Study on human factors in automatic platooning using a truck driving simulator

Cooperated with Suda Lab and JTEKT Corporation
Fund by New Energy and Industrial Technology Development Organization (NEDO)

Objective

The technical development is being achieved for the Energy-saving Automatic Platooning of Trucks through NEDO’s project for five years. However, it is still an inevitable topic on driver fitness, role of driver, and other problems about human factors in automatic platooning. The purpose of the study is to reproduce automatic platooning using a driving simulator (DS) for studying on the relations of driver and automatic platooning.

Human factors in automatic platooning

Human factors in automatic platooning are mainly about operations and conditions of driver during the processes of the formation and separation of the automatic platooning. Otherwise, it is also necessary to evaluate human-machine interface for the communication of driver and the system of the automatic platooning. As a novel technology in automobile field, a driving simulator for trucks is used for evaluate automatic platooning driving and its system considering human factors.

Truck driving simulator

A truck driving simulator was developed by our research group. In whole, a full-scale cabin of a real truck, steering equipment attached a servo-motor, an air seat, a sound generator based on the actual-vehicle driving of truck and control software are integrated into a driving simulator system to improve driver sense in a truck driving.

A control system including TruckSim software and dSPACE equipment was implemented into the truck driving simulator system. The TruckSim software is connected with the host computer of DS using the real-time dSPACE. Gap distance control and path following control for automatic platooning, adaptive cruise control (ACC), and cooperative adaptive cruise control (CACC) were built by Simulink connected with TruckSim software. Dependent on above setting, the dynamics and control of DS were realized for automatic platooning of trucks.

Evaluation of HMI system

The automatic platooning for 10 m gap distance and 80 km/h velocity is realized using the truck-driving-simulator as a following truck. For the application of the automatic platooning, human-machine interface (HMI) was designed for three types of numeric characters, graphics, and numeric characters & graphics types. The 10 professional truck drivers are cooperated for evaluation of priority ranking of the three types of HMI. The result is presented in the following table. The most preferable one is numeric characters & graphics type as is shown in the right figure, which is applied for the real demonstration driving.

Achievements

A highly realistic truck driving simulator system was developed for study on human factors in automatic platooning, which are mainly about driver behaviors for emergent avoidance of system failure, and evaluation of driver operations during the processing of the automatic platooning. Furthermore, operability and safety of the proposed HMI system were evaluated by professional truck drivers.

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