SIP-adus Workshop 2022

HMI and User Education

Task A：Communication method between AV and traffic participants

• Overview of the task

We will extract and classify unsafe and inefficient situations that occur between automated driving vehicles and surrounding traffic participants for low-speed transportation and logistics services. We also propose a method to achieve safe, secure and smooth communication in various situations. The results of research on vehicle behavior and communication with external HMI will be socially implemented in JAMA, ISO, related ministries and agencies, local governments, etc., with the aim of popularizing automated driving.

• Breaking down the task

【Examination of unsafe and inefficient communication】

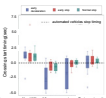
With the cooperation of the demonstration experiment of "automatic driving service based at roadside stations in hilly and mountainous areas", we analyzed the drive recorder video during automatic driving. Typical cases of unsafe and inefficient communication between low-speed autonomous vehicles (transportation and logistics services) and surrounding traffic participants were ``crossing", ``approaching/avoiding", and ``overtaking".

【Examination and proposal of communication by vehicle behavior and external HMI】

Through experiments on VR and on campus roads, we investigated the causes of unsafe and inefficient communication in various cases. As a result, ``how to use ``vehicle behavior and external HMI" to facilitate communication," ``elements related to the transmission of intentions and states of automatic driving vehicles," and ``negative effects caused by experiencing external HMI. " and other communication recommendations were found.

• Some results

【Approach/avoidance case】



Crossing start timing in crossing case (when crew is absent)

Implementing external HMI encourages avoidance behavior of pedestrians (right figure). Contributes to reducing anxiety and shortening the start time of avoidance behavior. Pedestrians are unaware that automated vehicles can only operate on electromagnetic induction lines.

【crossing case】

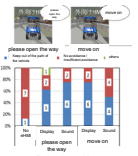
Reduced the time delay of crossing start judgment by external HMI implementation (left figure). It also contributes to reducing anxiety.

【overtaking case】

By presenting a warning when overtaking from an external HMI, it is possible to increase the visual recognition time just before overtaking. It also has the effect of reducing driver frustration when following low speeds.

【Negative impact of external HMI】

As a method to reduce the negative impact of external HMI, turning off the display has a limited effect, and it suggests improvement based on the knowledge of pedestrians.



Pedestrian avoidance behavior in the approach/avoidance case

• Outputs

- Collection of unsafe and inefficient use cases and countermeasures
- How to reduce the negative impact of external HMI, knowledge to be prepared and scope of application
- How to use external HMI and vehicle behavior, effects of road markings, knowledge to be prepared and applicable range

Task B：Development of evaluation methods of driver's OEDR and HMI for enhancing driver's take-over in a transition from automated to manual driving

• Overview of the task

Define and detect appropriate driver states for transitions from automated to manual driving

Target of the driver states in SIP Phase 2

- **Situation awareness**
- **Functional limitations awareness**

• Breaking down the task

System-initiated (with RtI) transition from automated to manual driving

Evaluation methods of driver's situation awareness that satisfy the requirements for safe transitions from NDRA (Non-Driving Related Activities) to manual driving

Driver initiated transition from automated to manual driving

Evaluation methods of driver's understanding on system functional limits, and examination of HMI principles that enable appropriate system understanding and quick response

• Some results

System-initiated (with RtI) transition

Quantitative evaluation methods of the driver situation awareness include **metrics** (gaze, head movements), **threshold** (70% or more gaze-on-front), and **time duration** (the rate of gaze-on-front tends to increase 5 to 20 seconds after the monitoring request), which were obtained from the results of present experiments.

Driver initiated transition

Evaluation method of driver's understanding on system functional limits is **driver's gaze**, and present experiments reveal **HMIs improving drivers' attention levels and responses to risks**.

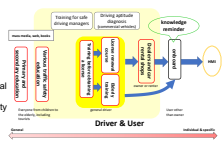
• Outputs

- Design guidelines for being attentive (metrics, threshold values, and necessary time for the driver to build proper situation awareness)
- Evaluation metrics of driver's system understanding status
- HMI principles to improve driver understanding of system functional limits and to promote driver's response

Task C：Education and Training for Users

• Overview of the task

In order to use automated driving, we will clarify the minimum knowledge, organize the educational content, and study effective educational methods. For efficient educational implementation, we emphasized matching appropriate opportunities and education by distinguishing between ``general knowledge that everyone knows" and ``system-specific knowledge". The research results will be implemented in society and will support the safe use and popularization of automated driving.



• Breaking down the task

【Framework for Educational Opportunities and Content】

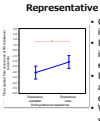
For the use of automated driving in Japan, we organized a framework for educational opportunities and what kind of content can be taught at each opportunity. Due to time and resource constraints, it is important to select educational content and methods according to the characteristics of each opportunity.

【Examination of effective educational methods】

From the web survey, it was found that it is more effective to explain the teaching content in video format or in quiz format than to explain it in text. In addition, when teaching general knowledge, it was found that motivation is important to think about oneself. For motivation, we found that watching an overview video (opening video) is effective for safe use of automated driving.

• Some results

Representative results and findings.



- General knowledge education of automated driving is important for drivers to use automated driving safely.
- In order to solidify the understanding of general knowledge, it is better to give concreteness such as incorporating an explanation of the actual system.
- In the case of taking over driving, it is possible to use automated driving even in more complicated situations by experiencing it in advance (left figure).
- We developed a method for evaluating individual learning styles and proposed adaptive learning according to them (right figure).

• Outputs

(Results provided to the National Police Agency)

Video teaching materials

Manual

産総研 | 慶應義塾大学 Keio University | 東京大学 生産技術研究所 Institute of Industrial Science, The University of Tokyo | 筑波大学 University of Tsukuba | 熊本大学 Kumamoto University | 東京都第三セクター企業 東京都ビジネスサービス株式会社