Utilizing machine learning in mobile networks to serve high-velocity users

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High speed trains are an example of an environment where providing mobile access to users is difficult. Base stations need to pinpoint their signal towards the user to achieve optimal transmission quality. Because the user is travelling at a high velocity, the rapid change in position makes it more difficult for the base station to choose the optimal transmission direction. In his master's thesis, Ville Kolehmainen from Aalto University studied the application of machine learning for predictive beam selection, where the direction of transmission is forecasted ahead of time based on historical data.

As the number of mobile subscribers grows each year and service is required in more demanding environments, new solutions are required in order to provide network service that matches the demand. An example problem area is high-speed trains where users move at very high velocities. When user velocity is high, selecting the transmission direction based on the latest status update from the user causes the chosen beam to be outdated. With machine learning, the optimal direction can be forecasted ahead of time using data from previous users who have travelled the same path.

The results show that predictive beam selection can improve the network throughput by up to 10%, which from the customer perspective corresponds to data rate. Further research is required to evaluate the concept in real world networks. The time and resource demands of the algorithm must be considered because of the strict time requirements in mobile networks.

Predictor antennas have been studied as a solution to address a similar problem to what was considered in this thesis. Predictor antennas work by placing multiple antennas on top of a high-speed train, where the first antenna is used as a predictor and the other antennas are used for actual transmission. However, this solution requires additional hardware, while predictive beam selection attempts to tackle the problem using algorithms only.

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