Initiatives for Realizing Automated Driving on Expressways

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Intelligent Transport Systems Division, Road Traffic Department

Head (Ph. D. Eng) ITSUBO Shinji Senior researcher NAKAGAWA Toshimasa Researcher ISHIHARA Masaaki

Guest researcher YUASA Katsuhiko Guest researcher HANAMORI Teruaki

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1. Introduction

Automated driving is expected to be safer and smoother than manual driving, and it is anticipated that it will also contribute to alleviating traffic jams, reducing environmental impact etc., The Public-Private ITS Initiative/Roadmap[1] clarifies the governmental goals for realizing automated driving (level 4) on expressways with a target of 2025 for privately owned vehicles.

This paper describes the outlines of research on “merging support information provision system” and “self-positioning identifying information (lane marking)” as NILIM initiatives aimed for realizing automated driving on expressways.

2. Merging support information provision system

A merging support information provision system supports safe and smooth merging by providing an information about a speed, a location etc., of main lane vehicles upstream an expressway to automated driving vehicle (Fig. 1). The information provided by this system is used to adjust a speed of a merging vehicle in advance on the connecting road when merging safely and smoothly. DAY2 system detects a speed, a location etc. of main lane vehicles in a certain section and provides the information to the merging vehicles continuously.

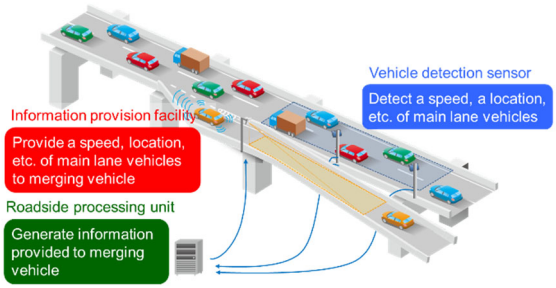

Fig. 1. Merging support information provision system

NILIM developed a section imitating a merging section on expressways on a test track, installed vehicle detection sensors on the main lane side and information provision facilities on the connecting road side, and verified the effects of merging support information (a speed, a location etc. of main lane vehicles) through DAY2 system (Fig. 2, Photo 1). As a result, all merging vehicles were able to merge “with merging support”, even though a length of acceleration lane was short (Fig. 3).

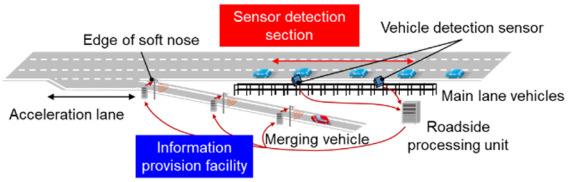

Fig. 2. Field operational test for verifying information provision by DAY2 system

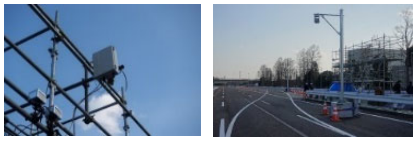

Photo 1. Devices used at FOT
(left: vehicle detection sensor; right: information provision facility)

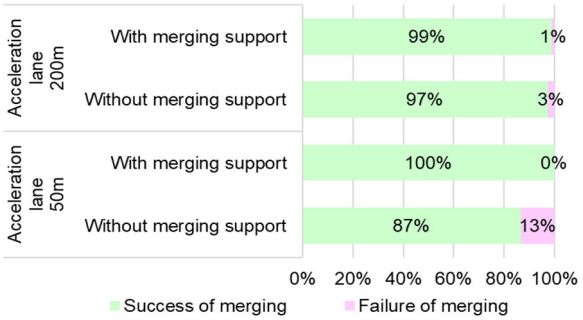

Fig. 3. Success rate of merging

Moreover, it was confirmed that the merging vehicles were not side by side with main lane vehicles "with merging support", when they reached to an end of soft nose and were able to merge into the main lane (Photo 2). Based on the findings acquired in the field operational test, NILIM has organized the technical specifications for the merging support information provision system.

