Hindawi
Mathematical Problems in Engineering
Volume 2017, Article ID 8706164, 2 pages
https://doi.org/10.1155/2017/8706164

Editorial

Applied Mathematics to Mobile Robotics and Their Applications

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Received 29 October 2017; Accepted 30 October 2017; Published 15 November 2017

The topics of this special issue are related to hot problems for the scientific community working not only in robotics since mobile robots are challenging systems for many fields with increasing applications.

Mobile robots can move autonomously in a wide range of environments with or without assistance from external human operators and can be used in a great variety of applications, such as agricultural and industrial works, road transport, exploration, services, information, and orientation in large shopping malls. They can be included in many other systems such as humanoid robots, unmanned rovers, entertainment pets, and drones. A distinctive feature is their ability to move independently, with some intelligence to react and make decisions based on the perception they receive from the environment by means of sensors.

The design and developments of mobile robots involve different technological areas such as mechanics, electronics, and computer science. This multidisciplinary approach implies studies of the dynamic behavior of a mobile robot which are necessary to ensure the performance and safety not only of the mobile robot but also of the environment within which it moves. Sensor and the control systems are also needed to guarantee the result.

It is important to bear in mind that the main pillars of mobile robotics, according to many literature sources, consist of the fields of locomotion, perception, cognition, and navigation.

Locomotion problems mean the understanding of the robot mechanism and its kinematics, dynamics, and control theory as related to the system mobility. Perception implies the fields of signal analysis and specialized areas such as computer vision and sensor technologies. Cognition and perception systems give information about the environment, the robot itself, and the relationship between robot and environment. This information is processed and then appropriate commands are sent to the actuators, which move the mechanical structure. Navigation skills are intended to the robot to move from one place to another in a known or unknown environment, taking into account the values of the sensors. The robot must rely on aspects, such as perception, localization, cognition, and motion control (path, trajectory, and tracking planning). Over the years, numerous methodologies have arisen that attempt to solve motion planning.

This special issue contains the set of the following works that are related to the above-mentioned topics.

In S. Peng et al., the uncertainties in the trajectory tracking problem for a wheeled mobile robot are approximated by a fuzzy logic system. A robust controller is employed to compensate for the lumped errors. As a result, the tracking position errors converge asymptotically to zeros with faster response than other existing controllers.

F. Valero et al. have tackled the influence of the friction coefficient on the trajectory performance for a car-like robot.

Y. Zhang et al. develop a fast-simultaneous localization and mapping (FastSLAM) algorithm for a vehicle in indoor environments. It is based on nonlinear adaptive square root unscented Kalman filter.

L. Bai et al. consider a pneumatic hexapod robot which is driven by inert gas carried by itself. Kinematics, dynamics, and optimal control are attached with design purposes. The optimal input gas pressure of leg swing and body moving in one step is obtained by pseudospectral method.

In Y. Hua et al., a path tracking control of an automatic parking cloud model is proposed by considering the influence of time delay. This paper presents a kinematic model of the automatic parking system and analyzes the kinematic constraints of the vehicle. The effectiveness and timeliness of automatic parking controller are tested in the aspect of path tracking through a real vehicle experiment.

A. Zhiyong et al. present a novel visual tracking algorithm that learns the translation and scale filters with a complementary scheme to object tracking with robust scale estimation which is a challenging task in computer vision.

In P. Li et al., the authors propose an improvement of a path planning algorithm based on Ant Colony Algorithms (ACA). This is carried out by a better parameter selection method that is based on the bacterial foraging algorithm (BFA). The results indicate that the proposed parameter selection is a superior method as being able to determine the best parameter combination rapidly, accurately, and effectively.

We hope that readers will consider this special issue useful for their work on mobile robots regarding advanced mathematical modelling, design, analysis, optimization techniques, and so forth.

Acknowledgments

Finally, we would like to thank the reviewers whose collaboration has made it possible to prepare and publish this special issue, as well as the authors who have submitted their papers.

