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## Abstract of master thesis

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Topic: Applications of traffic signal control for intersections with tramways in China

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Since recent years, the modern trams have been introduced in China and started trial operation in some cities, like Shanghai, Shenyang and etc. In the near future the projects of trams are booming in China.

However, the operation of trams in China isn't trouble-free. Especially in the intersections, happened many conflicts and accidents between the tram and the other road users. This is due to the fact that the present signal control isn't adapted to the characteristics of the tram. Therefore the signal control for the tram becomes the essential part of the operating of trams in China.

Unfortunately, the specific features of the tram make the proper signal control more difficult. The traffic safety with the tram becomes the core problem in China. At the same time the traffic quality and the interests of other road users are subordinated. By the priority of the tram the situation worse further, although the priority in China achieves less success. So the tram seems to become the sources of interference. Hence, the entire capacity of the intersection and the tram priority face the problems. Thus the solutions for the signal control of the tram are expected.

In comparison, trams are running in Germany for quite time and the signal technological knowledge for that is already finished. It's worth that the signal control in China draw lessons from Germany. Nevertheless, the transference is limited due to the country-specific backgrounds. So the application possibility of German methods in China will be researched in the master thesis.

First of all, the basic contents for the signal control of trams have been picked in the German norms. Referred to the signal setting, the signal head, transition signal, intergreen time and signal phasing for the turning tram are specially stipulated differently from vehicles. As a complex system the tram priority comprises the control principles, control strategies, the tram detection and leading green for trams. Additionally, the interaction between the tram station (pedestrian request) and the signal technological demands are concerned, because the pedestrian interests are substantial factors during the tram priority.

In analogy the basic contents for the signal control of trams in China have been grasped from the practice. The signal setting for trams almost accepts from the signal setting for vehicles besides signal phasing. In view of the tram priority, many considerations and tries for that have been taken. But the lack of knowledge in traffic engineering hinders the success of the tram priority. As regard to pedestrians, they haven't been taken into consideration by signal setting or tram priority.

At the same time the studies are conducted in six example intersections respectively in Germany and China in order to gain practical experiences in Germany and to identify the problems in China exactly. In Germany the intersection Rheinstraße/Neckarstraße/Kasinostraße (A4), intersection Frankfurter Straße/Pallaswiesenstraße (A6) und intersection Nieder-Ramstädter Straße/Jahnstraße (A66) were selected. Accordingly, the intersection Middlehunnan Road/ Southfumin Road (H01), intersection Zuchongzhi Road/Guanglan Road (Z01) and intersection Shenben Avenue/Hongyun Road (H02) were in China chosen.

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Many kinds of advice, got from experience of professionals and design documents of example intersections, can be obtained from the practice in Germany. The additional value for the tram entering by intergreen time calculation, the signal phase for the straight tram with left-turning movements, the determining of detector location and the structure of control algorithm etc. are all the practical key points for die proficient signal control of trams.

Meanwhile, the traffic survey is carried out in the field. The survey ranged from observation of traffic flow and driving behavior at the intersections, measurement of the traffic quality (average wait time) and analysis of clearing and entering processes. These are all prepared for comparisons of country-specific conditions.

In this way, following problems by signal control for trams are recognized in China.

- a joint signal group narrows the flexibility of signal control with trams and it increases the probability of signal misread by vehicle drivers.
- the inadequate intergreen time with irregular driving behavior threaten the traffic safety.
- the unsuitable signal phase restrains traffic quality of other road users.
- the tram priority gains less success.
- the pedestrian requests are underlain.

On the basis of that, the application possibility is identified. The legal, infrastructure-base (Hardware), signal technological and intersection-specific basic conditions are involved at that, in which the signal technological condition plays an important role, and it has influence on driving behaviors and related traffic safety.

Subsequently, the variants aimed at intergreen time, signal phase for straight and turning tram are proposed. And a qualitative preliminary evaluation occurred from the aspect of traffic safety and traffic quality in consideration of acceptance of every whit. The concepts of tram priority are intersection-specific, so there are no general solutions to that.

Following arises the constructing of traffic simulation model in software Vissim in order to process the quantitative analysis and evaluation. In this case, the problems of intergreen time, dealing with signal phase between left-turning movement and straight trams and concepts of tram priority will be imported in the model.

The variants of intergreen time are simulated respectively with 20 km/h and 50 km/h speed limits of trams in the test model. The evaluation can be made from the aspect of traffic safety. And the traffic safety is again described by the number of and the severity of conflicts in use of software SSAM. Through TTC-Value in SSAM the conflicts can be recognized.

The variant evaluation of signal phase between left-turning movements and straight trams is starting from the point view of traffic quality. The favorable variant can be picked out by comparison of the average wait time for vehicles and pedestrians

The concepts of tram priority are also presented. The concepts of tram priority involve the development of control algorithm, the optimization of detection location and the improvement of pedestrian interests. Three concepts are given. The first concept is based on the actual state, while the third concept is future-oriented. The evaluation sets out also from the average wait time (traffic quality).

Finally, pieces of advice are given for the current signal control separately in Germany and China. The suggestions refer to the general problems as well as the detailed traffic scientific blank in the field of signal control for trams. Simultaneously the further research needs are represented. The research needs lie in the capture of Chinese specific behaviors of cycle traffic and pedestrians at intergreen time calculation, the spreading of intergreen time calculation according to German methods in other cities with trams in China and the integration of the bus running into the tram operation.

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