2007

Application of UML for Modeling Urban Traffic System Using Producer Consumer Theory to Generate Process Algebra Model

Manuj Darbari
Babu Banarasi Das National Institute of Technology and Management

Sanjay Medhavi
Lucknow University, India

Abhay Kumar Srivastava
ICFAI Business School, India

Follow this and additional works at: https://scholarworks.lib.csusb.edu/jitim

Part of the Business Intelligence Commons, E-Commerce Commons, Management Information Systems Commons, Management Sciences and Quantitative Methods Commons, Operational Research Commons, and the Technology and Innovation Commons

Recommended Citation
Available at: https://scholarworks.lib.csusb.edu/jitim/vol16/iss4/6

This Article is brought to you for free and open access by CSUSB ScholarWorks. It has been accepted for inclusion in Journal of International Technology and Information Management by an authorized editor of CSUSB ScholarWorks. For more information, please contact scholarworks@csusb.edu.
Application of UML for Modeling Urban Traffic System Using Producer Consumer Theory to Generate Process Algebra Model

Manuj Darbari  
Babu Banarasi Das International Institute of Technology and Management, India

Sanjay Medhavi  
Lucknow University, India

Abhay Kumar Srivastava  
ICFAI Business School, India

ABSTRACT

UML is widely used as an industry standard for modeling any system. In this paper will be dealing with simple UML diagrams and show that low it can be transformed into process algebra models specially designated to model urban traffic systems. The model capture functionality at the level of mesoscopic as well as microscopic level and it is merged with process algebra’s producer consumer theory. The model is also formalized using Process algebra equations. This paper focuses on complex situational activity diagrams enhancing the expressivity by refining at the abstraction levels. Performance requirement is annotated by the UML profile for schedulability performance and time.

INTRODUCTION

There are number of information processing methodologies (Rao, Teran, & Savard, 2004) used in modeling Urban Traffic flow but unfortunately they are not able to model the Traffic flow completely. We would like to suggest a methodology by using UML (Buchholz, 2000) which will help in easily building Macroscopic, mesoscopic and microscopic models (Aalast & Van Hee, 2002; Darbari, 2003). The modeling methodology which we will be following can be divided into two sub classifications.

Decision Model and Physical model. The decision model contains various functionalities and Control Algorithms (Galup, Dattero, & Quan, 2004; Jitpaiboon & Kalaian, 2005) and Physical model contains operational details.
GENERATION OF DECISION MODEL USING UML

Decision Models are based on average signal timings. They are particularly useful for signal system timing design software because they provide efficient procedures for formulating objective functions used in optimization logic.

In the post decade, many decision models have incorporated more details to account for actuated signals and coordination between them.
We can have the basic class diagram (Tari, 2000) being converted into producer consumer methodology.

Converting the Class diagram in Figure 2 in Producer Consumer methodology we can have.

---

Figure 2: Class Diagram of UTS.

Figure 3: Class diagram for producer Consumer.

Figure 4: Basic Producer Consumer interpretation of UTS.
We can generate collaboration/State diagram for UTS in Producer consumer mode.

Figure 5: Combined Collaboration State Diagram for producing/Consumer of UTS.

The basic diagram for producer/Consumer of the combined collaboration/State Diagram.
GENERATING A PROCESS ALGEBRA MODEL OF UTS

Generation of a process algebra Model (Hilston, 1997) from the UML (Ashley, Meehan, & Carr, 2005) model concentrates on the combined collaboration and state chart diagram shown in Figure 6.

The transition from producer to blocked requires the completion of the produce action which let us twice t1. In PEPA (Gilmore, 2002) terms this translates to a rate of 2/t1. The transition from blocked to producer requires completion of the passive action add.

Communication way \( \text{def} \) (Main Road, 1/t1).

Blocked \( \text{def} \) (add, T). Communication way Traffic flow \( \text{def} \) (Free lanes 1/t2). Halted

Halted \( \text{def} \) (take T). Traffic Flow.

The Buffer is a simple counting process, which will not allow a take action if it has zero substances and will not allow an add if it has all the free sub lanes with it.

The decision to define rates for add and take only in the buffer is arbitrary and in a real example they might be defined in the other processes as well or instead.
Main Road Blocked \textit{def} \hspace{0.5cm} (add 1/3) Sublane 1 \\
Sub lane and Overflow \textit{def} \hspace{0.5cm} (add 1/3). Sublane + (take 1/4). Main Road Blocked. \\
Sublane 2 Overflow \textit{def} \hspace{0.5cm} (add 1/3). \\
All Sublane + (take, 1/4) Sublane 1. \\
All Sublane \textit{def} \hspace{0.5cm} (add 1/3) (take, 1/4) sublane 2, Overflow. \\
To complete the model we must combine the separate processes using the PEPA cooperation. We will now build a 
model by first combining the producer with buffer, forcing them to cooperate in add action. It can be represented as:

\begin{align*}
\text{Prod Cons} \textit{def} \hspace{0.5cm} \text{(Producer add Buffer) take Consumer.}
\end{align*}

Mainroad Traffic (Free Sublanes add Buffer) take Traffic flow.

Once the producer (Mainroad) enters the blocked state and send its add message, it cannot proceed until that 
message has been received by the buffer. The direction of message passing implies that it is the buffer which 
supports the operations add ( ) and take ( ), which is partial justification of our decision to define their rates 
entirely in term of the capabilities of the buffer. UML plays a vital role in giving the diagrammatical representation 
first and then converting it into producer consumer representation.

\textbf{CONCLUSION AND FUTURE SCOPE}

In this paper we have shown the conversion of Urban Traffic Road Network annotated into UML model and then 
later on converted these models into process algebra PEPA. The extension of the work can be in the direction of 
signal light and traffic diversion gateways which should automatically become active in case of Traffic congestion. 
Next aim will be to develop a simulation model which could cover all the UML modeling diagrams to develop and 
simulate real time Traffic modeler with Multi-Agent systems. We will try to simulate Multi Agent Process Algebra 
Models by incorporation of intelligent cooperation algorithm dedicated to urban traffic system. It will enhance its 
ability to coordinate and optimize the traffic signal control networks.

\textbf{REFERENCES}


357.

of Systems Management. I (3).

Galup, S. D., Dattero, R. & Quan, J. J. (2004). The Demand for Information Technology Knowledge and Skills: An 
Exploratory Investigation, Journal of International Technology and Information Management, 13 (4), 253- 
262.


