Proposal of Effective Utilization Method for ETC2.0 Probe Information in Traffic Safety Measures

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1. Introduction

In light of the recent successive occurrence of traffic accidents killing children or caused by senior drivers, it is urgently required to promote effective traffic safety measures.
NILIM has been studying ways to identify potentially dangerous locations using ETC2.0 probe information, which enables wide-area collection of data on the movement of vehicles (location, speed, longitudinal acceleration, etc.).
However, there is still room for further consideration in terms of both "quality" and "quantity," including efficiency and accuracy improvements to the method used to analyze ETC2.0 probe information and ensure the necessary number of data samples.
Therefore, this paper introduces a "method for determining dangerous events in ETC2.0 probe information using the results of drive recorder data analysis" and a "study for the effective utilization of a portable ETC2.0 roadside unit" as a proposal on how ETC2.0 probe information can be effectively utilized for traffic safety measures.

2. Proposal of method for determining dangerous events in ETC2.0 probe information using the results of drive recorder data analysis

NILIM has developed a method for identifying potentially dangerous locations by analyzing the sudden deceleration data of ETC2.0 probe information (e.g., longitudinal acceleration of -0.3G or below). However, as Fig. 1 shows, the sudden deceleration data includes behaviors other than dangerous events (e.g., hard braking merely to stop in front of a red traffic light) since the sudden deceleration data is determined by simply taking deceleration behaviors showing a longitudinal acceleration not higher than a certain value. For this reason, in order to improve the accuracy of analysis, it is necessary to efficiently identify whether the sudden deceleration data of ETC2.0 probe information represents a dangerous or non-dangerous event.
Therefore, in this study, using a drive recorder ("DR") that records acceleration data, we determined whether driving behavior corresponded to a dangerous event or non-dangerous event, as Fig. 2 shows, by visually checking images ahead of the car, and checked

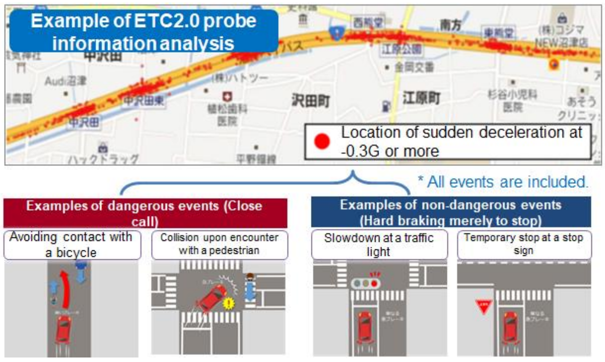

Fig. 1 Issues underlying the sudden deceleration data of ETC2.0 probe information

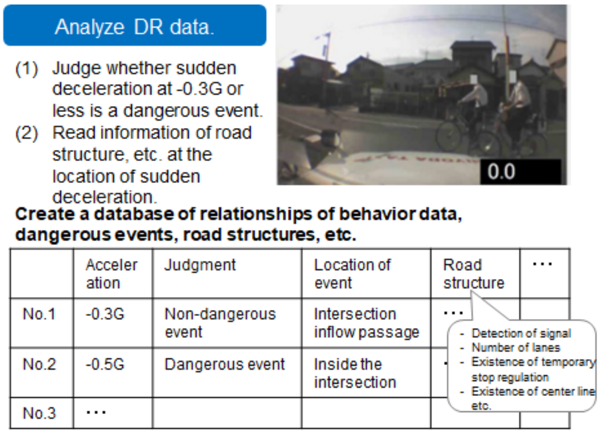

Fig. 2 Relationships between judgment of dangerous events by analysis of drive recorder data and road structures

sudden deceleration data (value of the longitudinal acceleration recorded in DR), etc. against the road structure in the event location.
Consequently, as Fig. 3 shows, it was found that a dangerous event occurred with a probability of about 90% on a non-intersection road or inside the intersection when longitudinal acceleration was not higher than -0.3G.
It was also found that non-dangerous events were included at a rate of about 70% in the intersection inflow passage. Figure 4 shows the ratio of dangerous and non-dangerous events in an intersection inflow passage by the longitudinal acceleration. It can be seen in this figure that, when longitudinal acceleration is not higher than -0.6G, about 80% of intersection

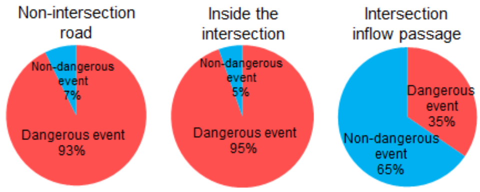

Fig. 3 Ratio of dangerous and non-dangerous events by position of sudden deceleration (when longitudinal acceleration is -0.3G or less)

