Master Thesis Abstract

Name: Marko Nicklich

Topic: Traffic situation detection as the basis for dynamic traffic management

Supervisor: Prof. Dr.-Ing. Manfred Boltze
Dipl.-Wirtsch. -Ing. Leif Fornauf
Dr.-Ing. Heiko Jentsch (Traffic Office Frankfurt am Main)

In times of constantly increasing traffic as well as scarce resources, it is becoming more and more important to use the existing infrastructure effectively so that mobility demands can be met optimally. One approach to meet these requirements is dynamic traffic management in cities. This is based on showing the current traffic situation as well as its forecast. The information is then applied in a traffic management system. It triggers previously planned strategies which implement defined measures to control traffic in order to affect existing traffic challenges positively. The overall goal is to establish a high level of automation in the respective traffic management systems.

While it is already possible to reliably identify the traffic situation on motorways (Germany's "Autobahn"), the reliability of in-town traffic detection remains limited. The executed automation level during the strategy triggering process is still extremely low. Manual decisions, based on video monitoring, are still a daily occurrence.

The purpose of this study is a systematic analysis of the current variety of traffic detection systems and their employability. Furthermore, they form a basis for suitable application in urban regions. The main focus is on traffic detection. The subsequent process of modelling and forecast up to a comprehensive presentation of the traffic situation are also mentioned.

The literature research explores the target area of dynamic traffic management in cities and the process of strategy development. It also covers the topic of traffic data detection. Besides common relevant parameters, data types, and traffic data detection systems will be examined more closely. Traffic data detection systems are broken down into fixed, mobile, and snap-shot detection. The final part of the literature research addresses data fusion techniques. Besides national literature, a closer focus lies on international literature research.

Based on the literature research, a 3-step-model for traffic detection is generated. The steps represent different implementation levels of urban traffic detection and can be based on one another. The first step is the so-called Hot Spot traffic detection. Hot Spots are defined here as individual road cross sections or intersections which are detected as individual selected areas. The aims of this step are mainly to influence mentioned intersections and, as a secondary goal, to provide an information basis for traffic participants. The second step of traffic detection is the strategy-oriented detection. As the name already implies, the strategy process of dynamic traffic management is already

in implementation. The overall goal of strategy-oriented detection is the targeted influence of intersections and road control as well as informing traffic participants. Strategic-oriented detection also means that a review of the strategies triggered has to follow, or in other words, the suggested alternative routes also have to be monitored. The third step of traffic detection deals with the traffic situation report. Mapping out comprehensive traffic situations for the strategic network is the main goal here. Data fusion techniques and forecast procedures are an integral part of this step. The information gathered shall then provide the basis for decisions on information output and steering of traffic participants in the respective network.

For each step, different methods are developed for practical implementation of the steps. Two methods are allocated to each step: one of fixed detection and one of video monitoring. In step 2, strategic detection, a method with snap-shot detection, is also allocated. In step 3, a traffic situation report, a method with mobile data, is added. The methods are then evaluated with regard to previously defined requirements and the results are compared. The different methods are then contrasted using an economic feasibility study.

After the literature research and the step-model, an expert survey is drawn up and was carried out. All experts are traffic management employees of different cities with more than 150 000 inhabitants. These cities all have an active traffic management system. The goal of the survey was to find out how traffic monitoring experts evaluate the developed step-model and to identify differences between theory and practice. The expert survey was carried out using an interview guide containing two main areas: On the one hand, questions focused on existing traffic detection of the respective city; on the other hand, questions were asked concerning the previously submitted step-model for traffic detection.

The methods are evaluated afterwards based on the expert survey and the fields of application for the methods are analysed. Two areas could not be defined for fields of application: snap-shot detection and video monitoring in step 3, the traffic situation report.

Based on the interview results, practical recommendations are developed. The practical recommendations are divided in two sections. One section considers cities with existing traffic detection systems, the other cities without any existing traffic detection. The first part describes issues such as quality, automation, possible influences, and financing. Possible solutions are presented for the individual points. One problem is inadequate data quality, which may either be based on inaccurate model calculations or being insufficiently equipped with strategic detection systems. Mobile data are also of insufficient quality at the moment. The second part, regarding cities without any traffic detection as of now, contains processes of visualization for planning and implementing traffic detection as well as possible implementation scenarios. In this scenario, reference is again drawn to the developed step-model. Different methods are combined and connected in solution scenarios.

The scenarios are finally evaluated and compared with each other. Advantages and disadvantages are shown. It becomes clear that the two variants using the fixed detection method during step 2 as well as the method of mobile detection in step 3 are superior to the others.

In the end, areas where potential research is still necessary will be pointed out, as seen in this thesis, and future developments will be examined.

Marko Nicklich

June 2011