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Visualization of evidence by AI Object Detection results using 3D Point Clouds in Autonomous Driving

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In recent years, a lot of research about object detection using AI has been widely conducted for the purpose of the development of autonomous driving system. In particular, 3D object detection using point clouds of LiDAR has gathered attention and it has been improved to achieve both of high detection accuracy and high speed inference. Although AI helps object detection to achieve high detection accuracy, it is difficult to explain the evidence of results due to its black box mechanism. The ambiguity of evidence may cause the difficulty of quality assurance, therefore it has become a major obstacle for AI being implemented to products and working in real world. The technology which visualizes evidence of AI has gained attention as XAI (Explainable AI), however, most of it is intended for tasks of image recognition, especially image classification, not object detection which identify the object locations. In addition, most of XAI methods depend on internal information of AI model and few of them can be applied to various AI models generically. Therefore, we have considered XAI methods which can be intended for 3D object detection and generically applied to various AI models to be necessary.

In this study, we extend the existing XAI method named as D-RISE which has already adopted in the field of 2D object detection and we established the versatile XAI method which is intended for 3D object detection using point clouds of LiDAR. We indicate the overview of the process of this method in Fig. 1. The input point clouds of a vehicle are illustrated in the upper left in Fig. 1. At first, from the fluctuation of object detection results of randomly masked point clouds, we calculate the importance score of each point. And then, we visualize the evidence of object detection results by coloring each point according to those importance score, and the output is illustrated in the bottom right in Fig. 1. We also indicate the results of applying this method to our own dataset and the importance scores of some vehicles are visualized with two views in Fig. 2. This result shows that highly important point clouds are located in the vehicle surfaces faced with the ego vehicle and points from the ground and surrounding structures are considered as less important. By visualizing this method, we can confirm whether an object detector under development can grasp features properly for learning and we can take advantage of it for the development of object detection.

Although there has been less researches about XAI for 3D object detection until now, we can assume that there will be growing demands of it, considering the spread of autonomous driving system. If effective XAI besides this method appears in the future and supports the development of 3D object detection, we may be able to remove the obstacle to implementing AI to products of autonomous driving. We expect that the technology in XAI field will continuously make progress and realize the products of autonomous driving system equipped with highly reliable AI.

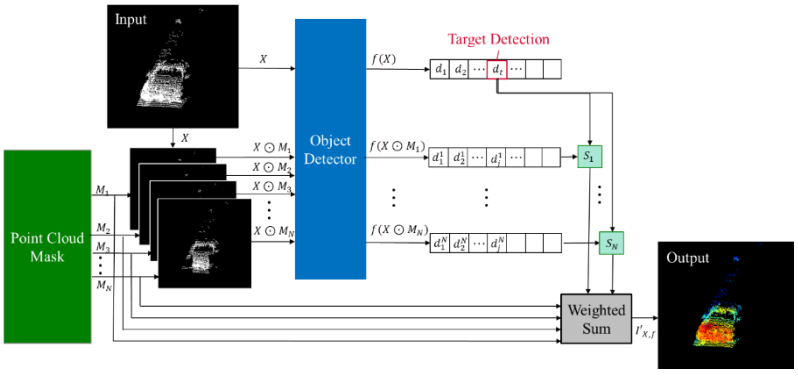

Fig. 1 Overview of XAI method for 3D Object Detection

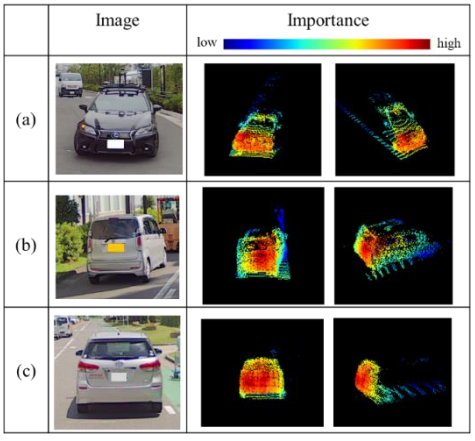

Fig. 2 Visualization of Importance score of Cars