Special Issue on Advanced Mobile Robotics

Mobility is an important feature that sets mobile robotics apart from other robotics fields. Mobile robots must be true intelligent systems capable of motion while executing a given task. Most of the key problems in mobile robotics arise from the inherent uncertainties involved in sensing and acting in real-world environments, which are usually unstructured and unpredictable. Autonomous and safe behavior for mobile robots acting in such environments and coping with a wide set of tasks in all operational modes constitutes a fundamental requirement for tomorrow's mobile robotic machines. These systems should detect unforeseen situation and recover into a controlled state.

There is a need to endow the mobile robotic systems with higher cognitive functions that allow recognition of context, reasoning about actions and a higher degree of error diagnostics and failure recovery. Such flexibility can only be achieved through use of advanced cognitive skills and requires elements of perception, decision making, machine learning and other intelligent systems. Cognitive skills are also highly relevant to effectively and safely use mobile robot systems and thus increase user acceptance. Rapidly maturing technology and already proposed approaches support the hope that mobile intelligent robots and other emerging robotic technologies will play an increasingly integral role in improving and protecting our lives in both indoor and outdoor applications.

Nine papers of this special issue of the *Journal of Computing and Information Technology* reflect some, but by no means all of the latest achievements in different technical topics relevant to the development of advanced mobile robotic systems.

An iterative design strategy of advanced mobile robotic systems capable of performing challenging tasks in unstructured and unpredictable environments is the topic of the paper by Michaud *et al*.

Motion control of mobile robots is addressed in three papers. Maček and Siegwart present a new control strategy for path following which combines advantageous characteristics of both Traversability-anchored Dynamic Path Following and Sliding Mode Path Following control strategies, yielding inherent safety and vehicle dynamics margin. Fraichard and Delsart introduce a trajectory deformation technique for robot motion generation, wherein a path, that has been computed beforehand, is continuously deformed on-line in response to unforeseen obstacles. Xie and Fierro propose a so-called first-state contractive model predictive control algorithm, whose stability is guaranteed by adding a contractive constraint on the first state at the beginning of the prediction horizon. The algorithm is applied to the trajectory tracking and point stabilization problems of nonholonomic mobile robots and extended to multi-robot formations.

Intelligent autonomous acting of mobile robots in unstructured environments requires 3D maps. In his paper, Nüchter summarizes a 6D-SLAM algorithm for 3D map building and presents novel algorithmic and technical means to reduce computation time, i.e., the data structure cached k-d tree and parallelization.

Robot interaction abilities with objects, devices and humans in the environment are addressed in three papers. Sjö *et al*. present a method for search and localization of objects in indoor environments with a mobile robot using a monocular camera with zoom capabilities. They show how to overcome the limitations of low resolution images in object recognition by utilizing a combination of an attention mechanism and zooming as the first steps in the recognition process.

Brščić and Hashimoto present an implementation of so-called Intelligent Space system that uses spatially distributed laser range finders for tracking the mobile robot and humans inside the environment and building the map of the environment. Based on these measurements, the control of mobile robot acting as a physical agent of the Intelligent Space is developed. Capezio *et al.* describe a system designed to perform surveillance activities in wide indoor and outdoor areas, like civilian airports, warehouses or other facilities. The overall architecture is based on both a network of heterogeneous devices in the environment and one or more mobile robots.

Robotic walking aid to assist elderly people with mobility constraints is an important application for mobile robots. In her paper, Graf presents a new adaptive guidance system for robotic walkers. It is able to lead the walking aid user to a given target while considering his inputs during guidance and adapting the path respectively.

I would like to take this opportunity to thank all authors for their valuable contributions to this issue. I am deeply indebted to the reviewers for their time and expertise that ensured the highest quality of the papers. Finally, I would like to express my gratitude to Prof. Sven Lončarić, the Editor-in-Chief of the *Journal of Computing and Information Technology*, for giving me the opportunity and honour to serve as the guest editor of this issue.

Prof. Ivan Petrović, CIT Guest Editor