



Use of Vissim in Heterogeneous Traffic Modelling-A Review

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ABSTRACT

Heterogeneous traffic mixes are creating problems in developing countries because different types of vehicles with different characteristics use the same roadways. In addition, the phenomenal growth of vehicular traffic has resulted in low speeds, excess travel time, delays, and other safety-related traffic problems in urban areas. Until recently, methods based on mathematical and statistical theories have been used. These methods are founded on simplified assumptions such as Poisson-distribution of traffic streams, fixed critical gaps and move-up times, and constant traffic volumes. These assumptions appear unrealistic for mixed traffic conditions. These difficulties can be alleviated with the help of simulation. Traffic simulation is an indispensable instrument for transport planners and traffic engineers. VISSIM is a microscopic, behavior based multi-purpose traffic simulation to analyze and optimize traffic flow. This paper mainly concentrates on the literature regarding adaptation of VISSIM for heterogeneous traffic modeling.

KEYWORDS

heterogeneous traffic; traffic flow modeling; VISSIM models

INTRODUCTION

A heterogeneous traffic mix consists of vehicles with varying operating speeds, sizes, driving characteristics and spacing. Vehicles within a heterogeneous traffic stream have widely different static (length, width and height) and dynamic (acceleration, deceleration, speed etc.) characteristics. By virtue of their wide-ranging characteristics, the vehicles do not follow proper lane-discipline and occupy any lateral position over the width of roadway while moving, depending upon the availability of road space. A heterogeneous traffic mix can have motorized two-wheelers, motorized three-wheelers i.e. auto-rickshaws and tempos, passenger cars, light commercial vehicles, buses, trucks, bicycles, tricycles, animal-drawn carts, and human-powered push and pull carts. Additionally, if sidewalk facilities are inadequate or lacking, this diverse mixture contains significant on-road pedestrian traffic. Cities in developing countries are characterized by heterogeneous traffic (mix of non-motorized and motorized modes) and mixed land-use patterns.

Since 1950s, considerable research has been made to develop traffic flow models for roadways with mainly heterogeneous traffic, representing the composition of traffic primary in developed countries. Very limited studies have been done to develop an understanding of traffic flow for non-lane based mixed traffic conditions in developing countries.

This paper contributes to the traffic modeling field, through practice of VISSIM techniques for heterogeneous traffic flow. It seeks to address questions relating to the effect of mixed vehicles on the operation of urban configurations and, thus, to the development of appropriate traffic simulation models for various road conditions.

SIMULATION MODEL-VISSIM

Today, many micro-simulation softwares have been made available in the market and used as tools for the evaluation of traffic management and control. One such software tool is VISSIM. VISSIM is an acronym of "Verkehr In Städten – SIMulation". The model was developed at the University of Karlsruhe, Germany during the early 1970s. Commercial distribution of VISSIM began in 1993 by PTV Trans world AG. PTV VISION is the worldwide leading software site for transportation planning and operations analyses over 70 countries. VISSIM is regarded today as a leader in the arena of micro-simulation software.

VISSIM offers a variety of urban and highway applications, integrating public and private transportation. Complex traffic conditions are visualized in high level of detail supported by realistic traffic models.

VISSIM is **multi-modal microscopic** traffic simulation software. "Multi-modal simulation" describes the ability to simulate more than one type of traffic. In VISSIM the following types of traffic can be simulated

- Vehicles (cars and trucks)
- Public transport (trams, buses)
- Cycles (bicycles, motorcycles)
- Pedestrians
- Rickshaws

VISSIM models the movements of individual vehicles dynamically and stochastically in the network on a second-by-second basis using car following models. These tools require detailed geometric, control and demand data and a large number of calibrated parameters to accurately model driver behavior in the network. Because of the fine level of detail required in a microscopic model, applications tend towards traffic operations over a relatively small geographical area. VISSIM has a graphical user interface, which allows the user to add traffic, and signal data to existing base maps of intersections and road layouts. This unique feature of VISSIM not only reduces the workload required for data input, but it also improves the quality of animation of traffic and transit operations.

REVIEW OF VISSIM BASED MODELS FOR HETEROGENEOUS TRAFFIC

Vipul N. Prajapati and P.J. Gundaliya (2010) conducted a study entitled "Simulation of Heterogeneous Traffic Intersection using VISSIM". The study mainly concerned with the conceptual simulation model of highly heterogeneous traffic flow, delay and saturation at signalized intersections, various cycle time's effect at intersection and to study the impact of provision of priority for BRTS at various frequencies. Study area of this research was Ahmedabad (India). The main objective of this study is to analyze the simulation model developed using VISSIM software and its application in transit signal priority for the existing Bus Rapid Transit System (BRTS) in Ahmedabad. The study included collecting all data required to design optimum cycle lengths

for a given phasing by using different available methods. Field data collected for this analysis were classified volume, saturation flow, delay and spot speed. Both calibration and validation results show that simulation tool VISSIM reproduced traffic flow very realistically under real world applications. Therefore, it was promising to adapt the VISSIM model to local traffic simulation; at least national traffic regulations and driving styles of a country must be taken into account.