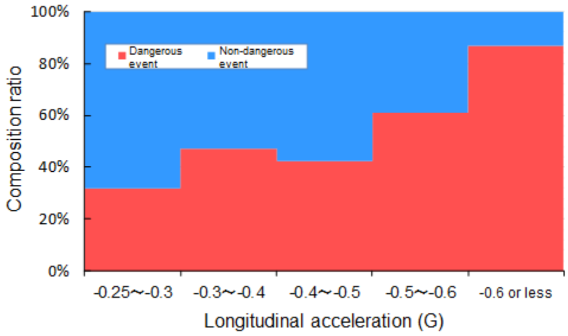

Fig. 4 Ratio of dangerous and non-dangerous events in the intersection inflow passage by longitudinal acceleration

inflow passage are recognized as dangerous events, while non-dangerous events are included at a rate of about 40 to 60 % when the range of longitudinal acceleration is in a range of -0.25G to -0.6G. Accordingly, we are going to develop a method for identifying dangerous events from road structures, such as by drawing stop lines and the number of lanes.

3. Study for effective utilization of the portable ETC2.0 roadside unit

ETC2.0 probe information data is collected when a vehicle with an exclusive in-vehicle unit passes by a roadside unit installed on expressways and national highways under the direct control. This data consists of "travel history data" in which the location of the vehicle, time, travel speed and other information are recorded, and "behavior history data" in which longitudinal acceleration, horizontal acceleration, etc. are recorded. However, according to the present arrangement of roadside units, behavior history data necessary for analysis cannot be obtained in some areas due partly to the capacity of data accumulation as the roadside units are spaced too far apart. Therefore, in this study, thinking that the necessary data could be acquired by temporarily installing portable roadside units as shown in Fig. 5, we analyzed the effect of installation in areas where portable roadside units were actually installed. Specifically, we obtained density estimation values for travel history data and behavior history data by conducting Kernel density estimation for each 50m mesh unit and calculated the "behavior history density estimation value per travel history density estimation value" with the data values obtained from the 50m

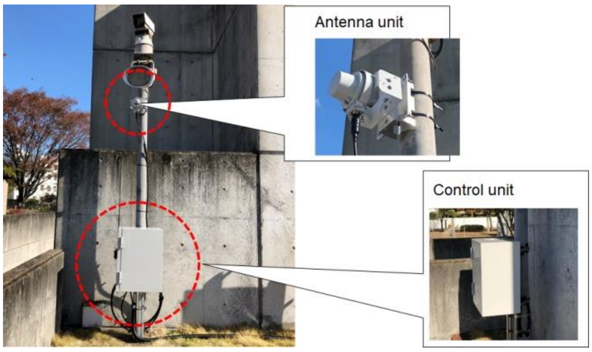

Fig. 5 Portable ETC2.0 roadside unit (Temporary installation is possible.)

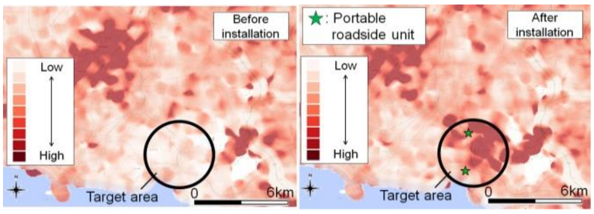

Fig. 6 Behavior history density estimation value per travel history density estimation value (Comparison before and after portable roadside unit installation)

meshes. Figure 6 provides a comparison of these values before and after unit installation. The figure shows that the ratio of behavior history density estimation value is high in the target area after installation of the portable roadside units. This means that behavior history data, which had not been obtained, could be newly obtained by installing portable roadside units. In addition, as a result of conducting such an analysis across a wide area by density estimation at the stage before installation, areas where the ratio of behavior history density estimation value was relatively low were pinpointed, which facilitated our studies of effective areas where portable roadside units should be installed. We are going to study in detail effective installation locations and methods, installation timing in order to ensure the necessary number of samples, etc.

4. Conclusion

We continue to improve our analyses of ETC2.0 probe information both in terms of "quality" and "quantity" and promote its utilization for planning and assessing traffic safety measures in the country.

☞**See the following for details.**
Website of the Road Safety Division
http://www.nilim.go.jp/lab/geg/index.htm