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EDITORIAL

Introduction to the focused section on sensing and perception for autonomous and networked robotics

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Next generation of industrial revolution will be featured with broad applications of intelligent technologies; among those popular ones are intelligent manufacturing and autonomous products like vehicles and robotic systems. In both cases, autonomous operations are at the center of the stage, in which appropriate sensing and perception play critical roles. Indeed, recent advances in sensing and perception technologies have produced exciting new ideas in facilitating autonomous manufacturing and/or robotic vehicular systems. These technologies will potentially evolve with more and more 'smart functions' and move manufacturing and robotic systems from single structured operation to sensing/perception-based self-governed yet collaborative multi-system operations. This Focused Section is dedicated to new progresses in modeling, design, control, communication, and implementation of sensing and perception systems for autonomous and/or networked robotics, and intends to provide the state-of-the-art update of research fronts.

The Focused Section consists of six research papers covering detection of human motion (Jiang, et al.), vision based pose measurement (Zhang, et al.), ream-time object detection and tracking (Benabderrahmane), 3-D map reconstruction (Turan et al.; Landsiedel and Wollherr), and vision based endoscopic capsule robot (Turan et al.).

In Jiang et al., an alternative method utilizing temperature fields and their gradients from infrared (IR) images is presented to improve the perception ability of the blind/visually impaired people who are generally familiar with stationary objects but less confident in congested environment where human motion is unpredictable. This approach takes the advantages of the fact that the human body is essentially a natural heat source and is applied to locate individual person and determine his/her face orientation and motion states. This alternative temperature field based perception method is potentially applicable in intelligent space, smart city and smart cars.

In Zhang et al., a global image-to-ground homography based calibration method is presented to obtain the mapping between the image and the planar scene lying in the whole camera field of view, through fusing multiple local homography matrices. The proposed method does not require the knowledge of internal parameters of cameras and renders high calibration accuracy with easy implementation. It can potentially provide sensing aid for mobile robot localization with an accuracy close to the performance limit of a monocular camera.

In Benabderrahmane, an improved real time object detection and tracking framework is presented, built on Adaboost classification, where a strong classifier is generated using an iterative combination of weak learners. A heuristics optimization algorithm is developed to accelerate the extraction of relevant features from the image. Considerable improvement has been observed when applying

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the method to develop an artificial vision for an intelligent transportation system in term of both computing efficiency and accuracy.

In Landsiedel and Wollherr, a method to localize a robot in a global coordinate frame is proposed, based on a sparse 2D map containing outlines of building and road network information with no presumed location information which is obtained from a single 3D laser scan around the robot. The approach extends the generic *chamfer matching* technique from image processing by including visibility analysis in the cost function. The method is evaluated on two large datasets collected in different real-world urban settings and compared with a baseline method from literature and with the standard *chamfer matching* approach, where it shows considerably improved performance, as well as the feasibility of achieving global localization based on sparse outline data of buildings.

Then it comes with two papers by Turan et al., in which the effective localization and mapping method is specifically investigated for an endoscopic capsule robot in minimally invasive medical diagnostic applications. The simultaneous localization and mapping (SLAM) based on RGB Depth image fusion is developed in the first paper to provide real-time localization of the capsule robot and the reconstruction of a precise 3D map of the inner organ of human bodies. It is seen that this SLAM method is capable of capturing dense, precise, and globally consistent 3D maps of the explored organ. In the second contribution by the same authors, anther novel localization idea is presented for the endoscopic capsule robot inside the GI tract, which is based on the interpretation of optical flow vector of camera frame pairs with deep learning techniques in order to obtain six degree-of-freedom localization information. It is noted that, in this development, only image information retrieved by a camera is assumed, without the need of extra sensors.

These six papers share a common feature in the work presented, that is, the methodologies developed are all applied to process data generated by sensing devices acting on certain kind of physical fields, such as camera and laser scanning, in order to render 2-D or 3-D information of fields. This kind of field sensing and perception development is the key to facilitate the autonomous operation of robotic systems in practices, which is the main theme of this focused section.

We wish to take this opportunity to extend our sincere gratitude to all of the authors and all anonymous reviewers for their valuable time to make this focused section possible. All of these joint efforts are the critical pushing force to ensure the quality of this focused section. Finally, We wish to thank the Editor-in-Chief, Professor Kok-Meng Lee, for his strong leadership, persistent and strong support, and for all the helps he offered during the whole process of preparing this focused section.

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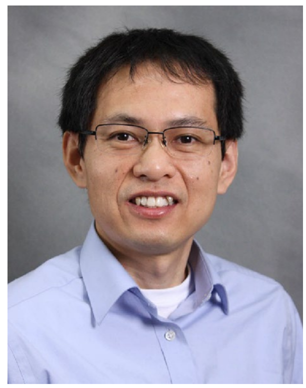

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