Summary of SIP-ADUS project (FY2015)

Name of the project	Research on Technical Requirements for Human Machine Interface (HMI) Related to Safety of Automated Driving System
Responsible Organization	Ministry of Land, Infrastructure, Transport and Tourism
National Traffic Safety and Environment Laboratory	

Object of the Project

If any failures occur in the Automated Driving System, and it becomes difficult for the system to continue automated driving, the main operator of the vehicle has to be made transition from the system to the driver safely and smoothly. In this case, if the communication via Human Machine Interface (HMI) from the system to the driver cannot be executed rapidly and appropriately, the driver would be confused, and he/she would not be able to execute safe driving. Therefore, it is necessary to research the appropriate way of HMI. In this research, we investigated the technical requirement of HMI etc. to ensure the safety of the Automated Driving Systems (level 2) by the experiment of the Driving Simulator (DS) which could simulate typical traffic scenes of transition of main operator from the system to the driver.

Project Summary

1) Summary of the experiment

In this research, the combination of Automatically Commanded Steering Function (ACSF) and Adaptive Cruise Control (ACC) was defined as the level 2 Automated Driving System which was premised monitoring the surrounding traffic situation by the driver. ACSF can keep the lane and can change the lane automatically, and ACC can keep the distance between the cars. While the system operates normally, it is not necessary for the driver to operate the steering wheel, accelerator pedal and brake pedal manually, especially he/she does not hold the steering wheel.

In this experiment, the following 2 scenes were executed as the experimental scenes, which simulate occurrence of a failure of the Automated Driving System and transition of main operator from the system to the driver.

Scene 1: A failure of ACSF occurs while the car is running on the curve, and the driver has to take over steering operation.

Scene 2: A failure of ACSF occurs while the car is changing the lane to overtake the frontal vehicle, and the driver has to take over steering operation.

In this experiment, visual information on the display and acoustic signal from the speaker were used as the HMI. 30 normal drivers participated the experiments.

2) Summary of the experimental result

- Scene 1: In the case that the control of ACSF was continued for more than 2 seconds after the start of warning for notification of a failure, or in the case ACSF was stopped gradually after the start of warning, most of the drivers could take over driving on the curve without lane departure.
- Scene 2: In the case that the time for changing a lane was 3 seconds (a lane change which supposes slightly rapid and higher lateral movement speed), a part of the drivers could not keep the lane after occurrence of a failure of ACSF, and departure of the lane was observed. On the other hand, in the case that the time for changing a lane was 6 seconds (a lane change which supposes normal lateral movement speed), most of the drivers could take over the lane change operation without lane departure after occurrence of a failure of ACSF.
- In the above scene 1 and scene 2, driver's reaction time until holding a steering wheel after the start of warning was slightly different by the experiment scenes and experiment conditions, but the time of average and standard deviation was in the range of 1–2 seconds.
- According to the results of the above experiment, it is considered that about 2 seconds are necessary as the margin of time for the driver to take over steering operation safely. In addition, to stop control of ACSF gradually after the start of warning, or to carry out a lane change by around 6 seconds in a normal condition are effective to keep the margin of time.

Future plan