

### Human Factors

#### 1. Project

This project is funded by the Cabinet Office and started in FY2016 as a 3 year project.

#### 2. Research team

(1) National Institute of Advanced Industrial Science and Technology, (2) University of Tsukuba, (3) Keio University, (4) DENSO CORPORATION, and (5) Tokyo Business Service Co.,Ltd.

#### 3. Tasks

Three research tasks identified as those with the highest priority (HMI Task Force FY2015).

- Task A investigates effects of system information (static and dynamic) on drivers' behavior in transition from Levels 2 and 3 to manual (Figure 1).
- Task B investigates effects of driver state (readiness) on his/her behavior in transition from Levels 2 and 3 to manual (Figure 1).
- Task C studies non-verbal communication between drivers and other road users (Figure 2), and investigates effective ways to functionalize the automated vehicle to be communicative.

#### 4. FY2016 Experiments

- Task A  
Subjects receive various levels of information about functions and limitations of Level 2 and 3 systems (Table 1), and drive the systems in a driving simulator. Subjects' behavior in transition is analyzed as a function of the received information levels.
- Task B  
Subjects drive Level 2 and 3 systems with cognitive and physical secondary tasks in a driving simulator. The scenarios include several events with low criticality. Subjects' cognitive and physiological metrics are measured to extract those correlated with behaviors in the events (Table 2).
- Task C  
Communication behaviors between drivers and between driver and pedestrians are observed at fixed points (Figure 3) and also in the car driven by a subject. The results are used to model the communication behaviors.

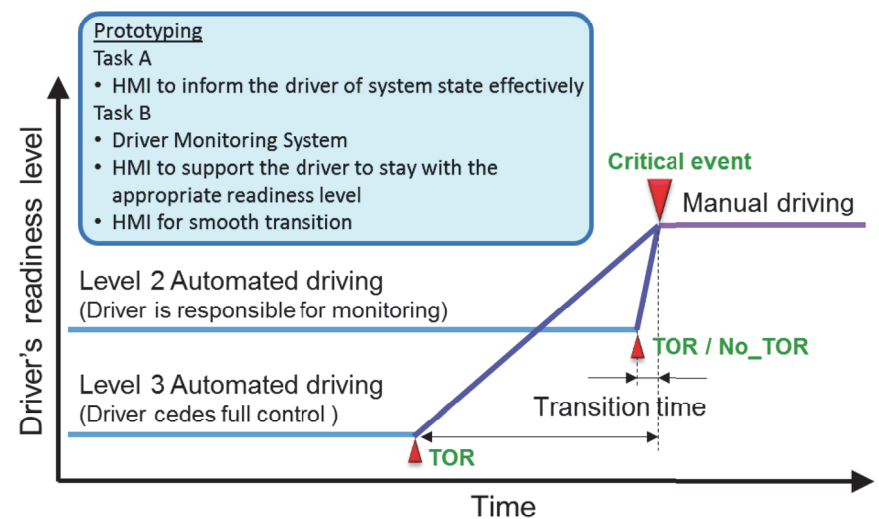


Figure 1. Driver's readiness and transition (Tasks A, B)



Figure 2. Non-verbal communication between drivers and between driver and pedestrians in Task C.

Occasional necessity of take-over
Meaning of TOR HMI
Take-over conditions
Possibility of silent failure
Driver's responsibility for monitoring

Table 1. Information given to the subjects in Task A. Various combinations of above information are studied.

Driver state	Measurement
• Lack of SA	• Driving behaviors
• Inattentive	• Head orientation and visual performance
• Physically distracted	• Heart rate and blood pressure
• Low arousal	• Temperature
• Out of position	• Skin conductance
	• EEG
	• Posture and body movements
	• Subjective evaluations

Table 2. Driver state and measurement

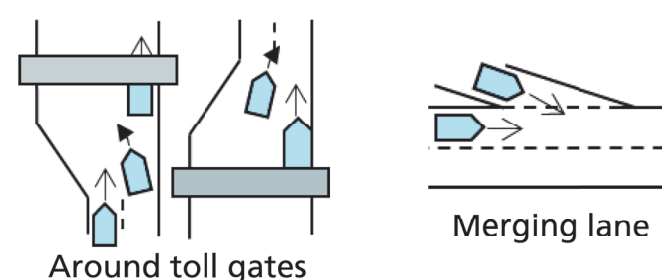


Figure 3. Examples of fixed point observation.