Sequence Optimization at Signalized Diamond Interchanges USING HIGH-RESOLUTION EVENT-BASED DATA

PURDUE
UNIVERSITY

Paper No. 15-0644

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ABSTRACT

Signalized diamond interchanges are pairs of ramp intersections characterized by interlocked left turns and relatively close spacing. This paper describes a series of performance measures derived from high-resolution signal controller event data that can be used to optimize the internal phase sequence and offset to improve traffic flows within diamond interchanges and to qualitatively and quantitatively assess the progression of the interior movements. The new heuristic developed in this paper improves on traditional green band optimization techniques by incorporating actual demand profiles measured in the field. A field analysis was performed on a diamond interchange at I-69 and 96th Street in northwest Indianapolis, IN, where the existing sequence data was collected and used to model the alternative sequences to identify the optimal sequence. Interior operations were improved under the optimized settings: the percent of vehicle arrivals on green increased by 19% during the 0900-1500 midday plan. Video observations were used to corroborate the data and are included in a video synthesis of the time-space trajectories.

SEQUENCES

AERIAL MAP

JURISDICTION DIAGRAM

TIME SPACE SEQUENCE SWAP SIMULATIONS

PURDUE COORDINATION DIAGRAM WITH DELAY

I-96 / 96TH STREET LANE PHASING AND DETECTION

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DELAY / AOG BY MOVEMENT

DELAY / AOG BY SEQUENCE

SOLUTION SPACE

PCD BEFORE / AFTER

WB FLOW PROFILE DIAGRAMS

EB FLOW PROFILE DIAGRAMS

PRODICTED VS. ACTUAL ARRIVALS

CONCLUSIONS

Diamond interchanges are a common geometric grade separation between access controlled freeways and crossing arterial roads. Passer III has historically been the most robust tool for designing diamond phase sequence. This paper builds upon that concept by leveraging high-resolution event-based data for modelling alternative left-turn sequencing at signalized diamonds. The linear superposition techniques used to model arrival characteristics were validated by comparing predicted arrivals with actual arrivals (Figure 11). This modelling technique was demonstrated to be effective at identifying a new sequence and offset that resulted in quantifiable improvement in field operation. For the study diamond interchange at I-69 and 96th Street, the methodology in this paper increased the interior AOG by 19% for the 0900-1500 timing plan.