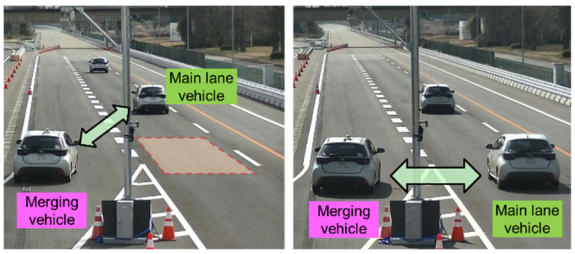

Photo 2. Relative position between merging vehicle and main lane vehicles
(left: with merging support; right: without merging support)

3. Self-positioning identifying information (lane marking)

Lane keeping assist system (LKAS) is a function that assists automated driving vehicle to travel near the center of the road, but it may not operate where a lane marking is faint.

NILIM conducted the field operational test to investigate LKAS operation from the perspective of a faint level of lane marking in order to acquire basic knowledge to organize ideas about maintaining lane markings. Specifically, we prepared lane markings at various faint levels on the test track (Photo 3, Photo 4), made vehicles with LKAS run under various conditions, and measured the state of operation of the LKAS.

Based on the results obtained in the field operational test, we have collated the relationships between the faint level of lane markings and the state of operation of LKAS (Fig. 4). We are also analyzing the maximum faint level (threshold value) that will still allow LKAS to operate and factors that affect LKAS operation and the extent of their impact. We intend to make use of the knowledge acquired in the field operational test to organize requirements for lane marking maintenance from the perspective of faint level to allow LKAS to operate and drivers etc,.

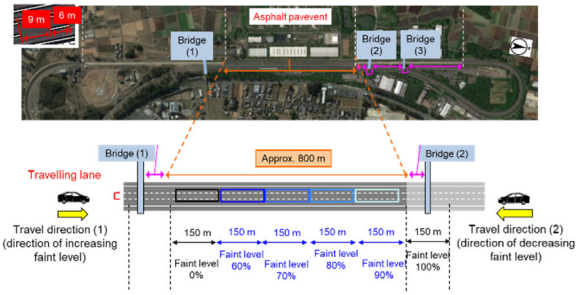

Photo 3. Layout for installing lane markings

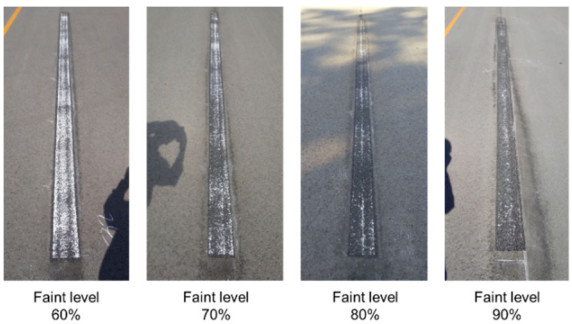

Photo 4. Faint lane markings

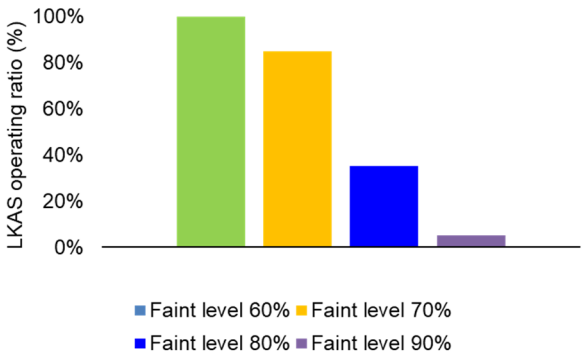

Fig. 4. Relationship between faint level of lane markings and LKAS operating ratio (image)

4. Conclusion

Developing system that allow road infrastructure and vehicles to share information each other through vehicle-to-infrastructure cooperation is important in early realization of automated driving on expressways. It is recognized that the merging support information provision system is an important one to support safe and smooth merging in merging sections, and that lane markings are recognized as important facilities to support a localization on the main lane. We hope to continue to contribute to early realization of automated driving and the safe, secure and smooth road traffic through public and private joint research and development etc..

☞References

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.
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