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Editorial

Special Issue on Mobile Robots Navigation II

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Mobile Robots Navigation II

Navigation is one of the fundamental abilities that mobile robots must be endowed with, so that they can carry out high-level tasks autonomously in any a priori unknown environment. Traditionally, this problem has been addressed efficiently through a sequence of actions. First, the surroundings of the robot are perceived and interpreted. Second, the robot estimates its position and orientation within the environment. With this information, a trajectory towards the target points is planned, and the vehicle is guided along this trajectory, often including a reactive action that considers obstacles, possible changes, or interactions with the environment or with the users.

The robot may be equipped with different kinds of sensors to perceive the environment, such as laser rangefinders or visual systems of RGB-D platforms, and any of them presents some particularities that must be considered while designing the navigation algorithms. Additionally, in broad lines, navigation can be addressed from two different perspectives, depending on the existence of an initial model or map of the environment. In cases where no map is initially available, an exploration step can be included to achieve complete knowledge of the environment. Integrated exploration systems consider all these issues jointly, and they develop trajectory planning and control, while a model of the environment is obtained, and the robot estimates its position and orientation within it.

The aim of this Special Issue was to present current frameworks in these fields and, in general, approaches to any problem related to the navigation of mobile robots either when they move in a plane (3D) or in a space (6D). There were 22 papers submitted to this Special Issue, from which seven papers were accepted (i.e., 32% acceptance rate), which addressed the previously described problems.

First, some of the papers focused on modeling the environment and extracting information from it. Román et al. [1] propose and evaluate an incremental clustering approach to obtain compact hierarchical models of indoor environments, using an omnidirectional vision sensor as the only source of information. The algorithm is structured in two loop closure levels, and the images are described through holistic methods. The most relevant parameters of the algorithm adapt their values as new information, which is included in the map. The experimental section shows the efficiency of the method with real data. Placed and Castellanos [2] address the Active SLAM problem (Active Simultaneous Localization and Mapping). They formulate this paradigm in terms of model-free Deep Reinforcement Learning, in such a way that the traditional utility functions are embedded in the reward function and the intensive computations of classical approaches are relaxed. Such formulation is validated in a complex simulation environment with realistic models for the robot, sensors and environment physics. Wu et al. [3] develop an intelligent path recognition approach for visual guidance of automated guided vehicles (AGV) in complex workspaces, to cope with some of the problems that arise in such spaces, such as non-uniform illumination, occlusion or stripe damage. The method can convert a curvilinear path into piecewise straight paths first and then estimate an accurate linear model for each straight line. The experimental results prove the efficiency of the approach to resist the interference from the workplace in which the AGV operates.

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Second, the Special Issue also addressed the problem of localization for different kinds of mobile platforms and sensory information. Ross and Hoque [4] describe a technique, named FAGPS (Fiducial Augmented Global Positioning System) which periodically uses geolocated fiducial markers to reduce the global positioning system (GPS) drift. Thanks to it, a more accurate GPS determination may be obtained for a period of time. The performance of the method is tested from simulations and from field testing in open-sky environments, where an improvement on horizontal GPS accuracy is reported. Dong et al. [5] also focus on the localization problem and propose a method for adaptive target tracking (TT-EKF), based on Extended Kalman Filter, to simultaneously estimate the state of an autonomous underwater vehicle and a mobile recovery system with unknown non-Gaussian process noise. The effectiveness of this method is verified under simulation and with experimental data analysis. Additionally, Dong *et al.* [6] address the problems of localization and guidance. They report an acoustic-based framework for automatically homing an autonomous underwater vehicle to a fixed docking station and a mobile docking station, including a method for simultaneous localization of AUV and docking station and a guidance method based on the position information. Experimental data are used to verify the performance of the proposal. Finally, Sheng et al. [7] develop Dynamic-DSO, which is a semantic monocular direct visual odometry based on Direct Sparse Odometry, using image semantic segmentation and deep learning to improve localization and mapping in dynamic environments. The validity of the approach is analyzed with the TUM dynamic dataset and the modified Euroc dataset from two points of view: positioning accuracy and ability to construct a semi-dense cloud map.

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