



13th Global Congress on Manufacturing and Management, GCMM 2016

An improved genetic algorithm for island route planning

Miao Gao ^{a,b}, Guoyou Shi ^{a,b}, Weifeng Li ^{a,b}, * , Yuchuang Wang ^{a,b}, Dongdong Liu ^{a,b}

^aDalian Maritime University, Dalian, China

^bKey Laboratory of navigation Safety guarantee of Liaoning Province, Dalian, China

Abstract

The island and reef area route planning is a sophisticated multi-objective combinatorial optimization problem. Meta-heuristics showed success in solving some optimizations and recently various efforts have been directed to hybridize elements from different meta-heuristics and search methods. This paper presents a scan searching method to initiate navigable path as for the original path, adopt the improved genetic algorithms to adjust the path finally get the optimal result. The performance of the proposed algorithms is compared. Using the single heuristics for solving the same problem. Experimental result indicated that the improved genetic algorithm both in the efficiency of search, convergence speed and the final results have certain superiority.

© 2017 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of the organizing committee of the 13th Global Congress on Manufacturing and Management

Keywords: improved genetic algorithm; island and reef areas; shipping route planning; elitism selection.

1. Introduction

With the development of the global shipping industry, sea transport has become the main means of transportation of bulk cargo. Taking account into the requirements of protecting the environment and saving transportation costs, many port constructions have gradually extended to the sea, some islands and reef have been established to become the port [1]. Previously the ship making through the island area only depends on captain's experience, manually make the routing plan. Now with the increasing frequency of reef area ship sailing, the workload and guarantee the safety of navigation becomes a huge challenge for the mariner.

Reef area can be divided into two categories [2]: which is the coral molting remains such as the South China Sea Islands area, second is composed of rocky islands such as Zhoushan. This paper takes the Zhoushan islands as an example. The feature as followed:

- (1) The sailing door is too discretionary to beyond the optimal capability of the normal artificial route planning;
-

* Corresponding author. Tel.: +86-1890-0982-505.

E-mail address: sddmlwf@163.com

(2) The channel is narrow and tortuous., the density of fishing boat and obstacles is especially notable, in terms of this, append the steering angle factor to the fitness function;

(3) Enough navigation targets are available;

(4) The distance from obstacle is relatively close, [3] it is easy that generate bank attract and push effect, on account of this taking the safe distance factor into the fitness function;

(5) At night, the influence of the crew's vision is greatly, and it will be easy causing the psychological fear of the crew.

As for the ship route planning problem, especially in the special restricted water area, the study of route planning is relatively rare, and the system is not yet formed.

Wang Zhu [4] first raise the intelligent algorithm based on the binary tree to generate route, which makes up the route in the formation of defects, improve the quality of route planning, but the treatment for obstacles binary tree bypass scheme is not perfect, the calculation efficiency is too low.

Wang Ying, Liu Weiting [5] proposed a route planning method based on improved ant colony algorithm, the improved artificial drawing route is time-consuming, not accurate enough and restricted range of applications and other issues, but the computational cost of the ant colony algorithm is too high, the cost of data requires a lot of supports, also let stagnation phenomenon occur easily.

Zou Chunming and Zhao Junchao [6] present based on punishment PSO method to handle the route planning multi-constraint group bridge waters, but as for the obstacle, which is simply abstracted into cylindrical longitudinal equal intervals, the simple route planning problem of the ship into the extremal problem of multi-dimensional function, but the conflict characteristics and obstacle path smoothing group bridge requirements, it is prone to local minimum or search stagnation.

Bandyopadhyay [7] proposed simulated annealing based multi-optimizer, but need to grasp the step accuracy of this problem, the division is too coarse, cannot find the optimal solution, the division is too fine, the amount of calculation is too large.

The choice of an appropriate algorithm is the core problem with the routing plan. The genetic algorithm is a heuristic search method with excellent global-search ability and the characteristics of multi-objective implicit parallel computing. Most of the optimization algorithms are single point searching algorithm. It is easy falling into the local optimal solution, and the genetic algorithm is a kind of multi-point searching algorithm, which is more likely to search the global optimal solution. [8] genetic algorithm in the overall search process is different from the deformable object of the greedy algorithm so in the optimization calculated using the shock search not depend on the gradient of the problem, But the standard genetic algorithm has its inherent defects, such as premature convergence, poor local search ability and so on. In view of these problems, this paper has made the improvement:

(1) Take the elitism selection into the GA;

(2) Expand the search population during initialize the population;

(3) Using the scan searching method to get the original navigable path cut down the initial blindness searching phase;

(4) The crossover operator on the same path of a single gene has been evaluated to protect the good genome from interruption;

(5) The mutation operator is improved. The delete and insert operators introduced, to enhance the local search ability.

The experimental results show that the improved genetic algorithm has a beneficial effect on the optimization of the ship movement path. Figure out the best route under the less time, reduce the workload of the officer on duty, ease the psychological pressure, so that they will take more attention to the ship manoeuvring. The perfect island area route planning is the key to improve the navigation safety island area. With the development of automatic control technique, the route planning combined with automatic control technology can improve the reef waters automatic navigation system.

2. Problem description

Use Vessel route planning refers to under the specific sailing environment search for the optimized path for the time saving and limiting the fuel consumption and safety. Traverse the path between the source and destination

Download English Version:

<https://daneshyari.com/en/article/5028429>

Download Persian Version:

<https://daneshyari.com/article/5028429>

[Daneshyari.com](https://daneshyari.com)