# ABSTRACT

The fifth generation of mobile communication (5G) is a new communication system expected to have higher speed, lower latency, and consume less energy. Device-to-Device (D2D) communication can increase mobile networks' system capacity and energy efficiency. One of the critical challenges in D2D communication is to extend the network lifetime with efficient and effective resource management. However, because communication occurs without going through the base station and D2D users do not have their resources, D2D users simultaneously use the resources owned by Cellular User Equipment (CUE) to communicate. It causes interference to occur. Power allocation has become an important technology for solving interference problems. Besides that, traditional methods for operating in real-time systems have limitations.

This thesis aims to design a Deep Learning model using the Long Short Term Memory with Fully Convolutional Network (LSTM-FCN) algorithm suitable for the transmit power control problem in the cellular network on an underlay D2D communication system with an uplink-side and multi-cell scheme. Previously, LSTM-FCN methods had to be trained using multiple datasets. The dataset used in this thesis consists of channel gain from all communication links as input and power control policies obtained through Convex Approximation (CA) based algorithm. The CA-based algorithm is used as the benchmark to test the performance of the LSTM-FCN model.

The simulation results show that the enhancement of CUE can increase the system's sum rate, power consumption, and energy efficiency. In contrast, enhancing the D2D pair can increase sum rate and power consumption but decrease energy efficiency. Both LSTM-FCN, LSTM, and FCN can approximate the performance of the conventional scheme (CA-based algorithm). However, LSTM-FCN has the closest performance to CA and stable computational time compared to the other two algorithms in both scenarios, with an accuracy above 97% accuracy. In addition, LSTM-FCN has less time complexity than CA, with the highest orde being 1, which means that LSTM-FCN can be applied in real-time conditions.

**Keywords:** Device-to-Device Underlaying, Multi-cell, Power Allocation, Long Short Term Memory, Fully Convolutional Network.