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Editorial

Introduction to the Special issue on “Future trends in robotics and autonomous techniques”



1. Background

Robotics is an extremely dynamic field with thriving advancement in its technology. As research progresses in robotic systems, more and more aspects of vision based processing, GPS enabled services, Autonomous techniques, very far distance communication in robots, dynamic environment handling, mobility techniques, multi-agent control and coordination techniques, multi-robot communication and coordination are explored to make robotics intelligent and to do specific tasks. Vision has helped in many areas for better services and fastens the process for localized results. Advancements in communication, positioning and localization techniques brought the robotics beyond the controlled industrial environments to more dynamic outdoor environments. Research in autonomous and other intelligent techniques has made robots capable of taking decisions in complex environments. The book covers future trends in robotics research topics including motion path planning, routing in dynamic environments, multi-agent control techniques, nature-inspired algorithms and synchronization techniques with interesting applications.

2. Scanning the issue

This special issue covers a range of topics in robotics that have captured high attention and interest of the research community in recent years. The topics include synchronizing motion dynamics between controller and robot, efficient motion planning algorithms for both single (PCB drilling) and multi-objective robots, multi-agent control system to minimize the distance between end-effector to the target and routing for distributed robots operating over the next generation 60 GHz that is prone to high attenuation. The chapters in the book are divided into two parts. The first four chapters form first part that bring novel and practical solutions for motion path planning and end-effector positioning and the last three chapters form second part that address diverse problems including application of meta-heuristics, coordination between controller device and manipulator and routing.

The first paper [1] proposes methods to achieve near-optimal motion planning for multi-objective mobile robots. The algorithm is power efficient and computes in reasonable time supported by data-driven genetic-neuro fuzzy inference system is built to learn and capture the desired dynamic behavior of the mobile robot.

While the first paper deals with multiple objectives of a robot, the second paper [2] takes on multiple agent control to achieve single objective, to bring the end-effector as close as possible to an imposed operational target in 3D environments with high degree of freedom. The interesting fact about this work is that it is generic and fault-tolerant yet does not require complex mathematical models, such as commonly used Inverse Kinematic Model.

The third paper [3] analyses the movement of mobile manipulator performing a pick-up task and proposes a simple and effective approach to perform tasks oriented manipulation in timely manner by transforming two weighted objective functions into only one cost function. The principal objective is time optimization, whereas the secondary objective is transformed into a constraint in the form of a Manipulability index threshold.

The fourth paper presents a solution to one of the most interesting problems, Optimizing PCB drill route process which is still a bottleneck in PCB assembly line [4]. The solution is based on the well-known Intelligent Water Drop (IWD) algorithm that emulates the behavior of the water droplets that constitute a river and how it determines its path while travelling from its starting point to its destination. The algorithm converges much faster than any of the previous methods.

The fifth paper focuses on applications of meta-heuristics in robotics [5]. Meta-heuristics are high-level nature-inspired strategies for collaborative robots to achieve common goals, which are not easily achievable with independent robots. The chapter gives a comprehensive critical survey with latest trends in the field.

The sixth paper proposes to slow down the operator's hand by augmenting by an additional force in inverse direction proportional to the motion (tracking) error caused by the mismatch between the dynamics of the master device and the slave manipulator [6]. This is an interesting approach that significantly reduces the motion mismatch errors over the time.

The seventh paper [7] deals with multi-hop routing for distributed mobile surveillance robotics platforms to stream uncompressed high-definition videos over 60 GHz wireless channel. It proposes a distributed buffering mechanism that is power-aware and stochastic for multi-hop routing for mobile robots.

The eighth paper presents a PSO based algorithms PSO-IAC for obstacle avoidance for manipulator, which can be a part of home service robots [8]. The proposed algorithm for 6 DoF manipulator integrates the constriction factor and the improved adaptive inertia weight with standard PSO.

In conclusion, we consider the outcome of this special issue bring state of the art papers together in the field of Robotics and would be a source of information for researchers in coming years. At the same time, it seems clear how many questions remain still open and unaddressed. We hope these papers can stimulate further and yet deeper research in this exciting field.

We would like to express our deep thanks to the Editor-in-Chief, Dr. Manu Malek, for providing us the opportunity to handle this special issue and his editorial staff for their support and help. We also thank all the authors who submitted their papers, as well the thoughtful work of the many reviewers who have provided invaluable evaluations and recommendations in a timely manner.

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