Application of Vissim Software for Traffic Simulation: Literature Review

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Abstract— Traffic simulation is the mathematical modeling of transportation systems (e.g., freeway junctions, arterial routes, roundabouts, etc.) through the application of computer software to better help plan, design and operate transportation systems. Simulation in transportation is important because it can study models too complicated for analytical or numerical treatment, can be used for experimental studies, can study detailed relations that might be lost in analytical or numerical treatment and can produce attractive visual demonstrations of present and future scenarios. The objective of this research paper is to obtain basic calibration for the simulation of traffic condition and to justify VISSIM as reliable source in modelling traffic behaviour and serve to improve decision making in balancing the need of traffic.

Key words: Application of Vissim Software, Traffic Simulation

I. INTRODUCTION

In developed countries, due to Urbanization and Industrialization there has been an increase in traffic, mainly because of Heterogeneous mixes. Transportation plays the most important role in economic development of any modern city. The phenomenal growth of vehicular traffic in terms of numbers of vehicles as well as increase in the magnitude and frequency of loading of commercial vehicles has resulted congestion.

Traffic Micro-Simulation Model is one of the best solutions to solve the traffic congestion problem. Traffic Micro-Simulation models have become very popular in transport studies and are extensively used in research by industry.

Unless the dynamics of vehicular traffic and the behaviour of drivers are known it is impossible to solve this problem. To study effectively the dynamics of vehicular traffic, mathematical modelling and computer simulation techniques can be used. Thus, VISSIM is widely used to solve all this problems

II. LITERATURE REVIEW

JoeGBared[1] studied two problems. Firstly, urban single lane and dual lane roundabouts are modeled in VISSIM traffic simulation software. Simulation results are compared with the results of empirical model (RODEd analytical model (SIDRA). Secondly, the impact of coordinated signalized arterial when a signal is replaced by a roundabout. A CAD layout of the roundabout is imported into the VISSIM software and set as background on which the VISSIM links are drawn. The priority rules for entering, and exiting traffic movements were set. A section of an arterial consisting of three signalized intersections is simulated in VISSIM and average delays per vehicle were recorded from the simulation. The second intersection is now replaced with a dual lane roundabout. The network is simulated for the same traffic flow. Simulated capacities of both Single-lane and Dual lane roundabouts are noticeably lower than RODEL and a SIDRA; however, they are comparable to U.S field capacity data. A roundabout placed within a signalized, coordinated arterial showed comparable delays to a fully signalized arterial.

LiuYu [2] gives an approach for calibrating the microscopic traffic simulation model VISSIM using GPS data for application to Beijing BRT systems. The Sum of Squared Error of the collected and simulated vehicle speeds at the cross-sections along the test route is specified as the evaluation index. It means that sum of the squared difference between each observations and its group mean. A Genetic Algorithm is adopted as the optimization tool to minimize the SSE. AUTO-SIM is designed to run VISSIM simulation automatically. The test site in this paper is the Phase I of the Beijing North-South Central Axis BRT Corridor, which is 5 km long, with 2.5 km exclusive bus lanes and 2.5 km mixed use roadway, including eight intersections. For the purpose of calibration, traffic and GPS data need to be collected. Traffic data include the traffic volumes entering into the network, the turning ratio at each intersection, the signal timing of the signalized intersections, the schedule of the BRT operation, and the BRT time at each bus stop.

The objective of the calibration is to search for the best combination of the parameters that minimize the SSE and a Genetic Algorithm is adopted as an optimization tool to implement the search process. For the efficiency improvement of calibration, a computer program is developed to integrate the MATLAB, Visual Basic, and VISSIM. The validity of the proposed approach was demonstrated via a case study for the Beijing North-South Central Axis BRT Corridor. Both the field instantaneous speeds of BRT vehicle and cars along the test route were collected by using GPS for calibration. The case study shows that the proposed approach is a practical and effective method for calibrating the VISSIM model.

Pruthvi Manjunatha [3] recognized simulation as one of the best tools for modeling of traffic flow under homogeneous as well as heterogeneous conditions. Fellendor and Vortisch (2001) presented the possibilities of validating the microscopic traffic flow simulation model VISSIM, both on a microscopic and a macroscopic level in homogeneous flows. Matsuhashiet. Al. (2005) assessed the traffic situation in Hochiminh city in Vietnam, using image processing technique and traffic simulation model (VISSIM). It was found that the high number of motorcycles in the network interfere with other vehicles which reduces average speed of traffic stream drastically. Further, the simulation model was applied for deriving the benefits of increasing the share of public transport. Nevertheless it is also clear that there is no study on Expressways of India in spite of the fact that Expressways are vastly different from other facilities in terms of design and operation.

