Initiatives Aimed at Realizing Automated Driving on Expressways

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Intelligent Transport Systems Division, Road Traffic Department

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1. Introduction

The automated driving is generally expected to be safer and smoother than the manual driving, and it is thought that it will contribute to the advanced use of the road networks (reducing the traffic accidents, the congestion, the environmental impact, etc.). The Public–Private ITS Initiative/Roadmap[1)] clarifies the goals for realizing the automated driving and specifies the achievement of the automated driving (Level 4) on expressways with a target of 2025 as a goal for private vehicles in particular.

The National Institute for Land and Infrastructure Management (NILIM) has conducted the research on cooperative ITS (the systems in which the road infrastructure and the vehicles share the information by mutual communication to realize the better road transportation), covering the settings where the vehicles cannot continue the automated driving on their own.

This paper describes the outlines of this research as a NILIM initiative aimed at realizing the automated driving on expressways.

2. Initiatives aimed at realizing automated driving on expressways

NILIM has conducted the joint public-private research with the automobile manufacturers, the road administrators, the communication device manufacturers, and others on the information provision services to enable roads to support the automated driving on expressways. The outlines of the information provision services we have considered so far are explained below with images of the systems.

(1) Merging support information provision service

The merging support information provision service gathers the information about the traffic conditions on the main lane via the vehicle detection sensors and provides it to the merging vehicles to support the smooth merging (Fig. 1).

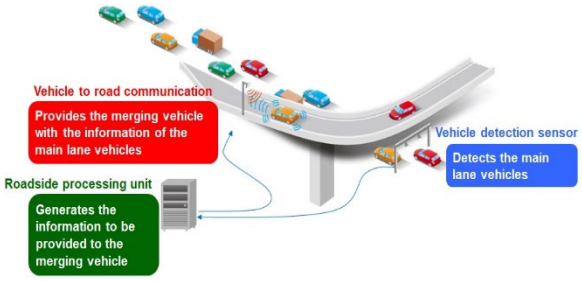

Fig. 1. Merging support information provision service (image)

Urban expressways in Japan have the locations where the acceleration lane is short and the main road is not readily visible from the connecting road. Therefore, by providing the information such as the speed of vehicles traveling on the main lane and the calculated arrival time at the merging section, it is expected that the merging vehicles will be able to adjust the speed and the timing of merging in advance. NILIM considered the contents of the provided information and the information provision formats etc.

(2) Look-ahead information provision service

The look-ahead information provision service provides the information on the items ahead that the on-board sensors cannot detect.

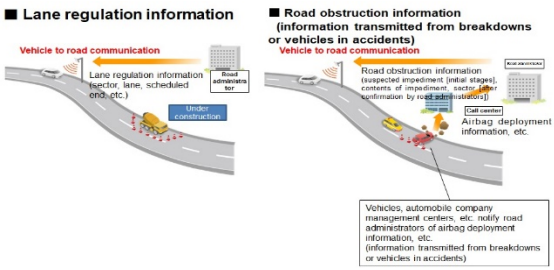

Fig. 2. Road obstruction information provision service

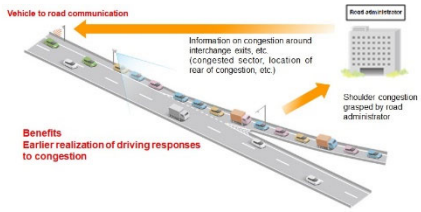

Fig. 3. Service providing information on congestion around interchange exits, etc.

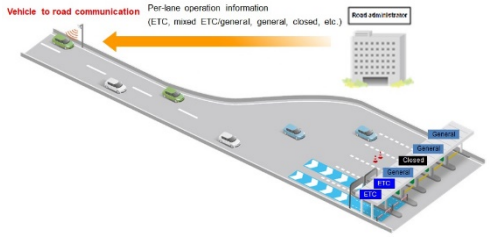

Fig. 4. Tollgate information provision service

The automated driving vehicles detect the surrounding conditions with on board sensors, but their scope of detection is limited. Providing the information in advance on items ahead is therefore expected to enable the automated driving vehicles to change the lanes or take other action for smoother automated driving. NILIM considered the details including the contents of the provided information and the information provision formats for providing it for the road obstruction information provision service, the service providing the information on congestion around interchange exits, etc., and a tollgate information provision service (Fig. 2–4).