Tom V. Mathew and Padmakumar Radhakrishnan (2010) proposed a methodology for representing non lane-based driving behavior and calibrating a micro-simulation model for highly heterogeneous traffic at signalized intersections. Three intersections were selected for this study, from two Indian cities: Trivandrum (two) and Jaipur (one). The choice of the intersections was based on the similarity in geometry and traffic characteristics. Classified inflow rate (including turning movements) and desired speed ranges were obtained using video data. The data required for this study were geometry of the selected intersections, signal timing and phasing, vehicle types, traffic composition, traffic inflow, proportion of turning traffic and stopped delay at intersections. Field delay was measured using the highway capacity manual technique recommended by the highway capacity manual. The simulated delay was then compared with the field delay. In this study, the methodology is applied in the context of signalized intersections and the micro-simulation software VISSIM is used in this study.

Shrinivas Arkatkar et. al. (2012) simulated heterogeneous traffic on an Indian urban expressway using VISSIM. An eight-lane divided Delhi-Gurgaon expressway was selected as the study area. The traffic on the selected expressway was video graphed for hours in the evening peak period. Free flow speeds were ascertained by observing 200 to 300 vehicles for each category of vehicles; during off-peak hours. Performance parameters such as flow and speed were extracted from the videos for achieving a high accuracy data for every 20 seconds time interval. This data was then used for the purpose of model validation. The validated simulation model was then used to develop fundamental traffic flow relationships: speed-flow, speed-area occupancy, and flow-area occupancy for the traffic flow levels, starting from near zero until capacity of the facility. From the speed-volume curve developed using the simulation model, it is found that, for the observed traffic composition, capacity of a eight-lane divided urban expressway in level terrain with 14.0 m wide road space hovers in the range of 9700 to 10500 vehicles/hour for one direction of traffic flow. Based on the simulation experiments, it can be noted that the capacity-level value (flow) decreases non-linearly with increase in percentage of trucks from 10% to 100% in the traffic composition of a stream, comprising of only two vehicle categories: cars and trucks.

Hemant Kumar Sharma, Mansha Swami, Bajrang Lal Swami (2012) carried out the speed-flow analysis for interrupted oversaturated traffic flow under heterogeneous traffic conditions. A 4-lane divided urban road network of Jaipur city was selected as the study area. This network consists of two signalized intersections and one unsignalized intersection in between. A simulation model was developed for heterogeneous traffic under constraints of roadway geometry, vehicle characteristics, driving behavior and traffic controls with the use of VISSIM. The model developed in this study predicts speed, delay, average queue, maximum queue estimates with varying volume for urban roads. The oversaturated portion of flow was investigated in detail and a congestion curve was also derived to quantify congestion. The model also predicts capacity which interestingly corresponds to all the meas-

ures of effectiveness (MOEs) investigated. The investigation and analysis presented in this paper gives more realistic values of speed, delay, queue, congestion and capacity as the investigation is based on total performance of network.

Dipti Thanki and A.K. Patel (2012) studied the methodology on Urban Road network using VISSIM. For the proposed study, a network with closely spaced signalized intersections of Ahmedabad city was selected. In the selected network, 3 intersections were four armed and signalized, whereas fourth intersection was six arms roundabout without traffic signal. For the VISSIM input, data regarding CVC, spot speed survey, average travel time, queue length and saturation flow were measured on the network. Model was calibrated for input of morning peak hour data, by adjusting values of some calibration parameters in order to match the simulated scenario with the real one found on the field. The actual delays and simulated delays were compared and it was concluded that the difference between these two was not too much, but the values were very similar.

VISSIM MODEL APPLICATIONS IN INDIA

In India, VISSIM has been used in many major projects which can be listed as following:

1. *Bandra Worli Sea link Traffic Dispersal Schemes*: VISSIM model was developed to analyze the impact of traffic growth on BWSL and to devise revised dispersal and traffic management schemes.
2. *Hospitality District, Delhi International Airport*: VISSIM model was developed to assess operational behavior of road network in and around hospitality district as a part of traffic study. VISSIM was also used for the simulation of internal circulation, pick up/drop off areas and access/egress.
3. *Shamaldas Gandhi Flyover, Mumbai*: VISSIM model was used to assess the impacts of proposed flyover in the local road network.
4. *India Tower, Mumbai*: VISSIM model was used to simulate internal circulation, pick up/drop off areas and access/egress.
5. *Kolkata Convention Centre, Kolkata*: VISSIM model was used to assess the impacts of proposed road network to the convention centre and to simulate internal circulation.
6. *Delhi Convention Centre, New Delhi*: VISSIM model was used to assess the impacts of proposed road network to the convention centre and also to simulate internal circulation.

CONCLUSIONS

Based on the literature reviewed in this paper it is concluded that traffic simulation tool VISSIM has a wide range of approaches and areas.

- VISSIM is a useful tool for both microscopic and macroscopic simulation models.
- VISSIM is able to simulate road corridors of heavily populated motorways to identify system performance, bottlenecks, and potentials of improvement.
- Corridor studies on arterials with signalized and non-signalized intersections can also be done using VISSIM.
- Signal priority schemes can be analyzed for public transport within multi-modal studies.
- Traffic circulation, public transport operations, pedestrian crossings, and bicycle facilities can be modeled for various layouts of the street network and different options of vehicle detection.

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