

University of Florida
Transportation Research
Center
and the
McTrans Center

January 2012



The CORSIM microsimulation software program is a powerful tool for use in analyzing traffic operations for a given set of traffic, roadway, and control conditions. It has been used extensively throughout the U.S. for the last twenty years. Four specific areas are currently the subject of CORSIM modeling enhancements, as described here.

Simulating High Occupancy/Toll Lane Operations

Congestion pricing has been advocated by economists and transportation researchers as an efficient way to mitigate traffic congestion. A prevalent form of congestion pricing in the U.S. is high occupancy/toll (HOT) lanes. Since the first HOT lane was implemented in 1995 on State Route 91 in Orange County, Calif., the concept is becoming popular and widely accepted by many transportation authorities. The managed-lane operator must ensure a superior level of service on HOT lanes in order to attract motorists to pay and use them. To achieve this, ideally tolls should vary in response to real-time changes in traffic conditions.

Microscopic simulation has been used to design and evaluate effective pricing schemes or operation strategies of managed lanes. As a trustworthy traffic simulation tool, CORSIM has a very limited capability of simulating dynamic tolling strategies and the drivers' lane choice behaviors in the presence of tolls. This research aims to enhance CORSIM and develop a CORSIM-based simulation platform to evaluate the impacts of a variety of pricing strategies on freeway traffic operations.

Three sets of modules are developed. The first one consists of a variety of pricing strategies including the one implemented on I-95 Express in Miami, a reactive dynamic pricing algorithm and a time-of-day pricing scheme. More precisely, the I-95 Express dynamic pricing algorithm adjusts the toll every fifteen minutes based on the actual traffic conditions, including the current traffic density, the difference in density between the previous and the current time intervals, the toll amount in the previous time interval. In the reactive pricing algorithm, the toll amount at the current time interval depends on the toll at the previous time interval, the current density and the desired density. Finally, in the case of the time of day pricing scheme, the toll is not determined based on real-time data (density, travel time, etc.) but it is predeter-

mined by the CORSIM user. This scheme is useful for freeway facilities that have similar traffic patterns during, for example, weekdays.

The second module mimics drivers' lane choice behaviors in the presence of tolls. More specifically, if a vehicle is allowed to enter the HOT lanes by paying, it needs to make a decision of whether to pay and use the HOT lanes or continue its trip on the general-purpose lanes. In the developed lane-choice model, the lane-choice decision depends on the toll amount, the travel time savings and the traveler's value of time.

The third module implements different toll structures for multi-segment HOT lanes, which have multiple well-separated ingress or egress points, and more than one tolling points along multi-segment HOT lane facilities. Depending on the toll structure implemented, a motorist may or may not pay at each tolling point. The toll structures implemented in CORSIM include zone-based, origin-specific, OD-based and distance-based.

Simulation experiments have been conducted using the network of I-95 Express in Miami to evaluate and compare the impacts of different pricing strategies on this managed lane system.

Implementing Two-Lane Highway Modeling

Access to rural areas transitioning into more developed areas is usually by two-lane highways, which may also include occasional traffic signals. In order to manage the growth and resulting traffic demands in these areas, it is essential that transportation planners and engineers have tools by which they can analyze these situations. However, no analysis tool exists for analyzing two-lane highway facilities with occasional intersections.

The objective of this project was to implement two-lane highway modeling into the CORSIM simulation program and also provide for the capability to model the combination of two-lane highway segments

RECENT MODELING ENHANCEMENTS TO CORSIM

Recent Modeling Enhancements to CORSIM (Cont)

and signalized intersections.

The most distinguishing feature of traffic operations on two-lane highways is passing in the oncoming lane (when passing lanes are not present); thus, the development of a passing model is the most important aspect of two-lane highway simulation. The developed passing model includes components for determining a driver's desire to pass, centerline striping, and passing sight distance.

The modeling logic also handles the passing of multiple vehicles at one time and safely aborting a passing maneuver when necessary. Passing lanes are also accommodated by identifying impeding vehicles and calculating a willingness to move over.

