Ⅳ-54 M O V E R - A STUDY TOOL FOR SIGNAL CONTROL EVALUATION

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Abstract This paper describes the development of a computer model that simulates the outputs obtainable from the vehicle detector. Comparison of simulated outputs with observed data from detectors validates the model for use as a study tool for evaluating signal control strategies based on various detector locations as well as detector output measurement periods.

1 Introduction

Modelling of Outputs from the VEhicle DetectoR (or MOVER) is a computer model which simulates the workings of vehicle detectors. It was developed for use as a study tool for various traffic signal control strategies. The data from which the traffic model of MOVER was constructed was collected from traffic flow along an entire link. Details of this survey were described by the authors in a previous paper[1].

2 Features of MOVER

In order to simulate the outputs obtainable from the vehicle detector, accurate modelling of vehicle movement in the vicinity of detectors is necessary. As a consequence, a microscopic traffic model is adopted. Periodic scanning using a resolution of 0.1 second seems necessary to avoid mis-detection of high-speed vehicles. Other specifications of MOVER include the following.

1) To better simulate real traffic flow, the model generates randomness in arrival patterns, vehicle lengths and speeds, queue spacings, departure headways, and saturation flow rates. Such randomness is incorporated through the use of various probability distributions.

2) For a realistic queueing situation, actual lengths of vehicles and queue spacings are considered. Individual vehicles are assigned unique lengths and spacings and thus the queue length at a stop-line has a physical meaning.

3) Outputs from detectors located at any position along the detected link are retrievable for the purpose of traffic signal control. Measurement and control periods are flexible to allow testing of various control schemes.

4) Measures of effectiveness - for example, average delay - are computed to provide a means for comparison of performance between different signal control strategies.

3 Validation of Model

Using data collected from field surveys, MOVER was checked to validate its performance with respect to its ability to reproduce the desired traffic conditions as well as the simulation of vehicle detector outputs. These outputs; namely, pulse length, volume counts, and occupancy measures, are the parameters obtainable from the ultrasonic vehicle detector.

Fig. 1 plots observed and simulated data for volume distribution. Although the two curves do not fall exactly on top of each other, the simulated curve generally follows the trend of randomness as exhibited by the observed volume distribution.

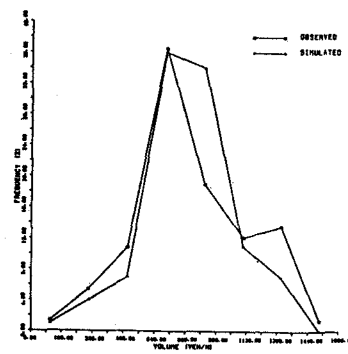

Fig. 1 Distribution of Volume

Koshi, Honda and Mori[2], in their research into the headway distribution of saturation flow, found that the normal distribution with a mean of 1.80 seconds and a standard deviation of 0.55 seconds is adequate to approximate observed headways for the case of through-lanes. Utilising this mean and standard deviation as input to the model, Fig. 2 was obtained. The histogram represents the frequency of simulated saturation flow headways. As illustrated, it compares rather well with the observed normal distribution.

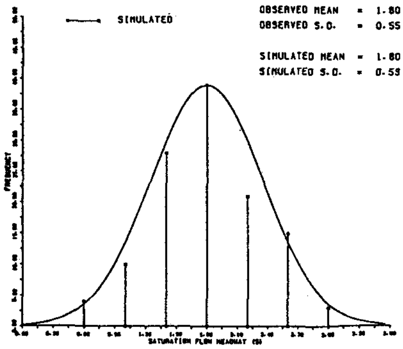

Fig. 2 Headway Distribution of Saturation Flow

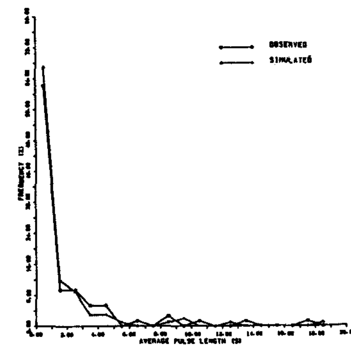

Fig. 5 Distribution of Average Pulse Length

Fig. 3 shows the plot of 1-minute volume versus 1-minute occupancy as obtained from observation in the field. The plot shows that the the boundary between free and congested flow is around 20 percent occupancy. Fig. 4 is the corresponding plot of 1-minute volume versus 1-minute occupancy as obtained from simulation. As illustrated, the simulated plot corresponds well to observed data.

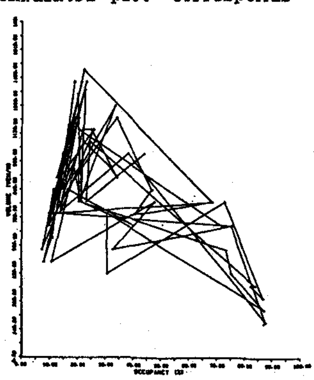

Fig. 3 Observed Volume versus Occupancy

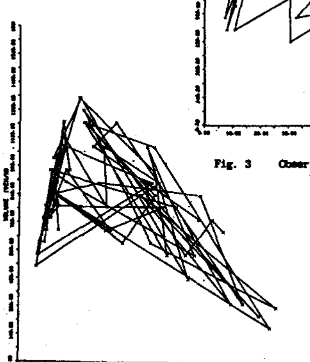

Fig. 4 Simulated Volume versus Occupancy

The distribution of average pulse length was also compared. Pulse lengths were averaged over 1-minute intervals, and both observed and simulated data are shown plotted in Fig. 5. It is noted that average pulse lengths of 2 seconds or less make up more than 70 percent of all pulse lengths observed or simulated. Comparison between observed and simulated distribution is fairly good.

The relationship between average pulse length and average queue length is one that is of particular application to traffic signal control. Fig. 6 shows simulated 1-cycle average pulse length plotted against 1-cycle average queue length. The figure portrays the above-mentioned relationship rather succinctly.

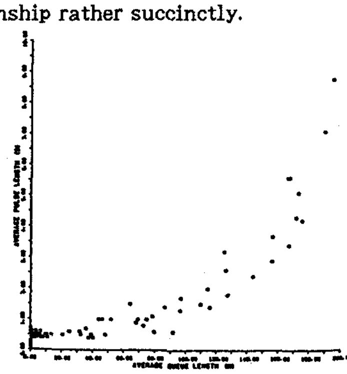

Fig. 6 Simulated Pulse Length versus Queue Length

4 *Concluding Comment*

MOVER, a computer model that simulates the workings of the vehicle detector has been described. Through validation checks using observed field data, it has been shown to perform according to specification. MOVER thus indicates promise as a study tool for the evaluation of signal control strategies based on various detector locations as well as detector output measurement and control periods.

References

1) HO, K. L., M. KOSHI and M. KUWAHARA, A Study on Vehicle Deceleration at a Signalised Intersection, Annual Conference, Japan Society of Civil Engineers, October 1988.

2) KOSHI, M., H. HONDA and H. MORI, Optimisation of Isolated Traffic Signals, Proceedings, IEE International Conference on Road Traffic Signalling, London, March 1982.