New 3-Truck CACC Field Test for Fuel Consumption and Control Performance

Poster Session 1 Abstract

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Under sponsorship of the U.S. Department of Energy's SMART Mobility Program and Transport Canada, the California PATH Program and National Research Council of Canada tested a 3-truck CACC (Cooperative Cruise Control) string extensively for wider range of spacings and more scenarios than any previous such tests at Transport Canada's Motor Vehicle Test Centre in Blainville, Quebec, Canada in August 2017. The test site is a 6.5 km (4.0 mile) high-speed track consisting of two straight 1.6 km (1.0 mile) sections, and two 1.6 km (1.0 mile) constant-curvature banked sections. The tested gaps were between 4 m (13 ft) and 87 m (about 300 ft) at speeds of 65 mph and 50 mph. The scenarios included: 2-truck and 3-truck CACC following at constant speed (65 and 50 mph), cut-ins between truck 1 & 2 and between 2 & 3 for 3-truck CACC following, 2-truck and 3-truck CACC following an SUV, and speed variations between 55 mph and 65 mph for constant cruising at 65 mph and 55 mph for 1 min alternatively,

Although the objective of the recent tests was for measuring fuel economy of CACC operations, the data have also been used for CACC performance analysis since most of the fundamental scenarios have been tested systematically. Statistical analysis of the CACC performance will be presented.

The fuel consumption benefits due to aerodynamic drag reduction can be summarized as follows: even at the longest of those gaps, we still saw savings in energy usage averaged across all three trucks of around 5% compared to the trucks driving in isolation from each other; the first truck saves energy when the gap is shorter than about 18 m, but does not save energy at the longer gaps; at the 18 m gap, the middle truck saves about 10% of its fuel and the last truck saves over 12%; the larger savings happen at the shorter gaps, which may require the trucks to be segregated from other truck traffic to reduce the hazards from bad driving behaviors by drivers of cars and motorcycles; at the 12 m gap, the first truck saves about 3% but the two following trucks each save

12% to 13% of fuel consumption; when we get closer than that, the middle truck saves more than the last truck, and at the shortest gap we tested, 4 m, the first truck saved almost 10%, the last truck saved about 12% and the middle truck saving jumped up to about 17%; and the average across all three trucks was almost 13%;

It is noted that the 3-truck platoon average savings were considerably higher than the average for two-truck platoons that we also tested. Even with the very frequent cut-ins and speed variations, the fuel savings were only decreased by 1% to 2%.