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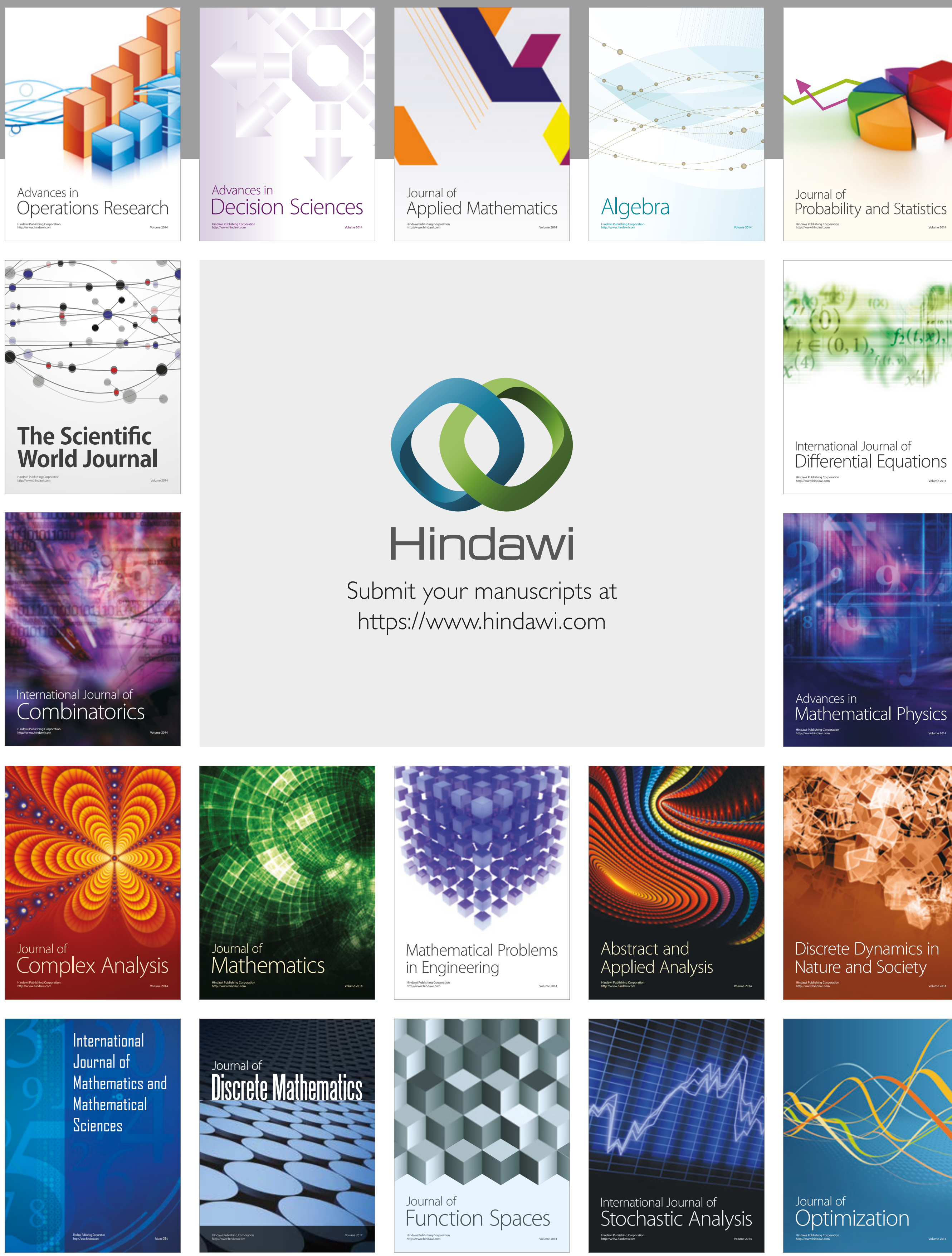
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