SIMULATION AND EVALUATION OF THE ORLANDO-ORANGE COUNTY EXPRESSWAY AUTHORITY (OOCEA) ELECTRONIC TOLL COLLECTION PLAZAS USING TPSIM© (PHASE II)

PROBLEM STATEMENT

Traffic simulation models are used to enhance planning, design, operation, and management of transportation facilities. The ability to simulate conditions at a toll plaza provides engineers and planners with the tools to evaluate current and future conditions at a toll plaza without the costly field data collection necessary to complete an in-depth evaluation. Simulation enables engineers to test suggested modifications or improvements to a traffic system, without incurring the risks of constructing them and, consequently, of creating undesirable impacts to traffic operations.

TPSIM© (Toll Plaza SIMulation), a stochastic microscopic simulation model developed by the Transportation Systems Institute (TSI) at the University of Central Florida (UCF), can aid in the analysis of toll plaza operations through animation capabilities.

OBJECTIVES

The objectives of this research included the following:

1. Test the transferability of TPSIM© to other toll plazas by selecting a toll plaza other than the Holland East Plaza for evaluation.

2. Develop basic animation capabilities to visualize traffic behavior at toll plazas.

FINDINGS

The model calibration process was determined utilizing the experimental design which first adjusts the input variables with the least direct impact on the individual vehicle operations; therefore, plaza geometric data and then the global parameters were adjusted. For the initial runs, the default values of the model were used and then adjusted based on the throughput and delay output values.

The parameters for calibrating the model are approach lane length (plaza geometric data), average approach speed, approach speed standard deviation, average deceleration rate, deceleration rate standard deviation, clearance, ETC lane(s) average speed, and service time (global parameters). Toll lane length, transition zone length, and lane width were held constant.

A random offset number (RON) was used as an input for each simulation model run, to ensure that each run was unique for a specific set of input variables and to provide the model with a starting number for the claculations.

TPSIM$^©$ and the actual toll plaza operations were alike most sensitive to the input variable *service time* because the service time directly impacts the approaching vehicles and vehicles queued in the lanes waiting to pay the toll. A noticeable shift of the throughput and delay occurred between the two manual lanes. Because service time had such a significant impact on the operations of the individual lanes, the TPSIM$^©$ output of the two manual lanes were averaged and compared to the average field values of the two manual lanes. Since TPSIM$^©$ has the same variability of lane choice as the drivers in the field, each run had a slightly different outcome, just as each day in the field could have had.

CONCLUSIONS

The measures of effectiveness used to evaluate the model were throughput, average queuing delay, maximum queuing delay, and total queuing delay. The output values from TPSIM$^©$ for 5-minute intervals were compared to the collected field values. A Chi-Square test was conducted on the throughput and a Wilcoxon Signed Rank test was conducted on the delay values. The first five minutes of analysis were excluded because they were considered a warm-up period for the modeling process.

The manual lane average, the automatic coin lane, and the ETC lane (for throughput only) indicated that there were no statistically significant differences between the simulation data and the field data at the 95% confidence level for all four measures of effectiveness. TPSIM$^©$ animation capabilities were developed and verified with field data collected at Dean Plaza.

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