(3) Information to assist localization

The lane-keeping assist systems (LKAS) in the automated driving vehicle read the lane markings with on-board sensors and automatically operate the steering wheel to travel in the center of the lane. However, on-board sensors may not be able to detect faint lane markings and the LKAS may not work. For this reason, we have conducted the research aimed at understanding the condition of lane markings recognition, which forms the base of the conditions for LKAS operation. We are currently investigating the faint level of lane markings (the proportion of the faint area in the area of the lane markings) using the image data, etc. acquired from on-board cameras and are actually driving vehicles with LKAS to understand the state of LKAS operation and analyze the relationship between the faint level of lane markings and the LKAS operation rate (Fig. 5).

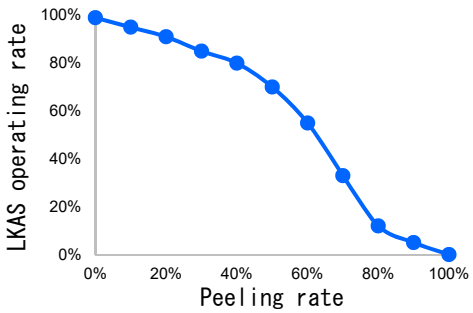

Fig. 5. Relationship between faint level of lane markings and LKAS operation rate (image)

3. Field operational test of the merging support information provision service

Regarding the merging support information provision service for which the NILIM created the technical specifications, the Cabinet Office Cross-ministerial Strategic Innovation Promotion Program (SIP) conducted the field operational test near Kuko-nishi onramp (upbound), Haneda Route 1, Metropolitan Expressway as the Field

Operational Test in the Tokyo Waterfront Area (photo). The FOT investigated the accuracy of the calculated arrival time from the merging support information provision system, the delay due to system processing, and the installation location of the roadside infrastructure and gained the information on challenges before practical application of the merging support information provision system and limitations on the application of the system.[2)]

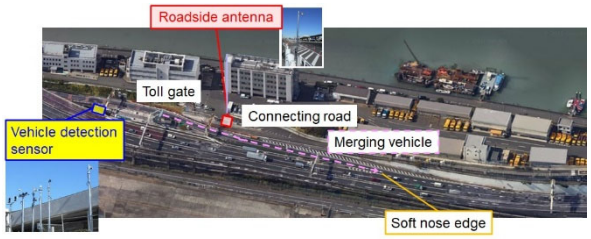

Photo. Field Operational Test in the Tokyo Waterfront Area (merging support)

4. Conclusion

For the early commercialization of the automated driving, it is important to develop the system that allows the road infrastructure and the vehicles to share the information through vehicle to road communication.

The merging support information provision service, look-ahead information provision service, and information to assist the localization are important services in expanding the automated driving. We hope to continue to contribute to the rapid practical implementation of the automated driving and the realization of the safe, secure, and smooth road traffic through joint public-private research.

☞See here for detailed information

1) Strategic Conference for the Advancement of Utilizing Public and Private Sector Data, Strategic Headquarters for the Promotion of an Advanced Information and Telecommunications Network Society. *Public–Private ITS Initiative/Roadmaps*, 2021.

2) Nakagawa Toshimasa, Sekiya Hirotaka, Nakata Ryō, Hanamori Teruaki, Fujimura Ryōta. "Verification of Merging Support Information Provision System (DAY1 System) through Field Operational Test in the Tokyo Waterfront Area." *Traffic Engineering*, vol. 8, issue 8/2022. pp.39–48. 2022.