Popular Science Summary
User Equipment Characterization using Machine Learning

Are you interested in fast download speeds and little to no buffering time when streaming your favorite online tv-show? Of course you are, and guess what? 5G can make it happen! 5G has been hyped for a few years, but this year many telecommunication companies have deployed their network in the first half of the year. The first 5G network has been turned on in the United Kingdom in May 2019.

With the new technology, more and more devices will be connected to the network, utilizing data-intensive applications. In order to deal with this high demand, more antennas are needed at the base stations, which are fixed structures on rooftops, in masts or on building walls, transmitting and receiving radio waves to communicate with mobile users. In order to direct these radio waves into specific directions, 5G employs what is called beamforming, which is a way to combine antenna elements in a way that limits interference between users and enables higher data rates for everyone connected to that base station. Beamforming relies on a good estimate of the transmission channel between transmitter and receiver. The user sends a reference signal, which is known by both transmitter and receiver, to the base station, which in return estimates the transmission channel according to this signal and is then able to make intelligent decisions on how to direct its signal beams.

You can imagine that with more devices being connected, and therefore more antennas needed, more of the reference signals will have to be decoded at the base stations, increasing the computational complexity immensely. This thesis aims to investigate, whether it is possible to use Machine Learning, which is a model that focuses on the development of computer programs that can access data and learn it on their own, to classify if a user is stationary or moving at different speeds. This automatic categorization would help the base station with reducing computations, allowing for more efficient beamforming and later profitable scheduling of users to avoid interference.

This thesis built and investigated three different machine learning algorithms: Neural Networks, Support Vector Machine and Logistic Regression. All three algorithms are intended for classification use, but they differ in complexity and their accuracy for different amounts of data. Data was collected from a test lab at Ericsson AB, Lund in Sweden, where different scenarios were simulated with random routes of a user moving or stationary positions. The result of the implementation and testing of the algorithms were greatly satisfactory, with high accuracy of all machine learning methods. Additionally, neural network was used to classify a user into different speed categories.

The building of these methods could result in an implementation in real world 5G base stations, therefore enabling higher data rates and larger capacity. Happy browsing!