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Evaluation of car following (Car Following) simulation models

Shadi ahmadbeigi
department of engineering, college of computer north Tehran branch, Islamic Azad university Tehran, Iran.
shadiahmadbeigi@gmail.com
kimiya shirini rad
Tabriz sahand university
kimiashrn@gmail.com

Astract:

The use of traffic simulation software for performance analysis is developing rapidly. Therefore, it is important to know the models used in these softwares and the capabilities and limitations of the models used to ensure the accuracy of the results obtained. Among these models are car following models. So far, various models have been presented to express the behavior of vehicles in adjusting their distance to the vehicle ahead in the form of a mathematical formulation that is used in traffic simulation software. In this article, after reviewing the types of these models, the car models are compared in two traffic simulation software VISSIM and AIMSUN. For better analysis and display of the difference between the performance of these two softwares and analysis of their sensitivity.

Keyword: CONTINUOUS CARS, TRAFFIC NETWORK DYNAMICAL MODELS, MICROSCOPIC SIMULATION

Introduction

Dynamic models of traffic flow are mainly studied in two forms, micro and macro, but depending on the details of the phenomena seen in traffic flow, the models are divided into the following three categories [1 and 2] to describe it more easily. Take: Microscopic models, Macroscopic models, Misoscopic models. Among these models, micro-models have been studied in detail and the specifications of these models are generally as follows: - The behavior of each vehicle is determined according to its front vehicle and is presented separately for each vehicle. .
- A crossing line is often used in simulations. - The proposed functions use ordinary differential equations in which the motion of each vehicle following the vehicle in front is expressed. - In these models, the system response time is very important. - The vehicle motion system is approximated by differential equations. Macroscopic models or continuous traffic flow are based on three basic parameters of traffic density, volume and speed: - In these models, fluid variables (such as density and flow are used to describe traffic density and density. - The characteristics of each vehicle are not considered. Numerical calculations are often performed in time and in discrete environments with partial differential equations. - Partial differential equations defined in arbitrary fields with suitable boundary conditions and can explain various

traffic phenomena. When both supply and demand models use collective rules, microscopic and macroscopic models are used, which have the following properties: - A group of cars together, in a package (Pocket Individual decisions are replaced and modeled with decision patterns. Consecutive car models In general, consecutive car models can be divided into the following four categories:

1-2- GHR models Gazis-Herman-Rothery GHR models) First introduced in 1961 [3]. In these models, the main relationship between two consecutive vehicles is a type of "excitation-response" function. GHR models express the acceleration of the rear vehicle in proportion to its speed and the difference in speed and spatial distance between the two vehicles. These models can be symmetric or asymmetric. Symmetric models in negative and positive acceleration modes use the same set of parameters, while in asymmetric models, the negative acceleration mode parameters differ from the positive acceleration.

2-2- Safety models - distance In this category of models, it is assumed that the driver always adjusts his distance to the vehicle in front so Makes sure that there is no collision between the two vehicles (safe distance is observed). In some models, this distance is calculated based on the distance required to prevent a collision if the vehicle in front brakes hard. In 1981, Gipps [4] proposed a broader model than the original model.

3-2- Psycho-Physical models These models are known as psycho-physical models or "Action Point" models. GHR models assume that the rear vehicle responds arbitrarily to relative changes in speed, and this reaction occurs even if there is a large distance between the two vehicles and disappears as soon as the gear change is zero. This can be corrected both through GHR models with additional diets such as free driving and emergency acceleration reduction, etc., and by using psycho-physical models. Psycho-physical models use "thresholds" or points of action when the driver changes behavior. Drivers can only respond to changes in relative speed or relative distance between two vehicles when they reach these thresholds.

Fuzzy models

Another approach to car modeling today is the use of fuzzy logic. In this method, fuzzy sets are used to define model thresholds. For example, the concept of "very close distance" can be introduced into the model with fuzzy logic sets. Therefore, when running the model, the "emergency driving" mode, which leads to the driver braking, is considered. In previous models, it was assumed that drivers knew exactly their speed and distance to other vehicles, while in fuzzy models it was assumed that drivers only knew whether the speed of the front vehicle was too low, low, medium, high and Or too much.

1. Consecutive car model in AIMSUN Consecutive car model used in AIMSUN is of safety-distance type, which is based on the models designed by Gipps (1981). In the Gipps car model, the traffic of vehicles is divided into two types according to the vehicle in front of them, restricted and free. When restricted, the rear vehicle

2. tries to maintain a safe distance by adjusting its speed to the vehicle in front. Safe distance means the distance between two vehicles so that the driver of the rear vehicle can react to any wise action of the vehicle in front to avoid an accident. During free movement, it has been shown to show. The speed of the vehicle is limited based on the desired speed and maximum acceleration [5].

