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Microscopic Simulation of Traffic using VISSIM

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Abstract—*Transportation today plays an important role in the economic and physical development of any modern city. Today, many micro-simulation software have been made available on the market and used as tools for the evaluation of traffic management and control. India has a growing population and hence growing traffic along .The density of Indian traffic has reached 1.31km of roads per sq. km of land and has mixed traffic conditions with Static and Dynamic Characteristics with both Motorized and Non-motorized Vehicles "Microscopic simulation", also called as micro-simulation, refers to each entity like car, train, person of reality is simulated individually along with their property, whereas "macroscopic simulation" is the description of reality is shifted from individuals to "averaged" variables like flow and density.*

VISSIM is a microscopic, time step and behaviour based simulation model developed to model heavy and urban traffic and public transit operations. It is regarded as a leader in the area of micro-simulation software. PTV Vissim is a microscopic multi-modal traffic flow simulation software package developed by PTV Planung Transport Verkehr AGin Karlsruhe, Germany. VISSIM was first developed in 1992 and the name indicates "Verkher in Staden" – SIMulations model" (German for "Traffic in cities - simulation model") and PTV VISSIM is part of the PTV Vision Traffic Suite which also includes PTV Visum (traffic analysis and forecasting) and PTV Vistro (signal optimisation and traffic impact).

Microscopic simulation can be defined as the best tool. For example a junction can be simulated for different signal timings and different proposals and its effect can found before implementing it. The Intersections of Jamshedpur namely Timken was simulated to determine the Queue length, the different proposals were given for the existing junctions and Queue Lengths were determined and compared with the existing model. The proposals Saturation flow is also calculated and the results were compared with Traffic Forecast to determine the number of years the different proposals holds good

Keywords*: Signal Design, Queue Length, Vissim.*

1. LITERATURE REVIEW

Siddharth S M Pa et.al (2013) ANOVA was used to find the sensitive parameters from a set of eight parameters that were to be calibrated The time taken to run a trial of ANOVA was 6 hours and 20 minutes while time to run for a trial of EE method was 6hrs and 30 minutes. Both these analysis were done in the same computer system having configuration of 32GB ram. The parameters from sensitivity analysis were suitable for Indian heterogeneous conditions their values calibrated. Automated calibration in the same computer system took about 35 hours. Automated calibration process reduces manual effort required to calibrate.

Arpan Mehar et. al (2012) in their studies found that Traffic flow data calibrated at a section of four-lane divided highway under mixed traffic conditions are analysed using microscopic traffic simulation model VISSIM. It was found that the VISSIM in its current form is not able to simulate mixed traffic flow of the type prevalent on Indian highways

Dong LIN et. Al (2013) explored that the operational conditions of four scenarios of Beijing CBD area in 2020 using traffic simulation software VISSIM. After comprehensive analyses of travel time, delay, queue length and travel speed, one way organization scenarios inside core area have generally better performance compared to way organizations

Manraj Singh Bains et al. (2012) analysed that the micro-simulation model VISSIM is suitable to simulate 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. This is due to the platooning effect of trucks. The capacity of the six-lane expressway facility is found to be approximately 7595 PCU/hour/direction as simulated under heterogeneous traffic conditions in VISSIM. 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.

Thomas Gabel et. Al (2012) analysed that the optimization of traffic flow on roads and highways of modern industrialized

countries is key to their economic growth and success. Besides, the reduction of traffic congestions and jams is also desirable from an ecological point of view as it yields a contribution to climate protection. This article, describes to a microscopic traffic simulation model and interpret the task of traffic flow optimization as a multi-agent learning problem. In so doing, adaptive agents to each of the vehicles and make them learn, using a distributed variant of model-free reinforcement learning, a cooperative driving behaviour that is jointly optimal and aimed at the prevention of traffic jams. Approach is evaluated in a series of simulation experiments that emphasize that the substitution of selfish human behaviour in traffic by the learned driving policies of the agents can result in substantial improvements in the quality of traffic flow. A novel multi-agent learning approach to microscopic traffic flow control is proposed. Both formal grounding of the approach taken as well as an empirical evaluation of its properties is provided. The latter has shown that a significant improvement of traffic quality – in terms of jam prevention, flow optimization, and fuel consumption minimization – can be achieved, if the selfish behaviour of human drivers is replaced by the vehicle controlling policies learned by the agents.. Another interesting challenge is the transfer of ideas to a simulation with multiple lanes and passing manoeuvres which are also supported by the Krauss model, as this would also increase the relevance of this approach to a practical application.

