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Evaluation of Cooperative Automated Vehicle for Arterial Roads on Traffic Flow

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The purpose of this study is to evaluate the impact of cooperative automated driving vehicles on traffic flow of arterial roads. The cooperative automated driving vehicle assumed in this study is a vehicle equipped with CACC (= Cooperative Adaptive Cruise Control) (hereinafter, we call it CACC vehicle). We analyzed the changes in traffic flow rate and traffic congestion reduction effects by the car following model IDM+ and the traffic simulation MicroAVENUE.

First, the impact of CACC vehicles on traffic flow was analyzed in terms of two points: the effect of maintaining a short distance between vehicles, and the effect of reducing reaction delays. Fig1 shows the estimated flow rate on basic road section by target time gap and speed using the derived relational expresson. The spatial redistribution effect by mainaining a short distance of CACC vehicle can be expected, on the other hand, it showed the possibility that sufficient effect could not be demonstrated in the low speed range. Next, in the analysis of the reaction delay, a simple simulation is performed assuming that 14 vehicles started after the green signal was is displayed on the traffic light. Fig.2 shows the simulation result of the estimated traffic flow rate for all vehicles. It was shown that there are cases which CACC vehicle stops in front of the line contributes to the traffic congestion reduction effect and other cases where a sufficient effect cannot be expected.

Furthermore, using the Mitaka/Kichijoji data set, a simulation of the traffic congestion reduction effect on regular roads was experimented, and it was shown that a certain effect of CACC vehicles could be obtained for the overall traffic condition (total delay) by the rate of 50% or more of CACC vehicles. We found a variation in the results from 10 to 15 percent, and the variation is greater in the case where CACC vehicles are mixed compared to the base case. This result suggests to be due to the hunting phenomena caused by route choice behavior. Vhicles in the simulation network choose the non-congesed route which pass thorough the bottleneck intersection, by the improvement of traffic conditions by CACC vhicles. However, the congestion at the bottleneck reoccurs, and leads to a situation in which onother route is selected to avoid traffic congestion.therefore, traffic congestion occur alternately between intersections. As the future works, we plan to discuss the relationship of the traffic flow and traffic signal timings in the situation that CACC vehicles are mixed in regular roads. And the conditions to improve traffic flow will be described through the simulation experiments.

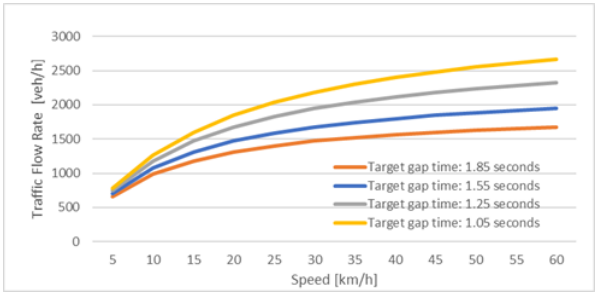

Fig.1 Estimated Flow rate by Target Time Gap and Speed

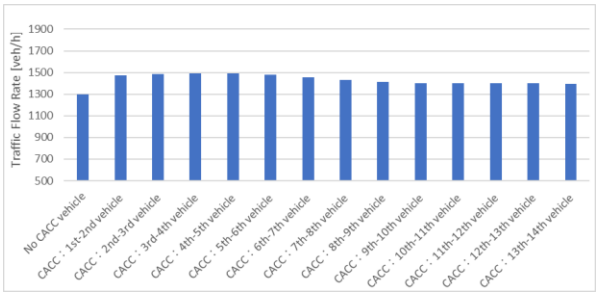

Fig.2 Estimated Traffic Flow Rate for All Vehicles

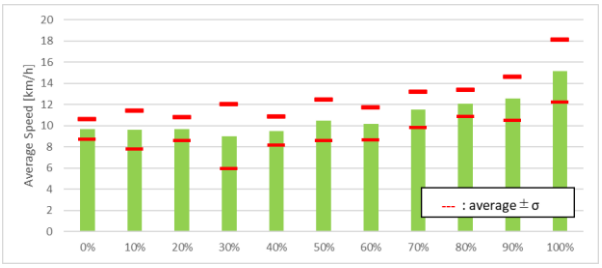

Fig3. Average Speed of the Whole Area

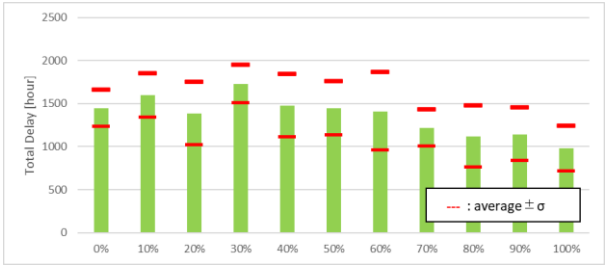

Fig.4 Total Delay