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Passing through the Intersection Based on the Blind Spot Information for Automated Driving

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Intersections are very critical environments for Autonomous Vehicles (AV) to pass through smoothly because of the necessity to consider the other traffic participants' motions and traffic rules. One common traffic scenario at intersections is illustrated in Fig. 1 where an AV plans to turn right with a blind spot of the opposing lane because of facing a car planning to turn left with respect to AV. As the safety is our prime priority, the AV must consider that an occluded vehicle may suddenly rush out from the blind spot towards the crossing point in the opposing lane and collides with the AV. Therefore, we modified our path planning module to safely deal with this situation during autonomous driving. The visibility of an intersection by an AV is evaluated by the time (t) of the occluded vehicle to reach the crossing point compared to the AV's time (T). As the occluded vehicle is not detectable, t is obtained from the map information of the lane regular and allowable speed in the blind spot. The passing time of AV (T) is estimated by continually considering the velocity, the speed limit (considering curvature parameters), the acceleration and the remaining distance to the crossing point. Accordingly, the visibility is low when t<T and the AV slows down and stops at the stop line. The AV starts to turn right when the visibility is improved due to the motion of the facing car or observing the change of the traffic signals.

The proposed strategy is evaluated using 50 trails of different driving scenarios and surrounding vehicles in Odaiba area. The path planning module's performance is compared in terms of the average speed and the maximum deceleration when passing through the intersections with/without the proposed method.

Fig. 2 and Table 1 show the evaluation results. One can observe that the number of the sudden decelerations (more than 3.0[m/s2]) is reduced 33% by the proposed method. The five sudden decelerations that occurred by the proposed method were not directly related to the right-turn decision. Furthermore, Fig. 2 demonstrates that the sudden deceleration in the range of 10.0-15.0[km/h] is significantly reduced by the proposed method. Accordingly, the safety of right turns at intersections was improved considerably. On the other hand, the number of data with almost no deceleration (Table1: less than 1.0[m/s2]) was reduced 50%. Finally, Fig. 2 indicates that the number of data with deceleration of 1.0-2.0 [m/s2] has been increased and this increment can be neglected. Thus, the modified path planning becomes more reliable and safer to control the AV vehicles during autonomous driving. We proposed a significant modification of the path planning module to safely deal with a common traffic situation at intersections based on blind spot information. The experimental results have verified that the number of sudden decelerations at the intersections was reduced 33% and the safety of autonomous driving has been improved as well.

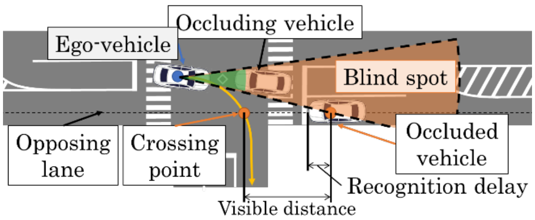

Fig.1 Turning right with bad visibility

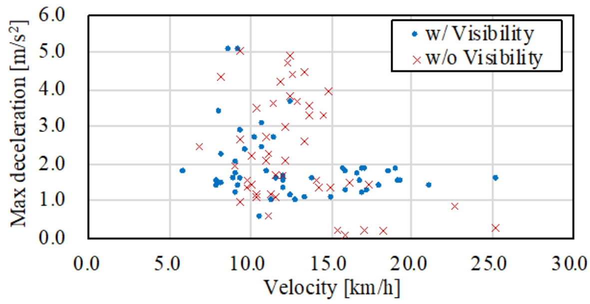

Fig. 2. Distribution chart of the simulation

Table 1 Number of sudden and gradual decelerations

	w/ Visibility	w/o Visibility
Number of samples	50	50
Deceleration above 3.0[m/s^2]	5	15
Deceleration bellow 1.0[m/s^2]	5	10