

# Proposal of a decision-making method for initiate lane change support functions based on investigation of the impact on other vehicles resulting from lane change action

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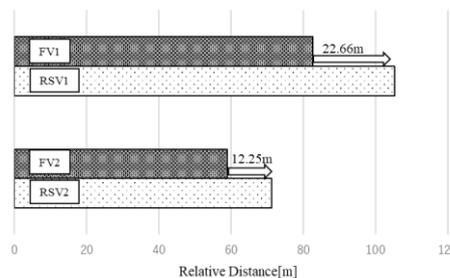
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Since lane change is mentioned as a driving technique that general drivers are not good at, moreover, there are accidents during lane change, functions to support lane change are being actively developed. It is necessary to improve social acceptance in developing a lane change support function with a high automation rate. In this study, we will clarify the following two things in order to develop a lane change function that is highly acceptable in society. The first thing is the difference in subjective evaluation between the driver that changes lane and the driver that receiving the lane-changing with respect the relational distance at the start of lane change. The Second thing is the effect of the lane change implementation procedure on the decrease in vehicle speed of vehicles receiving the lane-changing.

For the first thing, we implemented a subjective test. The test was conducted two vehicles. The driver in one vehicle will continue to

score whether he wants change lanes at the current relational distance from the behind vehicle. Additionally, the other driver in behind car will continue to score whether it is permissible for the vehicle in front makes change lanes. As a result, the driver in behind vehicle(hereinafter referred to as RSV) wants longer distance than the driver in front vehicle(hereinafter referred to as FV). Fig1 shows average distance difference between FV and RSV. In fig1, FV1 is the distance the driver in FV rated as 'comfortable' and RSV1 is the distance the driver in RSV rated as 'comfortable'. Also, FV2 is the distance the driver in FV rated as 'not optimal, but acceptable' and RSV2 is the distance the driver in RSV rated as 'not optimal, but acceptable'. The distance of RSV1 is 22.66m longer than the distance of FV1, moreover, The distance of RSV2 is 12.25m longer than the distance of FV2. This result suggests that if the lane change function sets the distance to determine the start of a lane change according to the criteria of the driver in FV, it may become an unacceptable criterion for the driver in RSV. Therefore, we conclude that the acceptability of the vehicle to change lanes is taken into consideration as the design of the relational distance required at the start of the lane change function with a high automation rate.



**Fig 1 Average distance difference between FV and RSV**

is 22.66m longer than the distance of FV1, moreover, The distance of RSV2 is 12.25m longer than the distance of FV2. This result suggests that if the lane change function sets the distance to determine the start of a lane change according to the criteria of the driver in FV, it may become an unacceptable criterion for the driver in RSV. Therefore, we conclude that the acceptability of the vehicle to change lanes is taken into consideration as the design of the relational distance required at the start of the lane change function with a high automation rate.

For the second thing, we implemented the survey using data that observed the relative relationships between general vehicles on the highway. The viewpoint of the survey is how the progress of the lane change procedure of the vehicle changing lane affects the decrease in speed of the vehicle receiving the lane change. In this paper, the lane change procedure is defined as the following four. A) is the period of from the start of lighting of the turn signal to the start of lateral movement. B) is the period of from after A) to a part of the vehicle enters the target lane. C) is the period of from after B) to a hole body of the vehicle enters the target lane. D) is the period of from after C) to convergence to the center of the target lane. As a result, 61% of general vehicles start decrease the vehicle speed in period B). This shows that even if the lane change is canceled before entering the target lane, the following vehicle in target lane will be affected and make decrease in vehicle speed. On the other hand, 18% of general vehicles start decrease the vehicle speed in period A). This result shows that deceleration of the following vehicle speed may start regardless of whether or not the forward vehicle has changed lanes when the turn signal is turned on, and the effect of this on the traffic flow cannot be ignored. Therefore, we conclude that considering the impact on traffic flow, the turn signal lighting start by the lane change vehicle should be carried out only when it can make the lane change be completed by predicting the surrounding environment at the end period of lane change.

Finally, based on the above two conclusions, we constructed a automatically lane change implementation judgment method and implemented it on public road verification vehicles. According to public road verification test, our method could suppress the effect to traffic flow by suppressing the lighting of the turn signal when the relative relationship with the following vehicle deteriorates beyond the prediction at the start of lane change.