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IMPROVING HIGHWAY TRAVEL TIME ESTIMATION IN FSUTMS BY CONSIDERING INTERSECTION DELAYS

BACKGROUND

Traditional travel demand models rarely consider intersection delays when estimating travel time. This is because modeling intersection delays is challenging due to the complexity in roadway geometry, signal plans, and vehicle movements. While signal plans may be coded in a base-year model, this information is unavailable for a future year. Because intersection delays constitute a considerable portion of total travel time in urban areas, especially on arterials during peak hours, ignoring them will introduce inaccuracies in model results. Currently, in THE Florida Standard Urban Transportation Model Structure (FSUTMS), trips are assigned to links based on link impedance and penalties for turning movements. A generalized method that appropriately incorporates intersection delays is desired for short-term model improvement.

OBJECTIVES

This study aims at improving link travel time estimation by developing intersection delay models that may be incorporated into FSUTMS to estimate highway and transit travel times. The objectives to be achieved in this research included the following:

1. Evaluate the appropriateness of different traffic engineering software for the purpose of determining intersection delays under different combinations of traffic conditions and intersection geometry.

2. Develop models capable of predicting intersection delays based on traffic conditions and simplified intersection geometry.

3. Evaluate model performance and develop recommendations for subsequent efforts.

FINDINGS AND CONCLUSIONS

Researchers developed artificial neural network (ANN) delay models for five common intersection types based on the network of the 2000 Gainesville FSUTMS model. All of the intersections are assumed to have a typical configuration with four-legs, 12-foot lanes, no exclusive right-turn lanes, and exclusive left-turning lanes. The ANN delay models are trained with inputs of volumes, capacities, and targets of simulation results from TRANSYT-7F to predict movement delays for given input of volumes. The ANN delay models can estimate intersection delays more efficiently than a regular complicated micro-simulation with accuracy adequate for long-range planning purposes.

Recommendations for future work include the following:

(1) With additional models developed in a similar manner for other types of intersections in Gainesville, the models may be applied during traffic assignment to measure the benefits of intersection delay models in terms of accuracy in link volumes and link speed.

(2) Improve model performance under oversaturation conditions by employing approaches in TRANSYT-7F such as utilizing a different objective function that focuses on minimizing queues, or employing the multi-period optimization.

(3) To consider signal coordination, corridor-wide signal plan optimization may be necessary. Research is needed to develop generic models that represent a variety of configurations of intersections within a corridor, which may be applied at various locations and in different urban areas.

(4) In this study, intersections modeled are isolated. To address the impact of downstream congestion on an upstream intersection, additional inputs that describe the nearby intersections may be incorporated into the models (e.g., distance from the intersection being considered and their volumes).

(5) Street parking and pedestrians may be addressed by assuming a lower than posted speed or by introducing additional area types as an input.

(6) In this research, symmetric intersections are investigated. Additional research is needed to determine the effect of asymmetric intersections where link properties change for through traffic.

(7) Finally, with more volume-delay data, the possibility of simplifying the models needs to be investigated through model generalization or possibly the development of analytical forms of the volume-delay relationships.

BENEFITS

In this project, the researchers developed several ANN models for intersections. In so doing, they have provided proof of concept for considering intersection delays in demand models and identifies additional research needed to implement delay models. When fully developed, delay models are expected to help improve model accuracy and facilitate better decision-making in transportation investments.

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