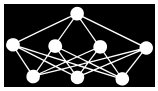

MODELLING OCCUPANCY-QUEUE RELATION USING GAUSSIAN PROCESS

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Abstract: One of the key indicators of the quality of service for urban transportation control systems is the queue length. Even in unsaturated conditions, longer queues indicate longer travel delays and higher fuel consumption. With the exception of some expensive surveillance equipment, the queue length itself cannot be measured automatically, and manual measurement is both impractical and costly in a long term scenario. Hence, many mathematical models that express the queue length as a function of detector measurements are used in engineering practice, ranging from simple to elaborate ones. The method proposed in this paper makes use of detector time-occupancy, a complementary quantity to vehicle count, provided by most of the traffic detectors at no cost and disregarded by majority of existing approaches for various reasons. Our model is designed as a complement to existing methods. It is based on Gaussian-process model of the occupancy-queue relationship, it can handle data uncertainties, and it provides more information about the quality of the queue length prediction.

Key words: *Queue estimation, uncertainty, traffic model, Gaussian process*

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1. Introduction

Queue length has been regarded as one of the key parameters in the process of signal plan design, as estimates of queue length may be used as a part of a criterion that is minimised by urban traffic control systems that provide coordinated control of signalised intersections.

The main difficulty of using the queue-length as a part of performance criterion is the fact that the length is difficult to measure automatically – the automatic systems are based exclusively on image processing [46, 47].

Numerous studies discuss the problem of modelling the queue development, see for example [9, 27, 38, 41]. Typical queueing models are for example those of Akçelik [1], Hensher [12], or Mück [25]. The American Highway Capacity Manual 2000 uses a modified version of Akçelik's model [37]. These models are derived from

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