A framework for an effective traffic congestion management in road networks

supervised by

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Scientific Background to Project

Road traffic congestion will continue to be a major social and economic problem due to the rapid growth of traffic density. The problem has been extensively investigated over the last few decades and wide range of theories and techniques to address the issue have been suggested in the literature. However, due to some physical space and financial resources' constraints as well as environmental concerns, the traditional approach that consists of expanding highways' infrastructures is no longer viable. Currently, the most prominent alternatives to ease traffic conditions on highways rely on an optimal exploitation of the existing highways' infrastructures via Intelligent Transport Systems (ITSs). The effectiveness of an ITS, in improving traffic conditions, in road networks depends highly upon the efficiency of their operational models. One of the corner stone of these models, which plays an essential role in traffic congestion management, includes methods of traffic control. Traffic lights at intersections have been essentially the major tool used to control traffic flow in urban road networks and a wide range of models to optimise a such control have been suggested in the literature e.g. [1, 2]. Recently, congestion pricing strategies [3, 4] have been used as an alternative to tackle traffic congestion in some major cities around the world. Congestion pricing is a mechanism used to shift purely discretionary rush hour highway travel to other transportation modes or to off-peak periods by surcharging users of a road network in periods of peak traffic, via some toll- like road pricing fees, in order to reduce traffic congestion.

The PhD Project

The purpose of this project is first to investigate the effectiveness of congestion pricing strategies e.g. [3, 4] in easing traffic condition compared to classical traffic control models e.g. [1, 2]. Then, the insight gained from this investigation will be used to develop an integrated framework, which combined both classical traffic control with congestion pricing, for an effective traffic congestion management and control so as to ease traffic conditions in road networks. The developed framework is expected to be computationally efficient as well as suitable for real-time applications.

Required Student Background

The current PhD-project requires high-level skills in mathematics, probability and stochastic processes theory as well as computer programming. An experience in programming and a liking of numerical simulation would be an asset.

References

[1] Chiou S-W, *A hybrid optimization algorithm for area traffic control problem.* Journal of the Operational Research Society 58: 816-823, 2007.

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[3] Dial R, *Minimal Revenue Congestion Pricing Part II: an efficient algorithm for the general case.* Transportation Research B 34: 645-665, 2000.

[4] Zhang X and Yang H, *The optimal cordon-based network congestion pricing problem.* Transportation Research Part B 38: 517-537, 2004.