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Overview of Application of Traffic Simulation Model

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ABSTRACT. Traffic simulation is a widely used method applied in the research on traffic modelling, planning and development of traffic networks and systems. From the literature study, a variety of traffic simulation models were found in experiments and applications with aims to imitate real traffic operations. The traffic simulation models can be categorised into three namely, microscopic modelling, macroscopic modelling and mesoscopic modelling. This report is aimed to overview these traffic simulation models, in terms of its function, limitation and application.

I. INTRODUCTION

Traffic modelling is aimed to accurately recreate traffic as observed and measured on street. Traffic modelling assumed the appearance of a traffic system without replicating. It was developed based on modeller's experience that integrates the mathematical models into traffic system. Traffic modelling plays an important part in traffic engineering. It can be applied to plan and manage the traffic within certain road network. For example, making a smooth traffic at an intersection and etc.

Principally, simulation models focus on three output values to solve traffic problems. First is the traffic flows. In traffic flows, alternative routes can be identified based on the number of vehicles. By using the simulation model, modeller can devise on how to reduce the levels of congestion of certain roads. Second output is the network element. Network element in traffic simulation consists of link, merge, link cross and other elements of the road. This is related to the geometric layout of the road. Using appropriate simulation software, the road geometric design can be changed to see how it can influence the current traffic situation. Third output is the skim category. Simulation model can help to estimate the time and cost of travel. This is especially used when the assessment of traffic improvement is needed to be measured. The transport planner can easily make a performance comparison without any extra cost of money and time.

II. CLASSIFICATION OF TRAFFIC SIMULATION MODELS

The models were grouped according to their areas of application. The three classifications of traffic simulation models, are microscopic modelling, macroscopic modelling and mesoscopic modelling.

2.1 Microscopic Modelling :

Microscopic modelling based on the characteristics of various vehicle movements such as cars, buses, motorcycles and so on in the traffic flow. Microscopic modelling aimed to collect data parameters, such as, flow, density, speed, travel and delay time, long queues, stops, pollution, fuel consumption and shock waves. The characteristics of microscopic modelling methods were based on car-following model, lane-changing models and gaps of the individual drivers.

2.2 Car Following Models :

These algorithms introduced a concept that a driver recognize and follow a lead vehicle in a lower speed [6]. This can be described as a situation such as in a car platoon without being able to change the lane. Generally, the following car algorithm determined the relationship with the lead vehicle at times. It was the function of spacing, speed and acceleration at times. The closer the following vehicle to the lead vehicle the more sensitive the reaction of the following vehicle to the lead vehicle. This sensitivity also increases with speed. This is because if the main vehicle was driven in a lower speed, the following vehicles will then reduce the speed. This resulted in the occurrence of car platoon and traffic congestion.

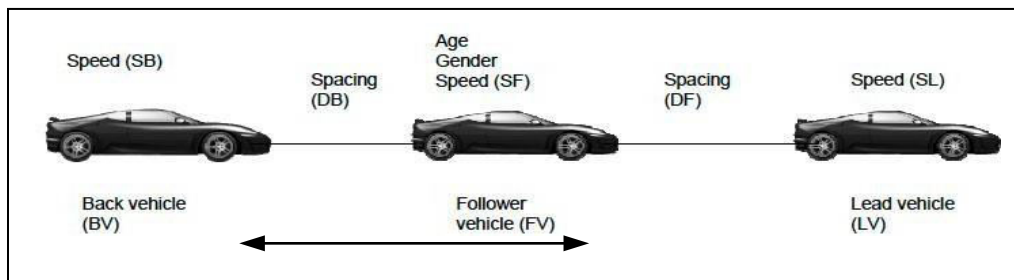


FIG. 1 Car Following Model

In the figure above, headway (h) is the horizontal distance between two vehicles. Spacing (s) is the distance measured from the rear-bumper of the following vehicle to rear-bumper of the lead vehicles pass at a certain point within time interval. The time headway is defined as the time difference of successive vehicles crossings at the point. Microscopic modelling is based on the movement of individual vehicles and their relative time and space.

