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Yaqub, Omar Seddeq Omar

Permanent Link:	http://hdl.handle.net/1805/3873
Date:	2014-01-29
Committee Chair:	Li, Lingxi
Committee Members:	Chen, Yaobin Rizkalla, Maher E.
Degree:	M.S.E.C.E.
Degree Year:	2012
Department:	Department of Electrical and Computer Engineering
Grantor:	Purdue University
Keywords:	Petri nets
LC Subjects:	Petri nets -- Research -- Evaluation ; Discrete-time systems -- Research -- Evaluation ; System analysis ; Automatic control ; System design ; Mathematical optimization ; Dynamics ; Roads -- Interchanges and intersections ; Urban transportation -- Mathematical models -- Research ; Computer algorithms -- Research -- Methodology -- Evaluation ; Computer simulation ; Electronic traffic controls ; Distributed operating systems (Computers)

Abstract:

In recent decades, Petri nets (PNs) have been used to model traffic networks for different purposes, such as signal phase control, routing, and traffic flow estimation, etc. Because of the complex nature of traffic networks where both discrete and continuous dynamics come into play, the Hybrid Petri net (HPN) model becomes an important tool for the modeling and analysis of traffic networks. In Chapter 1 a brief historical summery about traffic systems control and then related work is mentioned followed by the major contributions in this research. Chapter 2 provides a theoretical background on Petri nets.

In Chapter 3, we develop a HPN model for a single signalized intersection first, then we extend this model to study a simple traffic network that consists of two successive intersections. Time delays between different points of network are also considered in order to make the model suitable for analysis and simulation. In addition to HPN models, we also consider discrete Petri nets where their modeling simplicity enables the characterization of the occurrences of all events in the system. This discrete PN is particularly useful to give a higher-level representation of the traffic network and study its event occurrences and correlations. In Chapter 4, we build a discrete PN model to represent a traffic network with two successive intersections. However, we find that the model leads to unbounded places which cannot accurately reflect the dynamics of the traffic in terms of event occurrences. Hence, we introduce the Modified Binary Petri nets (MBPN) to overcome the limitation and resolve the confliction problem when we design our controllers. This MBPN model is a powerful tool and can be useful for the modeling and analysis of many other applications in traffic networks. Chapter 5 gives a summary for each chapter, provides conclusion and discusses future work for both discrete and hybrid Petri nets.

Description:

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