Applications of Microscopic Traffic Simulation Model for Integrated Networks

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Center for Transportation Research and Education
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Our Location
Infrastructure
International Port & Hub
Agenda

- CORSIM
- Modules in Traffic Simulation Models
- Applications of Traffic Simulation Models
- Related Research @ NJIT
CORSIM

- A microscopic, stochastic traffic simulation model that represents the real world dynamic traffic environment for freeways and streets
- A powerful traffic engineering tool producing a variety of MoE’s and graphics files for analysis
Model Representation

- Network representation
  - Link-node concept
  - Nodes depict
    - changes in geometry;
    - trip generators;
    - sign and signal control points
  - Links depict roadways between two nodes

- Traffic representation
  - Up to 4 different fleet components
    - Cars, carpools, buses, and trucks
Model Features

- Network geometry
- Sign & signal control
- Human behavior
- Vehicle movements
- Stochastic Simulation
- Others
Network Geometry

Lane Channelization at Intersections

Turning Pockets
Network Geometry

Grade Separation (Up to 8 Levels)
Network Geometry

On-Ramp Traffic Merging Operations

Off-Ramp Traffic Diverging Operations
Network Geometry

Lane Additions & Drops
Sign & Signal Control

Pre-timed Signals
Actuated Signals (Type 170 & NEMA)

Yield and 2-Way Stop Signs

Ring 1 Phases
Ring 2 Phases
Sign & Signal Control

Ramp-Metering Control:

- Clock Time
- Demand/Capacity
- Speed
- Occupancy
Stochastic Simulation

10 Types of Driver Behaviors
Stochastic Simulation

Major parameters affected by driver types:

- Desired free flow speed
- Headway for car-following
- Gap acceptance for lane-changing
- Start-up lost time and queue discharge headway
- Gap acceptance for minor street traffic
- Amber interval response
- Gap acceptance for permissive left-turns
Car-Following Logic

Headway = F(L, V_L, V_F)
Lane-Changing Logic

- **Discretionary Lane Changing**

- **Mandatory Lane Changing**

- **Anticipatory Lane Changing**
Look-Ahead Features

Responses to Advanced Warning Signs on Freeways
Bus Transit Operations
Time-Varying Demand

Traffic Demand

Time
Input Data Requirements

- Run control data
- Network geometry data
- Traffic control data
- Traffic operations data
- Traffic demand data
- Calibration data
- Others
Outputs

- Graphics (Animation) files
- Static MOE’s
  - Throughputs (vehicle trips; person trips)
  - Vehicle-miles or person-miles
  - Vehicle-minutes; person-minutes
  - Speed (mph)
  - Volume (veh/hr)
  - Travel and delay times (min; sec/veh)
  - Queue length, stops, phase failures, etc..
  - Fuel consumption (gal; mpg)
  - Pollutant emissions (CO, HC, NOx; kg/mi-hr)
Animation
Animation
Applications

Evaluation of Geometric Improvements
Intersections, Interchanges, & On/Off-Ramps
Warning in Using Simulation Models

- Requirement of input data at a detail level
- Users’ responsibility for input data accuracy
- Knowledge of simulation models capabilities and limitations
- Model calibration is not easy in some cases
- Limited capabilities in simulating ITS-related control strategies via CORSIM Run Time Extension
Microscopic Simulation Tools

- Paramics
- CORSIM
- VISSIM
- INTEGRATION
- Dynasmart
- MITSIM
- TRANSIMS
- Others
Applications

Traffic Operation Analysis
Parking Activities, One-Way System & Lane Use (HOV)

ONE HOUR PARKING 9AM-7PM

ONE WAY

BUSES AND 4 RIDER CAR POOLS ONLY
6 AM-9 AM MON-FRI
Traffic Control

Sign and Signal Control Analyses at Intersections
Freeway Capacity Analysis
Ramp Metering on I-80
Signal Optimization on NJ Highways
Benefit Analysis - Signal Optimization

**Input**
- **Cost**
  - Data collection & processing
  - Network modeling
  - Construction/Maintenance

**Benefit models**:
- User delay estimation
- Vehicle operating cost estimation
- Environmental impact

**Output**
- **Benefits**
  - Delay Savings
  - Fuel Savings
  - Emission Savings

**Sensitivity Analysis**
- No. of Stops
- Delays
- Travel speeds
- Value of time
- % of vehicle type
- Occupancy

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**NJIT**
New Jersey Institute of Technology
A Public Research University
Development of Simulation/Assignment Model for ITS Evaluation
Travel Time Prediction

Starting from
22 West Way
Green Brook, NJ

Arriving at
1605 Broadway Ave., New York, NY

Distance:
36.0 miles

Travel Time:
56 minutes
Travel Time Prediction for NY Thruway
Transit Simulation Model
Neural Network/Dynamic Algorithms to Predict Bus Travel Times

Sponsor: NJDOT for NJ Transit

- **Objective**: Develop a neural dynamic model (e.g., the integration of artificial neural networks and Kalman filtering algorithm) that can predict bus arrival information with the use of real-time and historic data

- Algorithm was tested on a selected NJ Transit route (Bus #62) and showed promising results

- Analysis helped to identify necessary improvements required for the successful implementation of the model
Newark Penn Station Circulation Study

Sponsor: NJDOT for NJ Transit

- Microscopic traffic simulation of Downtown Newark
- Evaluation of existing conditions and impacts of proposed improvements
- Recommended solutions for improved vehicle flow
Remove Barrier Tolls on the GSP

- Detailed Visualization Abilities
Garden State Parkway - Toll Removal Study

- Analyzed traffic congestion impacts as part of the development of a ten-year plan to remove toll barriers on Garden State Parkway
- Developed a traffic simulation model of the northern 50-mile section of the Parkway
- Alternative scenarios:
  - Maintain the existing toll plazas
  - Elimination of barriers in one or both directions
  - Construction of high-speed E-Z Pass lanes
- NJIT Report was part of the NJDOT Commissioner’s submission to the Governor
- Implemented by the Acting Governor Codey
Route 139 Construction and ITS Simulation
Work Zone Optimization
Work Zone Optimization
FIG. 6. User, Maintenance, and Total Costs vs. Various Work Zone Lengths (Combined Flow Rate = 1150 vph)
FIG. 4. Optimal Total Clearance, Discharge, Cycle Times and Optimal Work Zone Length vs. Combined Flow Rate

- Clearance Time
- Cycle Time
- Discharge Time
- Optimal Work Zone Length
Emergency Events
Traffic Diversion

Freeway Incidents and Diversion Analysis
Cape May Evacuation Study
Development and Evaluation of Emergency Plans

No evacuation plan

Evacuation plan in place
Managing Highway Incidents
Traffic Operations Centers
Incident Management Program
Thank You