A Simulation Application Programming Interface for Traffic Modeling

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ABSTRACT

A Simulation Application Programming Interface for Traffic Modeling. KENROY WILLIAMSON (Florida A & M University, Tallahassee, FL 32307) DR. JIM NUTARO (Oak Ridge National Laboratory, Oak Ridge, TN 37831).

This project aims to develop a software library for constructing the dynamic pieces of a traffic simulation. It is meant to complement a complete traffic modeling tool set that includes data import and export capabilities, traffic routing algorithms, and visualization tools. This software library provides an abstract framework for constructing event driven models of traffic dynamics. It is based on the DEVS (Discrete Event System) modeling and simulation framework, and will be implemented using *ADEVS* (A Discrete Event System) simulation package. There are three basic elements of a traffic model and they are represented abstractly in the modeling framework. The three basic elements of a traffic modeling are Traffic Sources, Traffic Sink and Road Segments. The Traffic Sources represent locations from which traffic can enter a road network. Traffic Sinks are destination locations where traffic can leave a road network. Road segments represent traversable pieces of a road network. A road segment can represent an intersection, a one way street, a multi-lane highway, or any other navigable piece of the road system. The road system is navigated by population units. Population units are characterized by a size (e.g., number of people or number of vehicles) and a destination. Population units originate at traffic sources and are ultimately deposited at traffic sinks. They travel from source to sink through a road segment graph. The paths taken by the population unit, and the time required for a population unit to traverse a road segment, are determined by the user

of the modeling framework. The modeling framework provides event scheduling, feedback for modeling congestion, and other time and structure related services that are needed to perform the actual simulation.

INTRODUCTION

ADEVS (**A D**iscrete **EV**ent **S**ystem simulator) is a C++ library for constructing discrete event simulations based on the Parallel DEVS and Dynamic Structure DEVS formalisms. In addition to basic and network Parallel DEVS models, *ADEVS* includes support for dynamic structure models based on the Dynamic Structure DEVS formalism. DEVS has been applied to the study of social systems, ecological systems, computer networks and computer architecture, military systems at the tactical and theater levels, and in many other areas. Recent advances in quantized approximations of continuous systems suggest promising computational techniques for high performance scientific computing (e.g. in the field of computational fluid dynamics).

Our research is focused on developing a simulation Application Programming Interface for traffic modeling. This program will be used to develop high-resolution distribution databases for the U.S. metropolitan areas to obtain refined hour-of-day and cohort-specific population distribution data amenable for human exposure modeling purposes. This data will then be used by the Exposure Modeling and Research Branch (EMRB) at the U.S. Environmental Protection Agency's (EPA) National Exposure Research Laboratory (NERL).

STEPS TAKEN

There were a lot of different approaches taken towards this project. First I had to read Theory of Modeling and Simulation by Bernard Zeigler. That book introduced all the necessary steps that are involved in modeling and simulation. After I read Theory of Modeling and Simulation I then implemented the fire spread model in C++. The fire spread model helped me to fully understand how the simulator works. Finally I had to familiarize myself with C++ and the ADEVS library.

The API is comprised of seven classes. Three of these are used to represent Sinks, Sources, and Road Segments. One class represents population units. Another class represents the state of Sinks, Sources, and Road Segments. This class can be used to implement feedback into the road network dynamics. The last two classes are used to describe the road network and run the simulation.

PROJECT

To understand the fundamentals of Modeling and Simulation, mentor Dr. Jim Nutaro gave me small assignment. I was to extend a single model simulator used in a previous example so that it can simulate generic two dimensional cell space models. I used the simulator to implement the fire spread model in C++. The object of this assignment was to understand how the simulator template used in conjunction with virtual model methods can be used to simulate any two dimensional cell space model. I also wrote a short paper describing the principles behind the simulation engine, which can be view on my webpage www.csm.ornl.gov/Internships/RAMS_05/websites_05/k_williamson/williamsonweb.html.

RESULTS

The predicated results is to have a program to develop high-resolution distribution databases for the U.S. metropolitan areas to obtain refined hour-of-day and cohort-specific population distribution data amenable for human exposure modeling purposes. This data will then be used by the Exposure Modeling and Research Branch (EMRB) at the U.S. Environmental Protection Agency's (EPA) National Exposure Research Laboratory (NERL).

This program will be able to detect exactly time given a node, a link and another node. In other words, we should be able to tell when and what time a bus in arriving and leaving their destination, which is school.

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REFERENCE

http://www.ece.arizona.edu/~nutaro/index.php