Study on Ship Dynamic Route Planning in Multi-bridges Water Area Based on PSO-OPF Algorithm

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ABSTRACT

With the implementation of the Strategies along River Economic Support Strip, bridges cluster construction has been formed in many waters such as the Yangtze River, Pearl River and other waterways. Ship-bridge collision accidents caused by multi-bridges influences occurred frequently. Therefore, it is quite seriously necessary and urgent to carry out the ship-bridge collision avoidance relevant studies. For the problems of ship route planning in multi-bridges water area, after analyzing the features of multi-bridges water area and the sailing regulation constraints, the unconstrained and multi-constrained route cost function models were established. By bringing several dynamic obstacles in a static environment model, the dynamic obstacles environment model in the multi-bridges water area was established. According to introducing dynamic collision detection modules method and applying Particle Swarm Optimization with Outer Penalty Function (PSO-OPF), a Multi-Constraints ship dynamic route planning method was applied to plan a Multi-Constrains ship dynamic route without collisions under 3 types of traffic flows environment with multiple dynamic obstacles in the multi-bridges water area. By using Matlab simulation platform, the effectiveness of the algorithm was verified to ensure the safety of ships navigation and the multi-bridges. The conclusions could be used for intelligent autopilot of ships, and for synergy search and rescue of Unmanned Surface Vehicles (USV).

KEY WORDS: multi-bridges water area; dynamic route planning; sailing regulation constraints; collision detection; PSO-OPF

INTRODUCTION

With the implementation of the Strategies along River Economic Support Strip, Bridges Cluster Construction has been formed in many waters such as the Yangtze River, Pearl River and other waterways. Resulted in ships’ navigation difficulty surging and ship-bridge collision accidents occurred frequently. Therefore, it is quite seriously necessary and urgent to carry out the ship-bridge collision avoidance relevant studies. There are many types of research methods for ship’s route planning, focused on unmanned aerial vehicles (USV), Unmanned Surface Vehicles (USV), missiles and other route planning research fields (Chen Hua, 2015. Liu Fan, 2015. Altmann Arne, 2013. Lee, Joon-Woo, 2012). However, it involves less researches for ship’s route planning. By analyzing the characteristics of multi-bridges water area and sailing regulations constraints, Multi-Constrains route cost function model was established. By introducing a number of dynamic obstacles in a static environmental model, dynamic obstacles environment model in the multi-bridges water area was built. According to putting forward dynamic collision detection modules method and applying Particle Swarm Optimization with Outer Penalty Function (PSO-OPF), a Multi-Constrains ship