2.3 Lane Changing Models

Gipps has proposed a development of the lane-changing model. The lane-changing model is a decision process to estimate the driver's behaviour in making a lane change within the time given. Lane changing can be categorised into two types. Mandatory lane change, which occurs when a driver change lane to a specified lane. For instance, a driver changed the right lane when he wanted to make a right turn at the next intersection and discretionary lane change, which the driver made to the next lane to avoid following trucks and increase speed.

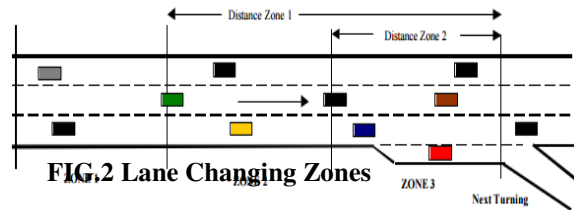


FIG.2 Lane Changing Zones

2.3 Gap Acceptance Models :

Gap acceptance are used to determine the number of vehicles of traffic that can pass through a conflict point. A gap is defined as the time headway in between the lead and lag vehicles in the target lane. The lead gap is the gap to the lead vehicle in the target lane. The lag gap is the gap to lag vehicle in the target.

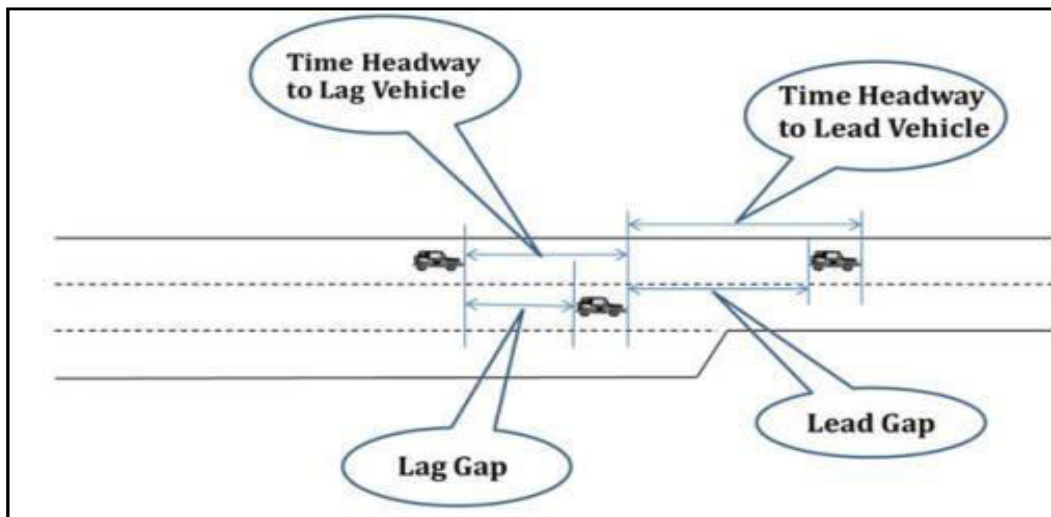


Fig. 3. Lane Changing with Consideration of Lead and Lag gaps

Gap acceptance models were used to determine the size of gap that will be accepted or rejected by a driver who aimed to merge or cross the intersection. Critical gap is defined as the number of accepted gap shorter than its equal to the number of rejected gaps. The driver needs time to clear the intersection and decide. The parameters of the gap acceptance model are the acceleration rate, desired speed and speed acceptance. Among these, the acceleration rate, the maximum giveaway time and visibility distance at the intersection are the most important. The acceleration rate is the ability of the vehicle to accelerate with required safety gap. The maximum giveaway time is to determine when a driver starts to get intolerant if they cannot identify the gap.

III. CONCLUSION

The objective of simulation model is to presents a real traffic situation in to dynamic model. There are three simulation model available to be used in traffic engineering namely macroscopic, microscopic and mesoscopic. The application on each model is depending on the aim of study to be conducted. selecting the right model according to study aims is an important step towards traffic problem resolution.

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