2. INTRODUCTION

Population Growth is rapid in India. Accordingly, the density of Indian traffic reaches 1.31kms of roads per sq.km of land. Indian traffic conditions is said to have Static and Dynamic behaviours with mixed traffic conditions such as motorized and Non Motorised Vehicles. The lane marking and lane discipline is not practiced in India. Hence, analytical modelling is necessary.

Micro-Simulation is required to check the best model for implementation before implementing it and to check their efficiency. It can be used to study and model heterogeneous traffic condition. Micro-Simulation traffic models are the models that try to describe the actions and reactions of the particles that makeup the traffic as accurately as possible. Micro refers to the resolution at individual vehicle level inevitable requirement of detailed analysis. Microscopic simulation represents the interaction of each individual vehicles such as cars, buses, two wheelers etc.; and their characteristics whereas the macroscopic simulation represents the individual to average variables like flow and density. It helps in analyzing and evaluating proposed alternatives. Therefore, Micro-Simulation of Traffic avoids congestion for the future years.

Micro-Simulation models can be used to analyze traffic operations in Urban areas and City centers, roundabouts, area networks, Signalized intersections, including interchanges and signal coordinated corridors. It can simulate even minute entities with their parameters such as lane allocation, vehicle compositions, signal control and detection of private, public transport vehicles, lane changing, Gap Acceptance and Spatial Collision. Each individual vehicle is treated as entity and each entity is allowed to interact with each other. It is generally used to model and analyze Congestion.

Different softwares used in Micro-Simulation of traffic are PTV VISSIM , TRANS modeler, TSIS_CORSIM, Cube Dynamism, LISA+, Quadstone PARAMICS, SiAS PARAMICS, Simtraffic and AIMSUN. Traffic Simulation models simulate individual driving behaviour of Vehicles and driver in the limits of road network and to predict the variation in traffic flow pattern or due to physical environment.

VISSIM is a microscopic, time step and behaviour based simulation model developed to model urban traffic and public transit operations. Today it is treated as a leader in the arena of micro-simulation software. PTV Vissim is a microscopic multi-modal traffic flow simulation software package developed by PTV Planung Transport Verkehr AGin Karlsruhe, Germany. In some countries VISSIM is used for Metropolitan, Regional and State wide infrastructure planning, multimodal network modelling. Gradually with days Vissim was developed to model 3D Animation so that even common people like Politicians, public can understand the models and plans. Micro-simulation models allows for two types of inferences: Animated displays and numerical output in text files. Animation helps analyst to fastly fit the implementation. It is a useful tool to analyze and evaluate various alternatives for public and private Transportation Planning. In VISSIM the road networks can be either Lane Oriented or Space oriented i.e. vehicles can move anywhere in the road without lane restrictions allowing for overtaking of vehicles and can be modeled for different types of vehicles. VISSIM does not require difficult coding and is user friendly hence is advantageous over other softwares..

3. METHODOLOGY

Certain sequential operations are involved in any problem wherein Simulation techniques are adopted. These are:

1. Data Collection involves Traffic Flow Data such as Static Characteristics, Turning Movements for each Junction, Turning movements for each Lanes, Input Flow in Vehicles per hour, Number of Lanes etc.; and Dynamic assignment characteristics such as OD Matrix, Location of Zones and parking lots, Traffic Composition, Travel Time, Saturation Flows etc.

