講演番号	123

文献番号	20226123

Improving Shape Estimation and Tracking Performance of Trailer Trucks at Turns

Yamato Yonemura [1)] **Keisuke Yoneda** [1)] **Naoki Suganuma** [1)]

1) Kanazawa University, Graduate School of Natural Science and Technology, Division of Frontier Engineering
Kakuma-machi, Kanazawa City, Ishikawa Prefecture, 920-1192, Japan

KEY WORDS: **Safety, Intelligent vehicle, Road environment recognition,** Tracking, Trailer trucks [C1]

In order to realize safe automated driving, it is necessary for an automated vehicle to accurately recognize its surrounding environment. In this research, LIDAR (Laser Imaging Detection and Ranging), which has superior ranging accuracy, is used for environmental recognition, and information on the surrounding environment is acquired as observed values. In this study, extended object tracking, in which objects are treated as rigid bodies, is used to improve tracking performance.The shape of the surrounding vehicles was represented by a rectangular box based on the observations and tracking information obtained. However, Robust tracking of trailer trucks at turns is very difficult for autonomous vehicles. This is because of the difficulty to represent the trucks by rectangular bounding boxes due to the massive change in the shape compared to the normal vehicles. Therefore, we propose a new strategy to represent the trailer trucks by two bounding boxes that are considered as individual objects and connected in the tracking process simultaneously.

The top of the bend of the articulated track (bend point) is searched for, and the point cloud obtained from LIDAR is divided into two parts at the bend point. By creating a rectangular box again for each of the divided point clouds, truck and trailer can be recognized and tracked separately. A temporary contour point (reference point) is searched from the point cloud obtained from LIDAR, and an approximate straight line using this point cloud is used to search for bend point. Details of the bend point search are shown below and in Figure 1.

(1) Divide the rectangular box in the longitudinal direction.
(2) Search for the point closest to the vehicle (this is the reference point) on the line to be divided.
(3) Create approximate straight lines from both ends of the obtained candidate points.
(4) If the angle θ of the two lines satisfies
$0.65\pi < \theta < 0.95\pi, -0.95\pi < \theta < -0.65\pi$,
the intersection point is the bend point.

Based on the obtained bend point, the point cloud is divided into two parts as shown in Figure 2. The bisector of the angle between the two approximate lines is calculated and the point cloud is divided into two parts, one above and one below the bisector. The bend point is stored in both point clouds. The rectangular box is obtained again for the divided point cloud. The obtained bend point is leveled by updating it with a low-pass filter.

Tracking using a segmentation algorithm and simple rectangular box tracking are performed and compared. The evaluation was conducted using a possible use case, in which an experimental vehicle and an trailer truck are running side by side. In the case of simple rectangle box tracking, the rectangle box generated to enclose the bent shape is large enough to include the area where no point cloud can be obtained, and thus may be misjudged as a collision. Therefore, the distance from the side of the vehicle to the object being tracked is calculated and compared. Figure 3 shows the evaluation results. By using the segmentation algorithm, the distance from the side of the vehicle to the tracked object was improved by approximately 1.8[m] at the maximum, the relative position of the vehicle and the adjacent track was estimated appropriately, and the misjudgment of collision was improved.

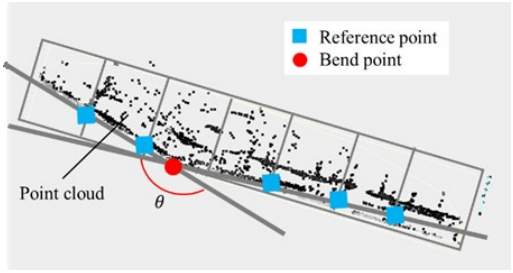

Fig.1 Finding bend point using approximate

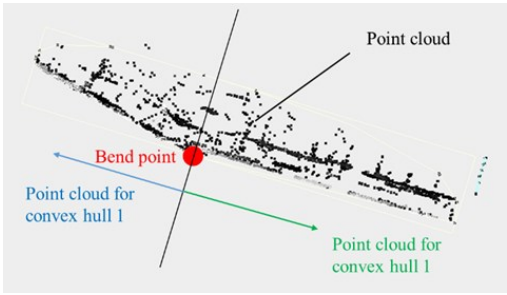

Fig.2 Divide the point cloud into two parts lines

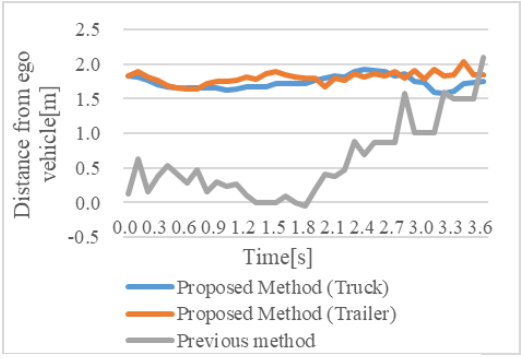

Fig.3 Distance between ego vehicle and tracked objects

In this study, we aimed at robust shape estimation for turning trailer tracks by searching for bends and dividing the point cloud based on bend point to truck and trailer separately. The segmentation algorithm greatly improves the tracking performance, and the position of the rectangular box of the tracking information can be estimated appropriately. It also improved the misclassification of collisions.