International Journal of Innovative Computing, Information and Control
Volume **6**, Number **7**, July **2010**

ICIC International ©2010 ISSN 1349-4198
pp. 2885–2899

3D PATH PLANNING FOR MOBILE ROBOTS USING SIMULATED ANNEALING NEURAL NETWORK

Valeri Kroumov[1], Jianli Yu[2] and Keishi Shibayama[3]

[1]Department of Electrical and Electronic Engineering
Okayama University of Science
1-1 Ridai-cho, Okayama 700-0005, Japan
val@ee.ous.ac.jp

[2]Department of Electronics and Information
Zhongyuan University of Technology
Zhengzhou 450007, P. R. China
yjl@zzti.edu.cn

[3]Electric Power Development Co., Ltd
15-1, Ginza 6-Chome, Chuo-ku, Tokyo 104-8165, Japan
keishi_shibayama@jpower.co.jp

Received March 2009; revised June 2009

Abstract. *This paper presents a highly efficient potential field-based 3D path planning technique for mobile robots, moving in a known environment. The path planner is based on a direct description of the obstacles by simulated annealing neural networks. The generated paths are piecewise linear with direction changes at the corners of the obstacles. The proposed planner can be successfully applied to snake robots, flying robots, and control of Gantry cranes. Several simulation results show the effectiveness of the proposed algorithm.*

Keywords: Path planning, Mobile robots, Artificial annealing, Unmanned vehicles

1. Introduction.

Path planning for mobile robots is a recurring theme in the field of unmanned vehicle control. Many path planning methods for mobile robots moving on 2D surfaces have been proposed. The 3D path planning issue is quite difficult [1-3] since unmanned aerial and underwater vehicles have fast and complex dynamics, and the paths have to be generated and modified in real-time.

The ideal path planner should be able to generate an optimal and collision-free trajectory in real time. If the planner fails, collisions (accidents) with obstacles may occur. Since the time complexity of deterministic algorithms grows exponentially with the dimension of the configuration space, many of these algorithms do not give a reliable solution for real-time applications [1]. Moreover, finding the shortest path between two points in a space filled with polyhedral obstacles is an NP-hard problem [4].

Motion planners can be classified in general as: (a) complete and (b) heuristic. Complete motion planners may potentially require a long computation time but can either find a solution if there is one, or prove that there is none. Heuristic motion planners are fast but they may fail to find a solution even if it exists.

To date, motion planners are classified into four categories [5]: (1) skeleton, (2) cell decomposition, (3) subgoal graph, and (4) potential field.

In the skeleton approach, the free space is represented by a network of one-dimensional paths called a *skeleton*. The solution is found by first moving the robot to a point on the skeleton from the start configuration and also from the goal, and then connecting the two