

High-precision localization system using infrastructure Lidar

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Infrastructure sensors are required to reduce-cost for connected AD-vehicle in limited-area, by reducing large quantity of high-cost onboard hardware. Conventional infrastructure localization system has low precision, to ensure safety, localization error must be below 10cm. Our system provides localization needed by low-level AD vehicles at junctions/parking-areas ODD as shown in Fig. 1.

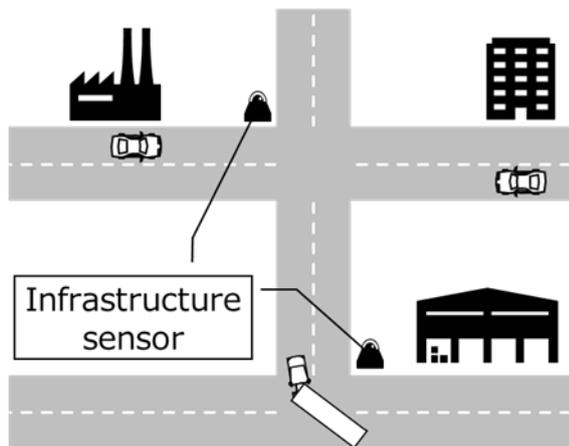


Fig. 1 Use case scenario

To maintain efficiency, an initialization mechanism is developed to estimate initial poses for ICP without stopping by triggering entry signals at ODD entrances. (Fig. 2)

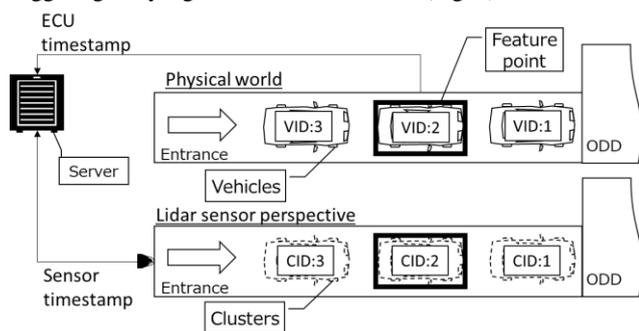


Fig. 2 Initialization mechanism at ODD-entrances

Also, considering vehicles operating within factories could potentially be a truck with a trailer connected by a rotating joint, a filtering function is proposed and added to the localization software, which enables the software to selectively localize the truck head. The filter function has been tested on LGSVL simulation with a truck and trailer model. This new filtering function managed to localize the pose of the truck head of the truck and trailer model as shown in Fig. 3.

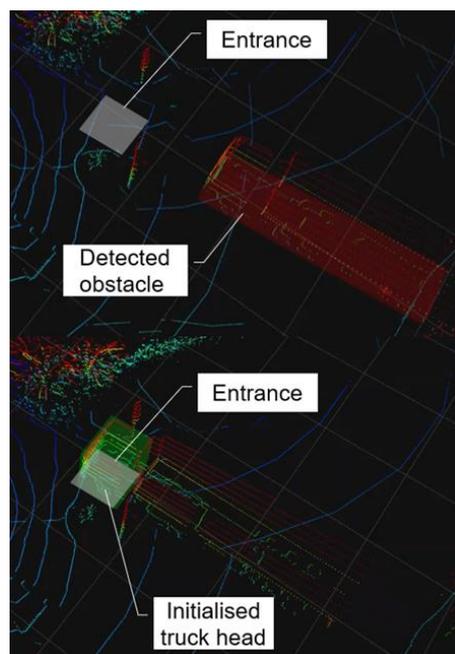


Fig. 3 Truck and trailer initialization and localization

The initialization mechanism has successfully provided an estimated initial vehicle pose, allowing vehicles to be localized without stopping to maintain a smooth operation. The localization software is verified with prerecorded experimental data from a passenger vehicle and an infrastructure Lidar. Result in Fig. 4 shows the maximum localization error of a stationary vehicle is 0.04 m. The target goal to localize vehicles remotely using infrastructure with less than 10 cm error has been achieved.

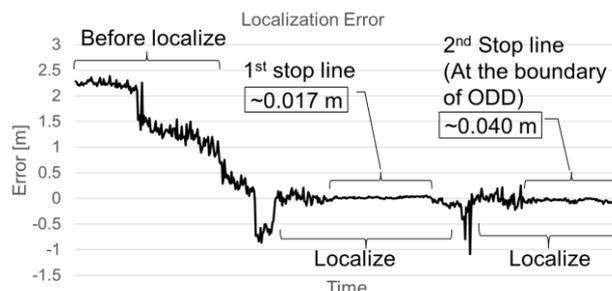


Fig. 4 Error between Localization result vs. Ground Truth

Future tasks remain: 1) A real-time experiment with vehicles has not been conducted to verify the effect of communication latency on localization. 2) The filter function to localize truck heads have to be tested with an actual truck with a trailer.