Master Thesis Project

Predictive Analytics Models for Maximum Capacity of Railway Networks

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Context

Railway networks are an important means of transport, providing a large part of society with cost-effective transport, as well as being a vital part of other logistical operations, like material transport. The National Market and Capacity Analysis by the Dutch government outlines a growth in capacity of 27% to 45% of railway km travelled by train by 2030. Nationale Spoorwegen, however, has shown an increase in travellers of 4.6% in the first half of 2019, leading to reaching the theoretical maximum capacity of the network significantly sooner. Because of limited resources, it is necessary for current networks to be used more efficiently. However, standard avenues of increasing efficiency are already being exhausted. Trains can no longer become longer because they won't fit on some of the busy stations, and a maximum rate of train departures is being reached at several points, taking into account current safety systems.

This is especially in De Randstad, where tram networks are reaching peak capacity, and a growth of half a million people is expected in the next ten years. A theoretical capacity of 30 trams per hour is possible on this network. However, because of the way the safety systems work, and the way trams interact with this, this capacity is difficult to reach in practice.

The underlying works of a train system are extremely complex, and research into more efficient use extends in several directions. Often, this type of research focuses on more efficient driving strategies for single trains on a single piece of track. Other strategies include research into more efficient scheduling, combining train scheduling with other means of public transit, and decreasing headway on railway sections, mostly by changing safety rules.

Project Task

The focus of this project will be on using machine learning techniques, or other similar models, to improve the efficiency of railway networks, focusing on reaching the necessary efficiency for the Randstadrail. To train or create a model, data is available from several parties containing current scheduling and the state of every part of the network including, for example, the state of every switch, and signal. Furthermore, the GPS location of every tram is available updated at least every fifteen seconds.

Using this data, three approaches will be attempted. Firstly, train headway and behaviour can be estimated, thereby improving the interaction of trains with current systems. Furthermore, by using this data a model of the optimal system can be made. Lastly, a hybrid approach can be done, whereby the current system could be changed slightly and cheaply, and trams could change their behaviour to create a viable solution.