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An Effectiveness Estimation Method for Active Safety Systems Based on Crossing Collision Spreadsheet Database

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Crossing collisions are responsible for the second highest number of traffic accident casualties in Japan after rear-end collisions. So, it is essential for automakers and traffic-safety-related stakeholders to take countermeasures to reduce the collisions. To help such actions, crossing collision study cases investigated by the Institute for Traffic Accident Research and Data Analysis (ITARDA) from 2013 to 2017 were reconstructed on spreadsheets as a crossing collision case study database. In almost all cases, two dominant parties are involved in one collision. Both parties' movement were expressed like in Fig. 1. Cars are assumed to have forward cameras and front corner millimeter wave radars as in-vehicle detection sensors and their ranges are also indicated in the figure to understand if the vehicles could take avoiding actions by themselves. As a result, a total of 108 car-to-car, 24 car-to-motorbike, and 65 car-to bicycle collisions were modeled on the spreadsheets.

The database was applied to estimate system effectiveness such as AEB (Automatic Emergency Brake), FCTA (Front Cross Traffic Alert) and V2X (Vehicle-to-X, such as vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-network and so on) with system specification assumption, those are, control delay, drivers' response delay, information transfer delay, average deceleration and so on. It was also counted in that vehicles and drivers would not apply avoiding brakes when they could not judge the oncoming targets trace collision path. The target combination were vehicle-to-motorbike and vehicle-to-bicycle. The result of vehicle-to-bicycle cases is shown in Fig. 2. It seems as if V2X shows more effective measure to reduce collisions than AEB and/or FCTA.

However, it should be noticed that ITARDA's case study database, which is the source of the spreadsheet database, has different distribution compared to traffic accidents actually occurring whole in Japan. So, a method is proposed to compensate the bias. In particular, the cases in spreadsheet database are allocated to number of traffic accidents in statistics by comparing both speed distribution. The result is shown in Fig.3.

Fig.3 indicates that AEB and/or FCTA shows more effective than V2X. It means that actual collisions are occurring in lower speed range than those in case study database which enables in-vehicle systems' braking in time for collisions.

It should be noticed that the result does not mean each number of collisions will be diminished by the system activation but indicates each system could be activated and the collisions may be diminished. The operation factor, for example, the ratio of drivers' taking avoiding actions after receiving crash possibility information or the ratio of collision risk detection/recognition should be taken into the result in addition.

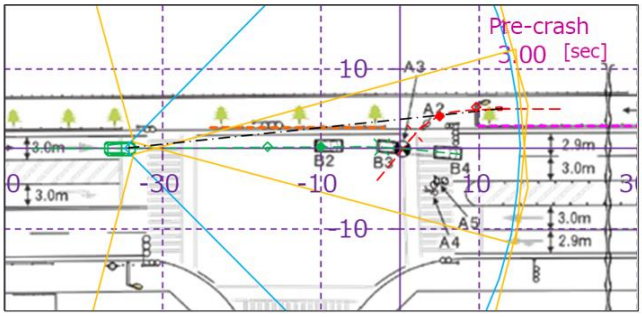

Fig. 1 Example of car-to-bicycle collision and in-vehicle sensor detecting areas

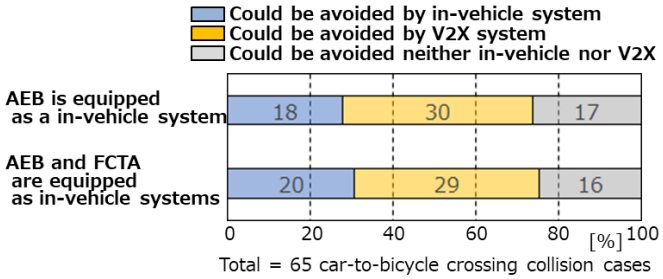

Fig. 2 Car-to-bicycle crossing collision cases which could be avoided in the spreadsheet database

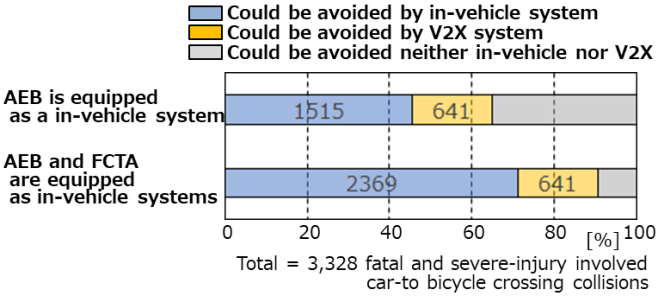

Fig. 3 Car-to-bicycle crossing collisions which could be avoided when expanded to the traffic accident statistics in 2019