   Data Collection done by

- Classified Volume Count Survey;

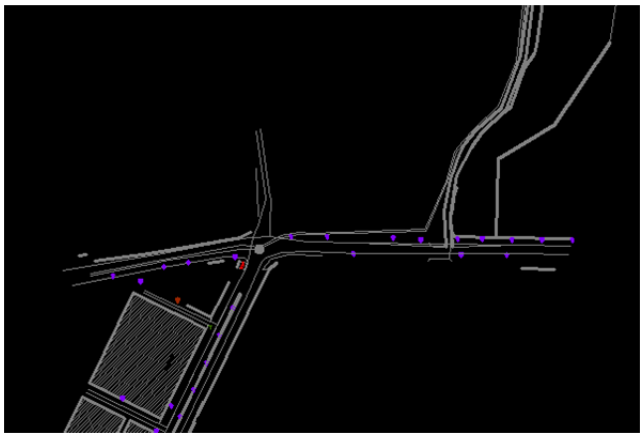
  Questionnaire Survey involves

  - Home Interview Surveys.

- Commercial Vehicles Surveys.
- Taxi Surveys.
- Post Card Questionnaire Surveys.
- Tag Surveys.
- Registration number Plate method.

2. Selecting the road Network- Selecting the overlay to the correct scale allows to cumbersome data input such as link lengths for different links of the study area network network to be omitted. Links, connectors and their properties can be adjusted and changed according to study network and the users needs.

3. Build Model-Model Bulid Up is done by using CAD files as Background Image.



Timken Junction

The Model is built along the background images with the help of Links and Connectors. Vehicle Types and Vehicle classes are Input in VISSIM. Vehicle Compositions are defined and Relative flows are Input for Simulation.

4. Calibration of Model –Adjustments and Verification of various parameters are made in the model to suit the real field data. ex:-Min gap time, Min headway, maximum speed of the Vehicles etc., Caliberation is the process in which the input parameters are refined so that the model replicates observed traffic conditions. Automatic Caliberation of Vissim is done to reduce the time and effort required for Caliberation.

5. Validation of Model- The Simulated model is compared with real field data and results are computed to determine Queue Lengths and Delays and to create a base model for the future Traffic Condition. Validation is done to confirm the predictive power of the Caliberated Model.it is done by giving a different set of data input during Caliberation.

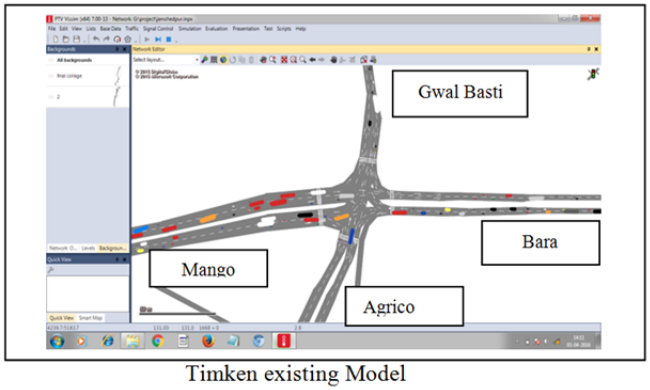
4. ANALYSIS

The Timken Junction is selected from Jamshedpur where the Volume Count during Peak Hour is as follows.

Timken Junction Peak Hour Volume Count

From	Mango			Gwal Basti			Bara			Agrico			
To	Gwal Basti	Bara	Agrico	Bara	Agrico	Mango	Agrico	Mango	Gwal Basti	Mango	Gwal Basti	Bara	Total
Volume	3	111	393	4	1	0	31	134	14	350	16	28	**1085**
PCU	4	341	1473	3	1	0	91	421	10	1270	12	38	**3662**

The peak hour factor is 11.84%



Timken existing Model

The model was developed in Vissim for the existing model. Different proposals were proposed for the existing model and Queue Lengths were determined for each model and compared with the existing model.