Preliminary testing results produced by the developed two-lane highway modeling logic are reasonably consistent with expected traffic flow theory and field observations discussed in the literature.

Implementing Toll Plaza Modeling

In the U.S. there currently exists a financial crisis for the funding of necessary roadway maintenance and expansion. It has thus become necessary to find other means to fund transportation based projects. One potential solution that is gaining momentum is roadway tolling. To cost-effectively analyze, plan, and design tolling operations, both conventional and open-road tolling, simulation is an essential tool.

Simulation software programs allow transportation analysts a means to analyze and visualize their proposed roadway designs under expected traffic conditions. This allows transportation analysts an opportunity to develop the appropriate toll network design before construction begins. This can save federal, state, and local agencies millions

of dollars in expenses to correct or alter already started/completed projects. Unfortunately, few of these simulation programs are capable of properly simulating traditional toll plazas.

CORSIM, one of the most widely utilized simulation programs in the U.S., does not currently allow for direct simulation of toll plaza facilities. This project resulted in the implementation of direct toll plaza modeling into CORSIM. This was accomplished through the development of new algorithms and modeling features.

To accommodate toll plaza simulation, a new lane selection algorithm was developed exclusively for toll plazas. This algorithm takes into account a vehicle's payment type, the payment types accepted by each toll booth, the queuing at each toll booth, and the number of lane changes needed to reach each toll lane. In addition to the new lane selection algorithm, new inputs, such as average service time and payment type distribution, and outputs, such as toll booth delay and throughput, were included in CORSIM.

Using Microsimulation to Evaluate the Effects of Advanced Vehicle Technologies on Congestion

Advanced Driver Assistance Systems (ADAS) are electronic devices installed in vehicles to assist drivers in tasks such as lane changing, merging and speed control by providing warnings or even taking control of the vehicle. These systems have shown promise in the improvement of road safety.

An important question is whether the use of these systems would also result in traffic improvements and congestion mitigation. Some papers already show positive effects of one particular system (Adaptive Cruise Control), but the integration of these systems' impact and the use of such systems by different drivers have not been evaluated yet.

This research uses CORSIM to evaluate the impact of Adaptive Cruise Control (ACC) and Lane Change Assist (LCA) in traffic operations and congestion occurrence. The research evaluates traffic operational impacts based on various market penetration levels for each of these technologies separately and in combination.

The selected algorithms were implemented and tested in a CORSIM network. Three flow scenarios were tested to evaluate the impacts of the technologies under various demands: The "average demand" scenario had freeway entry volumes ranging from 1400 to 1800 veh/h/lane, and arterial entry volumes ranging from 300 to 400 veh/h/lane. The "heavy demand" scenario had freeway entry volumes from 1900 to 2200 veh/h/lane, and arterial entry volumes from 400 to 500 veh/h/lane. The "congested" scenario had freeway entry volumes from 2200 to 2500 veh/h/lane, and arterial entry volumes from 550 to 650 veh/h/lane. All scenarios used only passenger cars.

Preliminary results show that the ACC has significant potential to increase average travel speeds in a network, and its impact is larger for the heavy demand and congested scenarios. The impacts of LCA on traffic operations are mostly positive, but relatively minor.

For technical information, contact:

