



University of
Salford
MANCHESTER

New management scenarios for weaving sections using micro-simulation models

Al-Jameel, HAE

Title	New management scenarios for weaving sections using micro-simulation models
Authors	Al-Jameel, HAE
Type	Conference or Workshop Item
URL	This version is available at: http://usir.salford.ac.uk/19065/
Published Date	2011

USIR is a digital collection of the research output of the University of Salford. Where copyright permits, full text material held in the repository is made freely available online and can be read, downloaded and copied for non-commercial private study or research purposes. Please check the manuscript for any further copyright restrictions.

For more information, including our policy and submission procedure, please contact the Repository Team at: usir@salford.ac.uk.

New Management Scenarios for Weaving Sections Using Micro-simulation Models

Hamid A. E. Al-jameel

Civil Engineering Research Centre.

Email: hamidathab@yahoo.com

Traffic simulation models have been proved to be more effective methods of dealing with weaving sections than traditional methods such as the Highway Capacity Manual (HCM) 1950 to HCM 2000, Leisch method - 1981 and Fazio - 1986. These have proved to be inadequate methods for weaving analysis (Cassidy and May, 1991, Ostrom et al., 1993, Vermijs and Schuurman, 1994, Lertworawanich and Elefteriadou, 2003, Zhang, 2005 and Lee, 2008). Recently, the HCM 2010 has been released with the same limitations as in previous versions even though there are some changes in some procedures. Then, it was found that not only were those mathematical methods inadequate for the analysis of weaving capacity but so were the Artificial Neural Network (ANN) models (Zhang, 2005). The advantages of microscopic simulation models are capability of evaluating various traffic management alternatives in order to determine the optimum solution for any traffic scenario and provision of visualisation for the case under study. However, there are several shortcomings that have been reported through the literature such as computational performance, the accuracy of models in representing the traffic flow, and the difficulty of integration with advanced traffic management and traffic information systems (Skabardonis and May, 1998 and Hidas, 2005). Moreover, shortcomings were found in certain models, such as AIMSUN, relating to the cancellation of vehicles that could not reach their destinations because of their failure to achieve appropriate manoeuvres after waiting for a time known as maximum waiting time (TSS, 2002).

To overcome these problems, a new model has been developed by this study for weaving sections. The developed model includes different sub-models. Firstly, a car-following model which governs the longitudinal movement between the subject vehicle and its leader (Al-jameel, 2009 and 2010). Secondly, a lane changing model which controls the horizontal movement of the vehicle when changing lane. Thirdly, a gap acceptance model that governs the selection of suitable gaps for changing lane was also developed. Then, there were very limited data in the literature for calibrating and validating the developed model. Consequently, more than 50 hours of video recordings and several days of data collection from Motorway Incident Detection and Automated Signalling (MIDAS) data were collected. It is believed that this data is the most comprehensive collected looking at weaving sections (Al-jameel, 2011). Then, the developed model was calibrated with the field data in terms of the car-following model, the lane changing model, the gap acceptance model and the weaving simulation model. The results of calibration and validation of the developed model with field data show encouraging results that come very close to the reality according to the graphical and statistical tests.

After developing, calibrating and validating the simulation model, the model is capable of representing reality. Therefore, it has been used to study different management scenarios such as using different speed limits and using what is called critical area, the lanes in which all weaving activities occur. The results of analysis show there is no significant effect of speed limits above 50mph on the performance of weaving sections. A 40 mph speed limit is not recommended because of its bad effect on the operational performance of weaving sections in terms of reducing speed and increasing delay along a weaving segment. On the other hand, it was found that the critical area principle applied by HCM 2010 negatively affected the performance of weaving sections especially under moderate to heavy flow because it prevents non-weaving vehicles from benefitting by increasing their speed in the other lanes of motorways.

References

- Al-Jameel, H. (2009). Examining and Improving the Limitations of Gazis –Herman-Rothery Car-following Model. In: Salford Postgraduate Annual Research Conference (SPARC), University of Salford, UK.
- Al-Jameel, H. (2010). Evaluation of Car-following Models Using Field Data. In: Salford Postgraduate Annual Research Conference (SPARC), Manchester, 10-11th June, 2010, University of Salford, UK.
- Al-Jameel, H. (2011). Empirical Features OF Weaving Sections. In: *Proceeding of 10th International Postgraduate Research Conference (IPGRC)*, Manchester, 14-15th September, 2011, University of Salford.
- Cassidy, M., and May, A. (1991). Proposed Analytical Technique for Estimating Capacity and Level of Service of Major Freeway Weaving Sections. *Transportation Research Record* (1320), pp. 99-109.

- HCM (2000). Highway Capacity Manual. Transportation Research Board, TRB Special Report 209.
- HCM (2010). Highway Capacity Manual. Transportation Research Board, TRB Special Report 616.
- Hidas, P. (2005). Modelling Vehicle Interactions in Microscopic Simulation of Merging and Weaving. *Transportation Research Part C*, (13), pp.37 - 62.
- Lee, J. (2008). *Observations on Traffic Behaviour in Freeway Weaving Bottlenecks: Empirical Study and Theoretical Modelling*. PhD Dissertation, University of California, Berkeley, California.
- Lertworawanich, P., and Elefteriadou, L. (2003). Methodology for Estimating Capacity at Ramp Weaves Based on Gap Acceptance and Linear Optimization. *Transportation Research Record B*, (37), pp. 459-483.
- Ostrom, B., Leiman, L., and May, A. (1993). Suggested Procedures for Analyzing Freeway Weaving Sections. *Transportation Research Record*, (1398), pp. 42-48.
- Skabardonis, A. and May, A. (1998). Simulation Models for Freeway Corridors: State-of-The Art and Research Needs. Transportation Research Board, 77th Annual Meeting, Washington D.C.
- TSS, Transport Simulation Systems. (2002). AIMSUN Version 4.1 User Manual.
- Vermijs, R., and Schuurman, H. (1994). Evaluating Capacity of Freeway Weaving Section and On-ramps Using the Microscopic Simulation Model FOSIM. *Proceeding of the 2nd International Symposium on Highway Capacity*, (2), pp.651-670.
- Zhang, H., Kim, T. (2005). A Car-Following Theory for Multiphase Vehicular Traffic Flow. *Transportation Research Part B: Methodological*, (39), pp. 385-399.
- Zhang, Y. (2005). Capacity Modelling of Freeway Sections. PhD dissertation, Virginia Polytechnic Institute and State University, USA.