The different proposals given are as follows;

- Signal for the existing model
- Overpass from Mango to Bara
- Overpass from Mango to Bara with Signal @grade
- Overpass from Gwal Basti to Agrico
- Overpass from Gwal Basti to Agrico with Signal @grade
- Underpass from Mango to Bara
- Underpass from Mango to Bara with Signal @grade

The Signal Cycle Length for the existing Model is obtained as 90sec. The Signal Cycle Length for the Overpass from Mango to Bara with Signal @grade is obtained as 70sec. The Signal Cycle Length for Overpass from Gwal Basti to Agrico with Signal @grade is obtained as 70sec. The Signal Design for

Underpass from Mango to Bara with Signal @grade is obtained as 70sec.

Name	Timken existing	Overpass from Mango to Bara with Signal @grade	Overpass from Gwal Basti to Agrico with Signal @grade	Underpass from Mango to Bara with Signal @grade
Signal Timing	90sec	70sec	70sec	70sec

The Saturation flow results were compared with the Traffic Forecast to determine the number of years the proposals holds good further. It was found that the proposals Overpass from Mango to Bara, Overpass from Mango to Bara with Signal @grade, Overpass from Gwal Basti to Agrico, Overpass from Gwal Basti to Agrico with Signal @grade, Underpass from Mango to Bara, Underpass from Mango to Bara with Signal @grade .The Proposed model Queue results obtained from the Vissim is compared with the existing model Queue Results. The Saturation Flow Results are compared with the Traffic Forecast Results to determine the number of years the proposals holds good further.

Timken Qmax Results Obtained from Vissim							
Existing Model	**Existing Model with Signal @grade**	**N-S Overpass**	**N-S Overpass with Signal @grade**	**E-W Overpass**	**E-W Overpass with Signal @grade**	**E-w Underpass**	**E-W Underpass with Signal @grade**
216.7	76.31	33.98	14.45	89.4	10.03	107.09	6.88
99.38	92.41	28.74	44.65	98.11	91.86	99.36	99.25
309.17	75.22	364.68	15.08	8.54	100.43	16.84	138.21
88.6	4.27	10.92	77.86	78.09	29.51	134.21	190.65

Saturation Flow Results

	Volume Adjustment	EB			WB			NB			SB		
		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Overpass from Gwal Basti to Agrico	Adjusted Saturation flow per day(Veh/day), S=s*24		101669.1			84798.63			104215.07			98751.245	
Overpass from Mango to Bara	Adjusted Saturation flow per day(Veh/day), S=s*24		2440058.4			2035167.1			2501161.8			2370029.9	
Underpass from Mango to Bara	Adjusted Saturation flow per day(Veh/day), S=s*24		58561403			48844011			60027882			56880717	

Timken Traffic Forecast Result		
		Growth Factor
2015	3662	
2016	4096	1.118
2017	4580	1.118
2018	5123	1.118
2019	5729	1.118
2020	6408	1.118
2021	7166	1.118
2022	8015	1.118
2023	8964	1.118
2024	10025	1.118
2025	11212	1.118
2026	12540	1.118
2027	14024	1.118
2028	15685	1.118
2029	17542	1.118
2030	19619	1.118
2031	21942	1.118
2032	24540	1.118
2033	27445	1.118
2034	30695	1.118
2035	34329	1.118
2036	38394	1.118
2037	42939	1.118
2038	48023	1.118
2039	53709	1.118
2040	60069	1.118
2041	67181	1.118
2042	75135	1.118
2043	84031	1.118
2044	93980	1.118
2045	105107	1.118
2046	117552	1.118

The comparison of Saturation flow results and Traffic Forecast Result gives the result that all the proposals holds good for the further 29 years. By comparing all the three results i. e; Signal Cycle Length, Saturation Flow Result Qmax Results and taking the Volume Count in to account the best proposal is selected.

5. CONCLUSION

By comparing all the three Results and taking the Volume Count into account, the best proposal for the Timken Junction is Overpass from Gwal Basti to Agrico with Signal @grade is chosen.

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