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DRIVER'S CHOICE AND SYSTEM OUTCOMES IN CONGESTED TRAFFIC NETWORKS

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Extended abstract

Objectives and motivation

The evolution of information technology opens an entirely new perspective to the central issues of transportation in overloaded road traffic networks. At the forefront of progress in information technology is the opportunity for the individual vehicle drivers to acquire knowledge through media.

Our study is investigating the effects of spatial orientation in situations of road traffic networks. It starts from the representative scenario of congested traffic in the Zurich metropolitan area. Vehicles often move only at walking pace. Traffic demand leads to an average volume of 118 vehicles per kilometer. Each driver has planned his itinerary with the help of an off-the-shelf navigation device and sticks to his shortest route. The question investigated in this study is: How much will the traffic situation improve if part of the drivers use real-time navigation information (such as may be available via smartphone)?

General description

The research to answer this question proceeds on the assumption that a driver behaves either in a “conventional” or in a “progressive” manner. The population of the drivers is divided into two classes: the class of conventional drivers with static knowledge and deterministic behavior, and the class of progressive drivers with dynamic knowledge and stochastic behavior. The conventional (non-informed) drivers move along the route they perceived as the shortest one when starting their trip. The progressive drivers are informed about the current traffic situation and head for their destination dynamically by choosing the currently most advantageous link at each traffic node on their trip.

The decisions of the informed drivers will be mapped and microscopically simulated using the MATSim software. A model postulated for the route choice describes the behavior of drivers guided by real-time navigation information, but not obstinately following it; their experience regarding the reliability of the traffic information also influences their route choice. An informed driver's decision is based on the random utility in favor of a route. The utility function takes into account three properties: the travel time on the route, the confidence in the information, and the risk attitude according to the drivers mode of behaviour. Our transport simulation model analyzes how differing knowledge levels and modes of behavior of the drivers affect the state of the traffic system in the real-world setting of the Zurich metropolitan area.

Results and conclusions

Our experiments reveal considerable differences in respect of the load on the road network, the mean daily travel times and the consequential properties of a trip up to the driver's arrival time at his destination. The key result is that all drivers benefit even when only part of them navigate by using current traffic information. Further results quantify the time savings that each of the two classes of drivers achieves, and also how the entirety of drivers benefit from certain shares of informed drivers. Our analysis also shows the significant variation of descriptive and normative behavior in respect of route choice. The scenario's estimated mean saving

potential is about 25 percent. It can be fully exploited if the informed drivers behave in a disciplined manner and follow the recommended links.

Numerical outcomes: When 30 percent of the drivers (in the Zurich metropolitan area) are guided by real-time navigation system information and comply exactly with it, the traffic density will be reduced by more than 50 percent, and traffic speed will increase from 4 to 22 kilometers per hour. Starting from a share of 50 percent of informed drivers, traffic density will diminish to just above 30 vehicles per kilometer, and a driver will reach his destination at an average speed of little more than 50 kilometers per hour. Better distribution of the traffic may triple the distance of an informed driver, and yet it amounts to an 84 percent time saving for all drivers. If more than 70 percent of the drivers go by real-time navigation system information, the traffic situation will again deteriorate to as many as 43 vehicles per kilometer moving at a speed of 34 kilometers per hour.

System performance would be reduced if the share of informed drivers exceeds its optimal level. Most likely, the quality of the information must be improved. One hypothesis is that navigation system guidance must be based on marginal cost, which in turn requires that the traffic densities and the time-flow-capacity curves of the links are measured, and that this information is made available in real time.

Contribution: Our study shows and quantifies the impact of improved traffic information and its use (by individual choices) on the system performance. The study provides impetus to planners for increasing the social utility of the traffic system. Moreover, specific task fields in transport, such as itinerary planning can draw on the results of this study.

References

- Balmer, M., Meister, K., Rieser, M., Nagel K., and Axhausen K. W. (2008) Agent-based simulation of travel demand: Structure and computational performance of MATSim-T, Vortrag, 2nd TRB Conference on Innovations in Travel Modeling, Portland, Juni 2008.
- Dobler, Ch., Axhausen, K. W. and Weinmann, S. (2013) Transport Simulations: Knowledge Levels and System Outcomes. In Travel Behaviour Research: Current Foundations, Future Prospects, selected papers from the 13th International Conference on Travel Behaviour Research, Toronto, July 15–20, 2012, edited by Rooda, M. J. and Miller, E. J., International Association for Travel Behaviour Research, Toronto, Ontario, Canada, 299–319.
- Meister, K., Balmer, M., Ciari, F., Horni, A., Rieser, M., Waraich, R. A. and Axhausen, K. W. (2010) Large-scale agent-based travel demand optimization applied to Switzerland, including mode choice, paper presented at the 12th World Conference on Transportation Research, Lisbon, July 2010.
- Weinmann, S. (2013) Simulation of Spatial Learning Mechanisms, Dissertation 21511, Eidgenössische Technische Hochschule Zürich.

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