

Bayes Estimation of a Queue Length

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Abstract: The paper deals with an application of Bayes for estimation of the queue length in junction arm.

One of the main symbols of advanced society is high transportation. A lot of people permanently commutes to work and for pleasure. A lot of commodities travel from one country to another, frequently through the continents. Increasing demand for transportation is the reason why the amount of vehicles increases very quickly. A lot of those vehicles means higher density of transportation and large amount of junctions and roads are congested. Very frequent cause is older transport network, which has not sufficient capacity for contemporary vast volume of traffic.

The most common approaches to solution of these transport network deficiencies are attempts to rebuild parts of the network in order to increase their capacity, reroute transit traffic by building large bypasses around affected locations or making drivers pay for entering central zones. In many cities it is impossible or ineffective to reconstruct existing street network due to their historical development. This is the reason why advanced traffic control is being applied.

And so different category of possible solutions is to maintain the present transport network and improve the traffic control. But this control can be based on different ideas. Majority of attitudes uses detectors for giving feedback. Those detectors are based on inductive electric coils placed under the road surface. Presence of huge metallic object above the coil changes its magnetic properties and thus individual cars are detected. Each detector signalizes the presence or absence of a car above it. From this signal, basic transportation quantities such occupancy, intensity, density, velocity, number of cars, and others are evaluated or estimated.

For example Michal Kutil focuses [4] on the urban traffic control, based on the model using difference state equations. Model is described by the number of vehicles in the queue and mainly by the mean value of waiting time which describes the queue dynamics. To make the appropriate non-linear model and to identify its parameters he uses real data measured during one day in Prague. The objective of his work is to balance the vehicle waiting time on different streets in one intersection.

The paper will present other way based on Bayes estimation [1, 6]. In Bayesian view the concept of probability is not interpreted in terms of limits of relative frequencies but more generally as a subjective measure of belief of a rationally and consistently reasoning person which is used to describe quantitatively the uncertain relationship between the statistician and the external

world [5]. This model splits controlled networks into microregions [3]. The queue length and the occupancy of each junction approach are the basic state quantities for fully expressed traffic situation at given time instant. The occupancy determines relative time of the detector activation during sample period, i.e. the proportion of time when detector has been occupied and total time of measuring period. The optimization criterion for this attitude is minimization of the queue length. For clearness, the model is derived for simple junction.

In the Institute of Information Theory and Automation of the Academy of Science of the Czech Republic an algorithm for Bayes estimation of a queue length is developed by group which is lead by Dr. Nagy and Dr. Kárný. The algorithm is tested on real traffic data samples and the overall model estimation is done. The paper will present basic model for Bayes estimation.

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