Motivation of the Study

Estimating impacts of CACC on vehicle fuel efficiency at a typical freeway merging bottleneck area.

Highlights of the study:

- Analysis with state-of-the-art human driver model, ACC model and CACC model that have been calibrated and validated with real-world data.
- Comparison of the influences of ACC and CACC on vehicle fuel efficiencies.
- Identify if the freeway can serve more vehicles while the average vehicle energy consumption does not increase with the CACC operation.
- Explore the effectiveness of CACC operation alternatives on the vehicle energy consumption.

ACC/CACC Model

The ACC/CACC model was developed based on datasets obtained from the field ACC/CACC vehicle tests (see Fig. 2).

Vehicle Energy Consumption Rates

The energy consumption rates for individual vehicle operating mode were extracted from EPA’s MOVES model.

Study Results

The vehicle energy efficiency improves with the CACC market penetration, and decreases with the ACC market penetration. The ACC behavior can make the traffic flow unstable, leading to reduced energy performance.

If the vehicle energy consumption is to be kept the same as the level in the 0% CACC case, we further identified how much capacity improvement we can get under various CACC market penetrations.

Concluding Remarks

The results indicate the importance of implementing vehicle connectivity for reducing vehicle energy consumption. The study also demonstrates the mobility improvement under energy consumption constraints. The effectiveness of the CACC operation alternatives has also been identified.

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