Master Thesis Abstract

Name: Brian Hunter

Topic: Assessment of the traffic quality at signalized intersections for all travellers

Supervisor: Prof. Dr.-Ing. Manfred Boltze,
Dr.-Ing. Axel Wolfermann

The objective of this work was to develop a methodology to assess the multimodal quality of signalized intersections. The current methodologies focus on evaluating the quality of vehicle movements rather than person movements. Moreover, each mode is evaluated individually and the resulting qualities are not comparable. A framework that incorporates all modes and accounts for all travellers, rather than vehicles, is needed so that the assessment of intersections promotes the current and future goals of our transportation system and society. The multimodal model supports the existing transportation goals and allows for mode prioritizations.

The process to define this framework started with a literature review on quality and its definition and role in the transportation system. The term quality was defined as the perceived quality from the perspective of the user. In order to support quality assessment, level of service is used which divides the quality into several segments, namely A-F. This led to the review of the current intersection quality models defined in the German and American national traffic handbooks. Both handbooks utilize control delay as the performance measure that defines the level of service, even though this measure is not directly based on the user's perspective. Neither handbook considers vehicle occupancy and its impact on quality.

The next stage of the work reviewed other quality models as well as multimodal models. It was found that studies have been performed to develop perception-based quality models. Many of these were regression models based on participants' ratings of real intersections. Comfort and safety are particularly important criteria in the non-motorized modes. Similar segment-based models have started to be incorporated into state handbooks. A main difference between the delay-based and perception-based models is that the delay-based model uses an analytical performance measure and reflects traffic flow; whereas, the perception-based models are founded on user perceptions and are more reflective of traffic quality. It could be useful to use both types of models together; the delay-based model to assure adequate traffic flow capacities and the perception-based one to assess the intersection quality perceived by the travellers.

After the model reviews, the current methods and technologies were reviewed to determine the number of travellers per mode, or rather per vehicle, for motorized modes. The person counts were broken into two categories, namely offline and online. The online counts would be necessary for dynamic quality evaluations, such as, in the case of optimizing the current traffic quality of an intersection or network. The offline method obtains static counts for each mode. This is useful in documenting the quality of current intersections, as well as, in evaluating different scenarios during the design of an intersection.

The multimodal quality evaluations in the literature were reviewed. The literature included corridor-based evaluations as well as intersection evaluations. Within these frameworks, it was noted that new evaluation methods need to focus on the changing priorities of cities and urban planning. Although the

frameworks used new quality models, e.g. perception-based, they did not explicitly merge the individual modal qualities. Besides the perception-based models, the methodology used in combining individual segment qualities into an overall corridor quality was utilized in the developed model of this work.

The creation of the multimodal quality framework started with the definition of a set of model criterion. The main model criteria are that it: is traveller-based, supports traffic engineering goals, minimizes intermodal quality disparities and allows for mode-based prioritization. The model borrowed its structure from a corridor-based bicycle path model, in which lower quality segments were attributed higher weighting in the overall quality. Further factors were defined to account for the type of road, the area the intersection is located in and modal prioritization. The model evaluates the quality of each mode separately and merges them together along with their weighting and factors. The motorized modes (i.e. auto and transit) utilized the current delay-based models of the German HBS. Perception-based models were utilized for the non-motorized modes (i.e. bicycle, pedestrian). The multimodal model is modularly built which allows for the modification or replacement of the individual quality models without affecting the rest of the model.

The model was utilized in a case study to evaluate different scenarios of an intersection in Darmstadt. The base case was developed based on actual traffic counts and geometric design. The base case achieved a poor transit quality and this led to an overall quality of C. The first scenario reduced the cycle time which consequently reduced the transit delay. The transit quality improved, while all other modes remained unchanged. The overall quality improved. The third scenario utilized transit priority, which led to decreased transit delays and minor increased delays to motorized vehicles. The transit and the overall quality improved, although the auto quality worsened.

The model will be useful when transit priority is considered at intersections. Until now, priority has been implemented without the consideration of all travellers. With this new model, the overall impact of transit priority on an intersection can be considered. This consideration may also be used to evaluate different priority schemes, for example, partial priority, absolute priority and conflicting priorities. Although only the average bus occupancies were used in the case study, it could be helpful to utilize time dependant or line dependant occupancies. This would be particularly helpful in determining when a specific priority scheme should be utilized. That is, during peak transit periods, an absolute priority may achieve the highest overall quality, whereas, no priority may achieve a higher quality during the evening, when bus occupancies are lower.

Brian Hunter

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