The micro-simulation model VISSIM is suitable to simulating and hence studying heterogeneous traffic flow in expressways to a satisfactory extent. It is found that, the estimated PCU values of the different categories of vehicles of the heterogeneous traffic are accurate at 5% level of significance. For all categories of vehicles, the PCU of a given vehicle category decreases with increase in volume capacity ratio. This is due to the decreasing speed difference as volume increases from free flow to that at capacity. The PCU value of all categories of vehicles decreases when their proportion increases in the traffic stream. It is found that due to the complex nature of interaction between vehicles under the heterogeneous traffic condition, the PCU estimates made through simulation for different types of vehicles of heterogeneous traffic, significantly changes with change in traffic volume level.

Xiaochun Lu [4] found out problem of traffic congestion and its management has become increasingly prominent. It is a hot research about how to make full use of computer simulation technology to make transportation more rational and more organized. In this paper, they focused on traffic of Beijing West Railway Station north area, and try to find a way to reduce traffic congestion in this area. In this paper, they studied the traffic flow by survey. They also built a traffic simulation model with VISSIM software. Different types of vehicles and their speed are set in model according survey data. The simulation model provides different traffic scenarios of Beijing West Railway Station north area.

He found the traffic of this area up is to 1800 vehicles/hour. Heavy traffic burden causes traffic congestion in two positions: the bus hub and car drop-off point. If they can extend bus interval departure time and park cars to south square of Beijing West Railway Station, the traffic condition will be improved. This paper gives a solution to reduce traffic congestion in Beijing West Railway Station north area. The bus hub and car parking lots are the key point of traffic problem in this area.

Dipika Gupta [5] identified the means to reduce pedestrian delay. Micro-simulation modeling has shown the result for reducing pedestrian delay. However, most of them have been conducted in developed countries. Several procedures have been developed in literature to reduce pedestrian delay and simulate using micro simulation software VISSIM. Researcher have differed in their opinions of how to reduce the delay caused to pedestrians. They concluded that Micro-simulation modeling has shown that reducing pedestrian delay at signalized intersections is possible and beneficial during the middle of the day when pedestrian volumes are highest. Researcher looked at per-person 'delay, which includes the delay of both pedestrians and vehicle occupants. Observation studies showed that pedestrian delays were substantially longer than 30 seconds. This provides an average delay experienced by people arriving at an intersection, irrespective of their mode of arrival. Jodie Y.S. Lee and William H.K. Lam applied Pedestrian simulation (PS) for signalized crosswalks which estimates the variations of walking speed particularly on the effects of bi-directional pedestrian flows so as to determine the minimum required duration of pedestrian crossing time.

Mannilthodi Jabeena[6] has given Proper understanding and analysis of traffic stream characteristics which is necessary for design, analysis, operation and management of roadway facilities. An attempt has been made in this paper to analyze the traffic stream characteristics and to model traffic flow by taking Ahmedabad and Vadodara connecting four-lane divided, Mahatma Gandhi expressway. The selected road stretches are basic expressway segments in plain terrain. Vehicles are classified as Small Car, Big Car, Light Commercial Vehicle (LCV), Bus and Truck. Traffic data is collected using video graphic method. Data on traffic volume, vehicle composition, speed of different vehicle categories, lane utilization etc. Hasbeen manually extracted from video files. The results show that more than 97% of vehicles are following lanes under free-flow conditions. The results show different speed-density relationships along with parabolic relationships between speed-flow, flow-density. The capacity of expressway is found to be approximately 4377 PCE/hour/direction for a traffic stream having about 25% of heavy vehicles. The results of the present study are expected to highlight the existing scenario of traffic flow on Mahatma Gandhi expressway.

Namit Gupta [7] has stated that growth of motorization on highways in India has so far been of 2-wheeler and 3-wheeler variety, imposing negative impacts on both bus and car transport. It has also resulted in highly heterogeneous traffic conditions with varying static and dynamic characteristics of different types of vehicles. Since system is too complex and analyses needs microscopic simulation model. Stochastic models have better quality than deterministic and microscopic nature of traffic simulation delivers psycho-physical behavior of vehicular interaction. Present work signifies the applicability of VANET Traffic simulator VISSM. Therefore, present study makes the use of traffic simulation to understand the nature of mixed traffic by discrete, stochastic and time-step based analysis.