Dr. Scott Washburn
swash@ce.ufl.edu
352-392-9537 x1453
or

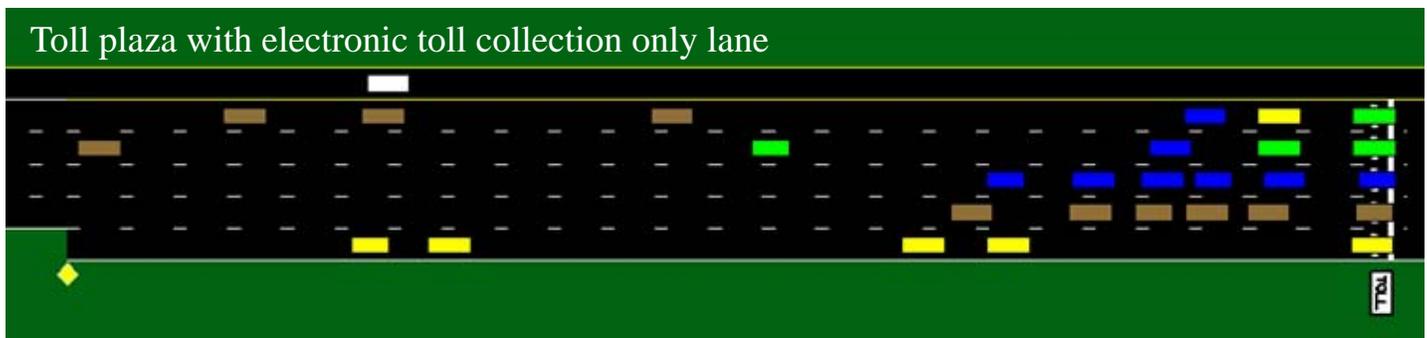
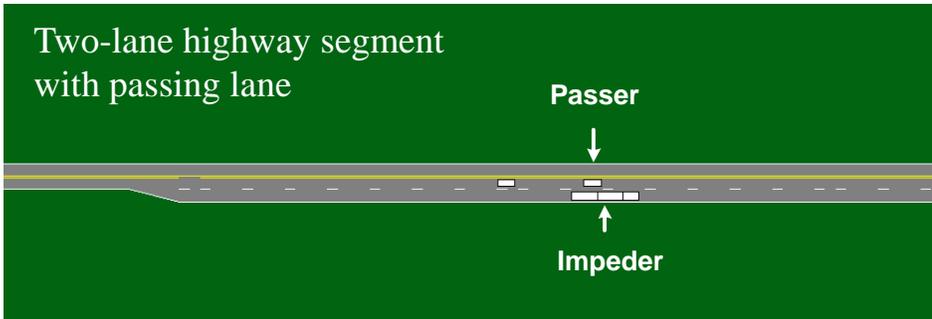
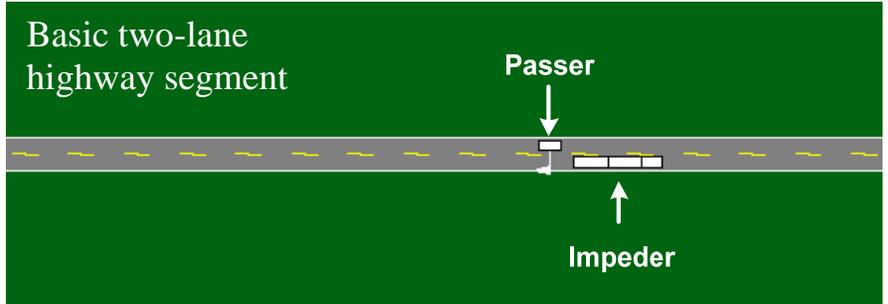
Dr. David Hale
david@ce.ufl.edu
352-392-0378 x240

For ordering information, contact:

McTrans Center
1-800-226-1013
mctrans@ce.ufl.edu
<http://mctrans.ce.ufl.edu>

RECENT MODELING ENHANCEMENTS TO CORSIM

Current Modeling Enhancements to CORSIM (Cont)



LEGEND	
VEHICLE COLORS	
Left	■
Right	■
Lt Diag	■
Rt Diag	■
Through	■
TOLL PAYMENTS	
ACM	■
Manual	■
Ticket	■
ETC	■
INCIDENTS	
Blocked	■
Restricted	■
SIGNALS	
Actuated	●
Fixed	■
Ramp Mtr	◆
TOLL COLLECTION	
ACM	■
Manual	■
Ticket	■
ETC	■
All	■

TRAFVU legend showing information for vehicle toll payment type and payment types accepted at toll booths.

