



An effective initialization method for genetic algorithm-based robot path planning using a directed acyclic graph



Jaesung Lee, Dae-Won Kim*

School of Computer Science and Engineering, Chung-Ang University, 221, Heukseok-Dong, Dongjak-Gu, Seoul 156-756, Republic of Korea

ARTICLE INFO

Article history:

Received 9 January 2015

Revised 9 September 2015

Accepted 2 November 2015

Available online 6 November 2015

Keywords:

Robot path planning

Genetic algorithm

Initialization

Directed acyclic graph

ABSTRACT

The goal of robot path planning is to find a feasible path that proceeds from a starting point to a destination point without intersecting any obstacles in the given environment. Recently, genetic algorithm-based robot path planning methods have been widely considered in the intelligent robotics community. Because the initialization process significantly influences the performance of the genetic algorithm, an effective initialization method is required. However, investigation on this subject is still lacking. In this paper, we propose an effective initialization method for genetic algorithm-based robot path planning. Experimental results comparing genetic algorithms with conventional initialization methods and the proposed initialization method showed that the proposed method leads to high quality paths in a significantly shorter execution time.

© 2015 Elsevier Inc. All rights reserved.

1. Introduction

The goal of robot path planning (RPP) is to find a path which proceeds from a starting point to a destination point in a given environment. Although there are popular RPP methods based on A*, D*, Dijkstra's algorithm, and Floyd's algorithm [1–5], genetic algorithm-based robot path planning (GARPP) has recently received much attention in the intelligent robotics community; especially in application areas with complex objectives and complicated environments, such as unmanned bomb disposal, unmanned aerial vehicles, robot soccer, etc. [6–10]. In such areas, the obtained path must satisfy particular objectives, such as path feasibility, short path length, execution time to find a path, and path volatility [7,11–13].

Since the genetic algorithm (GA) starts its search for the final path from the initial path set, the initialization process is inevitably important for the effectiveness of GARPP methods [14–17]. Although it is already known that a good initial population significantly boosts the effectiveness of a GA [18–20], a serious investigation of the initialization process for the GARPP problem is still lacking. Therefore, GARPP methods suffer from performance degradation due to ineffective initial path sets.

In this paper, we propose an initialization method that specializes in GARPP problems. The proposed method creates a directed acyclic graph (DAG) by exploring a grid-based map encoded from a given environment, and then generates multiple paths for the initial GA path set from the obtained DAG. Because the proposed method generates multiple feasible solutions with short path lengths, GARPP methods initialized by the proposed method are able to output high quality paths in a significantly shorter execution time.

* Corresponding author. Tel.: +82 2 820 5304; fax: +82 2 820 5301.

E-mail address: dwwkim@cau.ac.kr (D.-W. Kim).