For this study, a midblock section of four-lane Delhi-Hapur highway was selected which has 7 m road width in each direction with more than 1.8 m wide gravel shoulder on either side. The data were collected by video graphic method. Speed was measured by using a trap length of 30 m made on the road using white self-adhesive tape. The day of video data collection was sunny and the traffic was operated under the normal condition. Five type of vehicle have been observed on highway and information regarding vehicle types.

The following conclusions can be drawn from the above study. Speed data obtained through simulated outputs were compared with field observed speed. The comparison of speed profiles provides the information that the VISSIM is overestimating speed of all vehicles excluding the cars type vehicle and is failed to reflect the traffic conditions as observed in the field.

Vipul N. Prajapati [8] studied the conceptual simulation model of highly heterogeneous flow, delay and saturation at signalized intersections the main objective of this is to analyze the stimulation model developed using VISSIM software and its application in transit signals.

For a 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 4th intersections were 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 valves of some calibration parameter in order to match the simulated scenario with the real one found on the field. The actual delay and the simulated delay were compared and it was conducted that the difference was not too much, but the values were very similar.

VISSIM is a very useful tool for both microscopic and macroscopic simulation models. It is able to simulate road corridors of heavy populated motorways to identify system performance. Traffic-circulation, public transport operations, pedestrian crossing, and bicycle facilities can be modeled for various layouts of the streets network and different options of vehicle detention.

Byungkyu (Brian) Park [9] proposed procedure that appears to be effective in the calibration and validation by VISSIM for signalized intersection. There are two important issue first one claiming the calibrated Model to the field data and second variability in traffic volume. After research should be Conduct to determine whether the process is applicable to network or simply to this Specific one. Data collection was required to provide simulation program input parameters and output measures of performance for calibration and validation of the microscopic simulation model. While some data were provided from Virginia Department of Transportation (VDOT) plans, other data were collected directly from the field on two weekdays. Field counts included both manual and video counts along the test network. Counts were collected on a normal weekday afternoon.

The study used only a single day of data collection and two measures of performance. Collecting multiple days of field data is recommended, if possible, to consider variability of field data.

III. METHODOLOGY

VISSIMis a microscopic and behavior-based simulation tool for modeling urban and rural traffic as well as pedestrian flows. The traffic flow is simulated under various factors of lane distribution, vehicle composition, and signal control. A micro simulation model for mixed traffic requires special procedures to address the unique characteristics of such traffic. Accordingly a methodology is proposed which includes representation of vehicles, geometry and traffic, followed by identification of calibration parameters by multi parameter sensitivity analysis, setting their ranges heuristically and determining the parameter values by an optimization model. The proposed methodology is presented in the form a flow chart in Figure 1. The following use cases represent a few possible areas of application.

A. Comparison of junction geometry

- Model various junction geometries.
- Simulate the traffic for multiple node variations.

B. Traffic control systems.

- Model and analyze the impact of urban development plans.
- Benefit from the simulation of pedestrians inside and outside buildings

C. Signal systems operations and re-timing studies.

- Simulate travel demand situations for signalized intersections.
- Analyze traffic control with efficient data input for complex situations.

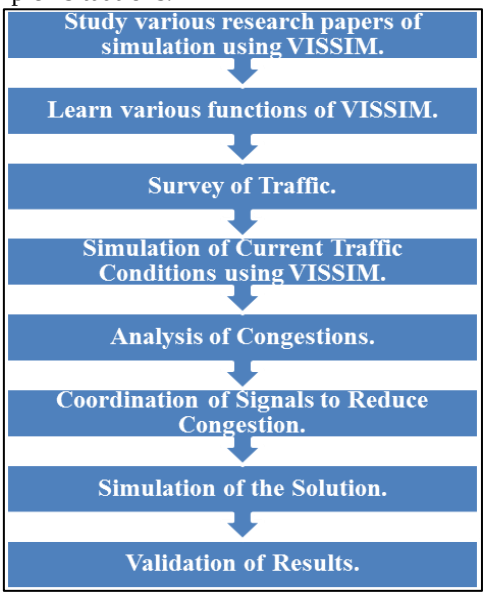

Fig. 1: Flow chart for signal optimization using VISSIM Software

First step to optimize signal is data collection. Various surveys like Volume count, Delay, Travel Time etc. need to be carried out at selected stretch and analysis of this data along with onsite features should be entered in VISSIM software.

Next step is to Simulate the Current Traffic Condition by using VISSIM software and make appropriate changes in signal timings, if required.

IV. CONCLUSION

VISSIM is useful tool for both Micro-scopic & Macro-Scopic Simulation Module. VISSIM Module are accurate and are practically verified also can be used to simulate the traffic including BRT, Pedestrian and Vehicles.

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