Probabilistic Model of a Traffic Network

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Urban surface transport networks are characterised by high density of streets and a large amount of junctions. In many cities these structures cannot easily accommodate the vast volume of traffic, which results in regular traffic congestions. As it is usually impossible or ineffective to reconstruct the existing street network, efficient traffic control mechanisms are sought for that would provide for higher throughput of the urban transport network without changing its topology. Many commercial systems exist that attempt to solve this task. However, these systems are costly black-boxes that cannot be easily tuned to specific on-site transport problems.

Several interesting deterministic traffic control models exist that attempt to solve the traffic control problem using feedback from different traffic detectors [1]. As the problem of traffic control has random components, idea of our contribution is to treat the traffic control as a sort of *multiple participant decision making problem* [2]. Our participants are junctions in the network equipped with traffic light controllers. The decision that these participants shall agree on is the overall traffic signal setting that would minimize the time spent by vehicles inside the controlled region.

This approach requires the behaviour of the transport system to be described in terms of conditional probability distribution functions $f(x_{t+1}|x_t, d_t)$ describing the prediction of the internal components of the system, x_{t+1}, based on previous state x_t and observed data d_t. Our contribution shows how this probabilistic description can be derived.

References

[1] J. Kratochvílová and I. Nagy. Local Traffic Control of a Microregion. In Multiple Participant Decision Making (proceedings of CMP'04), 2004, pp. 161–171.

[2] R.L. Keeny and H. Raiffa: Decisions with multiple aims: Preferences and value Tradeoffs. J. Wiley and Sons, New York, 1978.