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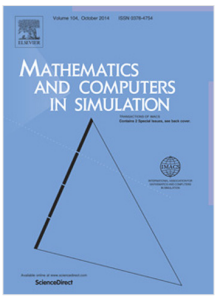

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A Novel Traffic Signal Split Approach based on Explicit Model Predictive Control

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Abstract

As a consequence of the rapid growth of vehicles in cities, urban traffic congestion has become more and more serious nowadays. As an effective control approach, Model Predictive Control (MPC) has been deeply studied for transportation management. However, the relatively complex on-line computing hinders MPC from being further applied on transportation system, especially for large scale transportation networks. Based on the refined store-and-forward model, we propose a signal split control approach with Explicit Model Predictive Control (EMPC) in this paper, by which the complexity of online optimization can be significantly reduced. With multi-parametric Quadratic Program (mp-QP), our approach can generate explicit signal control law, and then shifts the former repeated online signal split optimization offline. As a result, the real time signal control becomes an easier task by searching the lookup table corresponding to the transportation state. The simulation experiments demonstrate that our EMPC based approach outperforms the traditional fix-time signal control. Meanwhile, compared with traditional MPC based approach, our approach can decrease the total computation complexity, and then increase the applicability for real transportation system.

Keywords: Explicit Model Predictive Control, Signal Split, Traffic Network, Intelligent Transportation System.

1. Introduction

Nowadays, due to the rapid growth of vehicles in cities, the urban traffic congestion is much more serious than that of last decades. Meanwhile, as the scale of urban traffic system becomes larger and larger, it is incapable to control only an isolated intersection to alleviate the congestion of the whole traffic network. As a consequence, advanced traffic management measures are required to control traffic system coordinately [1]. Compared with various methods, plenty of efforts have been dedicated to improve the efficiency of the existing transportation infrastructure [2], and a large proportion of the studies focus on reducing the traffic congestion by optimizing the traffic signal split [3, 4].

It has been demonstrated that real-time signal control are much more efficient than fixed-time control for alleviating traffic congestion [5]. Since the early 1980s, a large number of traffic-responsive urban control (TUC) systems have been developed to address the issues of real time traffic management, *e.g.*, SCOOT [6] and SCATS [7]. These two systems determine the signal timings based on an adaptive control approach responding to the real time traffic

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