ABSTRACT

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Degree Received: May 2019
Title: Moving Objects Detection and Tracking with Doppler LiDAR
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Perceiving the dynamics of moving objects in complex scenarios is crucial for smart monitoring and safe navigation, thus a key enabler for intelligent supervision and autonomous driving. A variety of research has been developed to detect and track moving objects from data collected by optical sensors and/or laser scanners while most of them concentrate on certain type of objects or face the problem of lacking motion cues. In this thesis, we develop a model-free detection-based tracking approach for detecting and tracking moving objects in street scenes from time sequential point clouds obtained via state-of-art Doppler LiDAR, which can not only collect spatial information but also Doppler images by using Doppler-shifted frequency. We first use Doppler images to detect moving points and determine the number of moving objects, which are then completely segmented via a region growing technique. The detected objects are then input to the tracking session which is based on Multiple Hypothesis Tracking (MHT) with two innovative extensions. One extension is that a new point cloud descriptor, *Oriented Ensemble of Shape Function (OESF)*, is proposed to evaluate the structure similarity when doing object-to-track association in MHT. Another extension is that speed information from Doppler images is used to estimate the speed state of the moving objects, which is integrated into MHT to improve the state prediction of moving objects. The proposed approach has been tested on datasets collected by a terrestrial Doppler LiDAR and a Mobile Doppler LiDAR separately. The quantitative evaluation of detection and tracking results shows the unique advantages of the Doppler LiDAR and the effectiveness of the proposed detection and tracking approach.