A Novel Ship Path Planning Method Based on Fairways Information in ECDIS

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***Abstract*—A novel ship path planning method based on fairways information in ECDIS is designed to provide navigation routes that comply with maritime navigation rules ensuring safety and efficiency.**

Firstly, each layer of the Electronic Navigational Chart (ENC) is converted into ESRI Shapefile format by extracting key navigational elements. Next, the extracted ESRI Shapefile data is converted into raster data in GeoTiff format, constructing the ship's navigational environment model. An improved A* algorithm is proposed to plan a route in the base of environmental model. The ship's movement directions are expanded to 32 from 4, compared to the traditional A* algorithm. Additionally, the heuristic function is biased towards searching paths within fairway areas, and costs are increased for behaviors that violate traffic separation schemes, approach obstacles, or enter shallow water. Through the comprehensive consideration of multiple factors, an initial path that is both safe and compliant with navigation rules is made in the complex marine environments. To further optimize the path, the Ramer–Douglas–Peucker(RDP) algorithm has been introduced to refine the initially planned route. This step is intended to simplify redundant points in the path and reduce unnecessary turns, thereby effectively reducing energy consumption and operational complexity during navigation.

The simulation experiments were conducted in the path planning software in Electronic Navigational Charts that we developed using PyQGIS. The experimental scenario was set in the sea area between Zhanjiang Bay and the Qiongzhou Strait, with the starting point at Xinhai Port in Hainan and the endpoint at Zhanjiang Port. The results demonstrate that the algorithm performs excellently in complex marine environments, with a strong ability to select the most suitable fairways and strictly adhere to traffic separation schemes, resulting in routes that balance optimal path length, smoothness, and high safety. Compared to traditional algorithms, this algorithm not only improves the rationality of path planning, but also provides a practical solution for real-world maritime navigation.

***Index Terms*—path planning, fairways, improved A* algorithm, traffic separation scheme**

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