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GUEST EDITORIAL

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Special issue on recent advancements in simultaneous localization and mapping (SLAM) and its applications

Simultaneous localization and mapping (SLAM) is a computational problem of constructing or updating a map of an unknown environment while tracking an agent's location within it. SLAM algorithms have been widely and successfully used in the fields of navigation, robotic mapping, environmental reconstruction, and virtual or augmented reality applications. They are tailored to available resources, not aiming at perfection but at operational compliance. They often require various optimizations. Recent advances in deep learning, mobile technology, 5G communications, and sensors are changing and pushing the limits of traditional SLAM algorithms to enable SLAM to become accurate, fast, and even intelligent.

In this special issue, we have selected several papers representing recent outstanding results in the progressing subjects of SLAM and its applications.

The first paper, "Collision-Free Local Planner for Unknown Subterranean Navigation" by Sunggoo Jung et al., addresses an autonomous exploration framework in unknown environments, which is an important application of SLAM algorithms, using a small-sized and lightweight drone with a 2D LiDAR (light detection and ranging) sensor. Using the LiDAR measurements, the authors proposed a local planning method that can generate consistent collision-free paths, connected by the current position and their end-point selection method. The integrated autonomy framework from the proposed method is demonstrated through real-world experiments conducted in the scenario of subterranean navigation.

The next paper, "Automatic Wall Slant Angle Map Generation using 3D Point Clouds" by Jungyun Kim et al., presents a method for automatic generation of wall slant-angle map based on a combination of a LiDAR-inertial SLAM framework and set of data processing procedures. The LiDAR-inertial SLAM framework produces a gravity compensated 3D point cloud map, where the slant angle of walls can be computed. In addition, the authors propose a backpack-type mapping platform for capturing urban environments online. The effectiveness of the proposed method is validated by large-scale real-world experiments with multiple walls.

In the third paper entitled "DiLO: Direct LiDAR Odometry based on Spherical Range Images for Autonomous Driving" by Seung-Jun Han et al., a direct odometry-estimation method using LiDAR scan measurements is introduced. To apply the direct odometry estimation approach to the LiDAR scans, the LiDAR measurements are converted into spherical ranging images to extract the image-based geometric features and their keypoints; then, an optimization step is performed to estimate the pose transformation parameters between the image frames. The experimental results demonstrate the proposed method with the KITTI benchmark datasets and experimental dataset obtained using the authors' autonomous car platform.

The fourth paper, "Onboard Dynamic RGB-D SLAM for Mobile Robot Navigation" by Bruce Canovas, Michèle Rombaut, and Amaury Nègre, proposes a real-time dense RGB-D SLAM system targeting mobile robot navigation in static and dynamic indoor environments. The moving elements are filtered out using object detection and ego-motion compensation processes. The computational speed and memory efficiency of the SLAM algorithms is improved using a map representation based on 3D-planar patches generated from superpixels. The authors show that the proposed SLAM system can be successfully deployed on a mobile platform and integrated with a path-planning algorithm. The experimental results demonstrate the consistent performance of mapping and the robustness of tracking in challenging scenarios.

The final paper, "ETLi: Efficiently Annotated Traffic LiDAR Dataset Using Incremental and Suggestive Annotation" by Jungyu Kang, Seung-Jun Han, and Kyoung-Wook Min, introduces an efficiently annotated dataset for semantic segmentation of LiDAR data in the context of autonomous driving. This dataset presents various data collected from different mobile platforms under different weather and environmental conditions. The authors are planning to make it available to the public because it can benefit the SLAM research community. Besides the dataset, an efficient annotation routine is proposed to build a training dataset from raw data using a minimal set of representative frames. A semantic SLAM application is presented based on a LiDAR semantic segmentation model trained using the proposed dataset. This demonstrates the capacity of integrating the solution with existing SLAM systems.

The Guest Editors wish to thank the authors, reviewers, and editorial staff of ETRI Journal for making this special issue a success. We are very pleased to have been a part of this effort and for ensuring the timely publication of these high-quality technical papers.

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