## Guest Editorial Special Issue on 3D Sensing in Intelligent Transportation

H IGH-ACCURACY and high-efficiency 3-D sensing and associated data processing techniques are urgently needed for today's roadway inventory, infrastructure health monitoring, autonomous driving, connected vehicles, urban modeling, and smart cities. 3D geospatial data acquired by digital photogrammetry or laser scanning or LiDAR systems have become one of the most critical data sources to support the above-mentioned applications. While progress has been made to applying 3D sensory data to those applications related to intelligent transportation systems (ITS), such as road network extraction, platform localization, obstacle avoidance, high-definition map generation, and transportation infrastructure inventory, many essential questions remain regarding the processing and understanding such massive 3D datasets in ITS-related applications. The authors have selected four articles for review in this Special issue. A summary of these articles is outlined below.

The article entitled "Moving object detection by 3D flow field analysis," by Jiang et al., presents a complete framework to detect and extract moving objects, such as walking pedestrians or moving trucks, from a sequence of unordered and texture-less point clouds. The authors propose a novel 3D Flow Field Analysis approach to accurately detect the moving objects from data acquired with a possibly fast-moving platform. The proposed algorithm elegantly models the temporal and spatial displacement of the moving objects. The authors proposed a Sparse Flow Clustering algorithm to group the 3D motion by incorporating sparse subspace clustering framework flows to achieve 3D reconstructions. Experiments on the KITTI dataset proved that the proposed methods are highly effective for motion detection and segmentation and yield high-quality reconstructed static maps and rigidly moving objects.

The article entitled "Automatic extraction of roadside traffic facilities from mobile laser scanning point clouds based on deep belief network," by Fang *et al.*, extracts the traffic facilities (trees, cars, and traffic poles) beside the road to provide richer information to the intelligent transportation system, infrastructure inventory and city management related applications. This study separates the raw off-ground point clouds into individual segments and designs an object-based Deep Belief Network (DBN) architecture to detect roadside traffic facilities with limited labeled samples. One of their contributions is the development of a general and straightforward multi-view feature descriptor to characterize the global feature of individual objects and extend the training samples' quantity. Accuracy evaluations and comparative studies on trees, cars, and traffic poles prove that the proposed method can achieve promising performance of roadside traffic facilities detection in complex urban scenes.

The article entitled "Capsule-based networks for road marking extraction and classification from mobile LiDAR point clouds," by Ma et al., proposes a method to accurately extract and categorize road pavement markings to build a highdefinition map. The authors designed a capsule-based deep learning framework to extract and classify road markings from MLS point clouds to deal with the variations of point density and intensity from mobile laser scanning (MLS) systems. The network segments, extracts, and classifies road marking in stages. The article built a dataset containing both 3D point clouds and labels from three road scenes, including urban roads, highways, and underground garages. The proposed method was accordingly evaluated by estimating robustness and efficiency using this dataset. Quantitative evaluations indicate the proposed extraction method can deliver 94.1% in precision 90.5% in recall, and 92.4% in F1-score, respectively, while the classification network achieves an average of 3.4% misclassification rate in different road scenes.

The article "Three-dimensional entitled object co-localization from mobile LiDAR point clouds," by Guo et al., proposed a framework to locate 3D objects without any help of supervised training data to avoid the expense of manual annotation. The framework can automatically extract objects of the same category from different point cloud scenes by formulating a 3D object co-localization problem as a maximal subgraph matching problem. To handle the inconsistent representation of objects in various scenes, the authors propose a multi-scale clustering method to represent objects by a pyramid structure. Extensive experiments on the point cloud data collected by the Reigl VMX450 mobile LiDAR system demonstrate the promising performance of the proposed framework.

The Guest Editors would like to express their deep gratitude to all the authors who have submitted their valuable contributions and to the numerous and highly qualified anonymous reviewers. The selected contributions, which represent the current state of the art in the field, will be of great interest to the ITS community. The Guest Editors would also like to thank the IEEE publication staff members for their continuous support and dedication.

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