3. Consecutive car model in VISSIM The consecutive car model available in VISSIM is of mental and physical type, which was first presented by Wiedemamn in 1974, and this model has been further developed so far. Figure (1) Thresholds and regimes governing traffic in the model [7] SDV is assumed to be the equivalent of CLDV, and CLDV simply represents the VISSIM threshold introduced in 1992. [6] A simple example for comparing consecutive car models in VISSIM and AIMSUN The first numerical comparison between consecutive car models in traffic simulation software was done in 2004 by Johnson et al. [8]. In that article, the behavior of two vehicles in a row is done in a line with computer simulation and without considering the time steps in different software. In this article, with a simple example, compare two AIMSUN software and Due to the possibility of changing time steps. In addition, the effect of the existence of variable accelerations in consecutive car models is considered in these applications. VISSIM assumption.

The front car starts moving at a constant speed of 20 meters per second, right nowThe rear car starts moving at the same speed and with a distance of 28 meters compared to the rear of the front car. After 40 seconds, a reduction acceleration ranging from zero to 2 meters per square second is applied to the car in front for two seconds. Then Constant constant acceleration of 2 meters per square second for 2 seconds. Then, after 6 seconds, a positive acceleration of zero to 2 meters per square second is applied to this car for 6 seconds. It is assumed that the acceleration applied by the vehicle is applied in the middle of the time steps. Figures 2 to 5 show the speeds and distances of the two vehicles in order to compare and observe the differences in their results. Simulation of car models is followed by the two mentioned softwares in MATLAB programming environment and the results obtained from it are drawn in Excel. As shown in Figures 3 and 5, the follower of the tracking vehicle in AIMSUN is more than

But because the second software operates on the basis of thresholds and does not imply the need to match the movements of the tracking vehicle with the vehicle in front of it, it has a more logical function. According to Figure 4, it can be seen that at the beginning of the jump path, there is a follow-up vehicle in the acceleration, which is a sudden approach and it seems that the driver's will is not involved in it. Of course if this value is less than VISSIM

It was 0.2 m / s, not only was it not a problem, it was part of the Wiedemann model's assumptions that the engine fuel valve fluctuated, but the acceleration was about 1.5 m / s due to errors due to sudden changes in acceleration. Occurs at the thresholds.

- Sensitivity analysis based on simulation time steps in order to determine the performance of models with different time steps and also to determine a suitable number for use in simulations in two models, different performances with different time steps between 2 125 Seconds are taken to calculate the speed of the tracking vehicle, as shown in Figures 6 and 7. As can be seen in Figure 5, there is a similar trend at the moment of perceiving the change in velocities and only the type of behavior is different. Of course, it should be noted that changing the speed trend from time steps 2 and 1 to 5 /. Up to 125 /. It is due to the formulation of the model, and since the differences occur at the moment of movement and are the same in the rest of the process, it can be assumed that the model works correctly. Due to the large difference between the 2-second step and the vehicle ahead, as well as the large difference with the results of other steps, so the simulation step with this time interval does not seem appropriate. In the model used in AIMSUN, the smaller the step, the more similar the movement of the two vehicles is to each other, but it should be borne in mind that drivers can not use very small moments in reactions, and if steps are used. Too small the results of the model will be irrational. In addition, the use of small time steps in simulation also reduces the speed of the software. So use the time interval 5 /. Up to 1 second is logical. The curves in Figure 7 also confirm the above and show that the long time step delays the thresholds and as a result the rear driver seems indifferent to the vehicle in front of him.

Is. But in steps This problem will be solved in 1 second. Leader T = .5 sec T = 2 sec T = .25 5e T = .125 sec T = 1 === 40 t [sec] Leader T = .5 sec T = 2 sec T = 25 sec T = 125 sec T = 1sec t [Sec]

7- Conclusion The car model used in AIMSUN is of safety-distance type, which is based on the models designed by Gipps (1981). The consecutive car model used in VISSIM is of the mental and physical type developed by Wiedemann. AIMSUN follows the follower vehicle more than VISSIM, but since the second software is based on understanding the thresholds and does not imply the need to match the follower vehicle movements with the vehicle in front of it, it has a more logical performance. In general, it can be said that the results obtained from both softwares are similar in the general process, but the AIMSUN model is simpler in terms of formulation structure and performs faster processing in a large-scale network, but if we want to go into detail. Pay more and the purpose of the show simulation How drivers behave The model used in VISSIM provides more logical and accurate results. It is suggested that more research be done on these models by conducting more research and appropriate field surveys, in order to better understand the performance due to the growing use of these softwares.

They won.

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