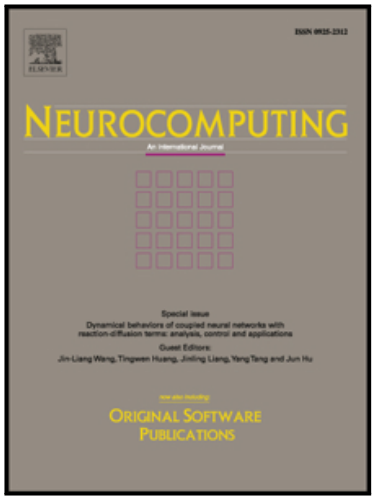
Communicated by Wei Wu

Accepted Manuscript



Car-like mobile robot path planning in rough terrain using multi-objective particle swarm optimization algorithm

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PII: S0925-2312(17)31842-8
DOI: 10.1016/j.neucom.2017.12.015
Reference: NEUCOM 19148

To appear in: *Neurocomputing*

Received date: 2 July 2017
Revised date: 27 November 2017
Accepted date: 4 December 2017

Please cite this article as: Baofang Wang, Sheng Li, Jian Guo, Qingwei Chen, Car-like mobile robot path planning in rough terrain using multi-objective particle swarm optimization algorithm, *Neurocomputing* (2017), doi: 10.1016/j.neucom.2017.12.015

Car-like mobile robot path planning in rough terrain using multi-objective particle swarm optimization algorithm

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Abstract

This paper presents a path planning algorithm for car-like mobile robots operating on a known static rough terrain environment. The purpose of this approach is to find collision free and feasible paths with minimum length and terrain roughness. First, a new workspace modeling method is proposed to model the rough terrain environment. Then, considering the nonholonomic constraints of car-like robots, a MOPSO (multi-objective particle swarm optimization) based method is used to solve the problem. In the proposed algorithm, a new updating method for particle's global best position based on crowding radius is used to increase population diversity. And to improve the algorithm efficiency, a nonuniformity factor is adopted to update the particle's position when the path collides with obstacles. Finally, two simulation tests are designed using Microsoft Robotics Developer Studio 4 and Matlab. Results show the advantages of the proposed algorithm in finding Pareto optimal paths.

Keywords: Multi-objective optimization, car-like mobile robot, path planning, rough terrain.

1. Introduction

Developing autonomous mobile robotic systems capable of exploring natural rough terrain, is of great interest to researchers [1]. Compared with other structures of robot, the car-like mobile robot has simpler mechanical structure and stronger robustness, which is more practical and helpful in geographical exploration [2], rescue after disaster [3], danger area detection [4] and agriculture cultivation [5]. As an essential part of mobile robotics field, the path planning problem in rough terrain is always an interesting and challenging subject for researchers.

The use of heuristic algorithms for robot path planning has significantly grown in the last few years [1]. The authors of [6] developed a new algorithm based on Bacterial Foraging Optimization technique. In [7], the authors presented a new method of global path planning by

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