

# Driver Interventions during Emergency Manoeuvres by Level-3 Automated Vehicles (Second Report)

- Effects and Countermeasures of Driver Intervention Behavior during Emergency Manoeuvres by Steering -

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An automated driving system, defined as Level 3 by the Society of Automotive Engineers, handles all dynamic driving tasks, including object and event detection and response, inside its operational design domain. However, when the system reaches its functional limit or if it malfunctions, it requests the driver to take over the driving task, called a request to intervene (RtI), and the driver must respond within several seconds. On the other hand, in UN-R157, emergency maneuvering (EM) is required to reduce an imminent collision risk due to sudden changes in traffic conditions because there is no time to issue RtI and driver response. In the previous report, we investigated driver behavior during various types of EM and its effect on risk. However, the amount of data on EM by steering was small; henceforth, this study increased the number of data and organized considerations for driver intervention during EM.

A total of 53 drivers participated in our driving simulator experiment. We set an experimental condition as EM by steering, as shown in Figure 1. The experimental results showed that more than half of the drivers first performed steering operations in response to EM by steering, as shown in Figure 2(a). As shown in Figure 2(b), drivers who intervened by pedal operation also always performed steering operation afterward, and there were no cases in which only pedal operation was used. In the cases where rightward steering intervention was performed at a relatively early timing during EM steering control, there were many cases of collisions with the median strip. As shown in Figure 3, the risk of collision with the median strip tended to increase when the driver intervened in the same direction at a time when the lateral control force (yaw rate) by EM was high. Therefore, it was suggested that measures such as temporarily restraining the driver's intervention operation would be effective. Based on the results of the first report and this experiment, we summarized the items that the system should consider when the driver intervenes during EM.

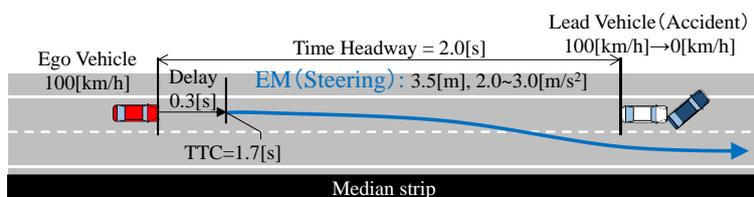
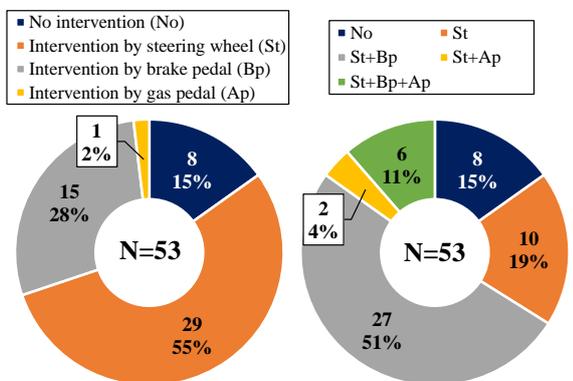


Fig.1 An experimental condition (EM by steering)



(a) First intervention (b) Combination of intervention  
 Fig.2 Composition rate of driver intervention

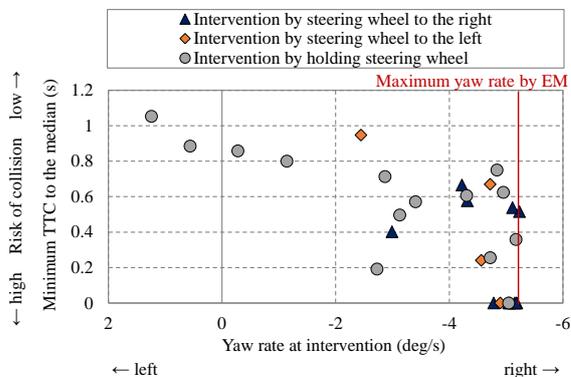


Fig.3 Relationship between yaw rate at intervention and minimum TTC