loss associated with a mm Wave channel, with very minimum error. The second application is the DNN approach to obtain BER vs SNR for the Spatial Modulation system. This work presents a method to calculate the closed-form expression of Bit Error Rate (BER) in multiple antenna spatial modulation. It also demonstrates the BER versus Signal-to-Noise Ratio (SNR) trend for a given signal and spatial constellation, utilizing regression models based on deep neural networks. Extensive experiments were conducted using QPSK, 8-QAM, and 16-QAM signal constellations, along with spatial constellations having up to 64 transmit antennas. The trends were evaluated using datasets generated for LMMSE and Zero Forcing detection cases, with Monte Carlo simulations confirming the accuracy of the results

Publications

1: Neema, M., Gopi, E.S. Data Driven Approach for mmWave Channel Characteristics Prediction Using Deep Neural Network. *Springer Wireless Personal Communication* **120**, 2161–2177 (2021). https://doi.org/10.1007/s11277-021-08768-7 ISSN: 0929-6212

2. M, Neema, Gopi, E.S, Viswas, R., Gandhi, M, DNN Approach to obtain BER vs SNR for Spatial Modulation System, Handbook of Formal Optimization, and Springer, ISSN: 978-981-19-8851-6 (accepted for publication in the referred book chapter)