ABSTRACT

Traffic congestion is one of the most common problems in cities and can hardly be avoided. The congestion, however, can be detected and minimized by applying suitable measures. It happens quite often that a big queue is waiting at one approach of the intersection, while a green time assigned for it is very short. In the means of traffic control, congestion has to be detected in order to adjust cycle times properly and grant more green time for the congested links.

The possibility of a precise congestion recognition decreases with lower amount of available measurement infrastructure. Single loop detectors, although highly reliable and used very often, do not give enough information for easy congestion identification. Several methods have been already developed in order to detect oversaturation of traffic links by using single loop detector and signal group data. All methods have their advantages and disadvantages. Literature and experts claim that there is no method used in practice, which considers traffic on several lanes for identifying oversaturation. The method in this thesis tries to look at the problem of the identification of oversaturation by taking into account traffic situation on more than one lane at the same time.

The technique described in this master thesis uses already known as well as newly described traffic characteristics and parameters acquirable from the single loop detector data. The traffic state estimation part for one traffic lane is based on the dynamic modification of the already known threshold values, calculated according to the traffic situation on the neighboring lanes. The traffic state estimation rules are combined into one algorithm, which uses available single loop detector data of the whole intersection approach in order to identify if the cycle has been oversaturated or not. The other part of the master thesis treats the evaluation mechanism to assess the quality of the estimations done by the algorithm and allowing to benchmark it.

The algorithm has been tested against reference data from video cameras and simulations. The results have shown that the error rate of the algorithm is 9%. It fluctuates only slightly over the data from different traffic networks. The results have been compared with the chosen benchmark the modified queue length estimation (QLE) algorithm based on Mueck (2002). The results have indicated that the overall error of the developed algorithm is lower almost in all cases. In addition, the developed algorithm is able to handle traffic situations (dependent on the traffic situation on neighboring lanes) with significantly lower error rates than the QLE algorithm, what confirms the selected approach. Nevertheless, further research is needed. There are also some cases which are handled with strongly higher than average error rates. It is also required to test the algorithm with more samples of traffic data.

Scope

The scope of this thesis includes:

- a research review of the previous attempts to identify oversaturation with data from single loop detectors;
- a general traffic flow theory review in order to explain the grounds of traffic parameters and characteristics used in the thesis;
- a description of single loop detectors and the way they collect data from a field;
- an overview of adaptive traffic control systems;
- a description of the approach used to generalize geometry of road sections in order to model lane grouping;
- a definition of rules used to identify oversaturation/undersaturation;
- a review of the reference data used from different sources: video data and simulation data;
- a description of evaluation done in order to assess the reliability of the developed algorithm and calculation of error rates;
- a comparison between the results of the developed algorithm and those of the benchmark;
- analysis of errors resulting from the algorithm
- and suggestions for the required improvements and further research

Objective

The main goal of this master thesis is to develop an algorithm, which detects oversaturation on signalized intersection approaches. The successful oversaturation identifying, while using only single loop detector data, would help traffic control to make decisions in signal plan changes. It would save energy and improve traffic conditions at signalized intersections. It would also let to achieve these goals with reduced investments into expensive traffic detection infrastructure, as the single loop detectors are already one of the most commonly used traffic sensing techniques. The objective while coming towards the goal is to develop an evaluation mechanism, which allows to check the progress and to make a conclusion that the results are already satisfactory. The goal is also to deliver evaluation results as well as error analysis and suggestions for possible future improvements and research.