

Title: Intelligent obstacle avoidance system for water surface unmanned craft

Industrial Applications ☐Intelligent Manufacturing ☒Intelligent Driving ☐Intelligent Life ☐Smart Medicine ☐Smart City

[Overall background]

Water surface unmanned craft is a new type of intelligent water surface robot, which can navigate safely and independently under the actual marine environment, and complete various tasks of the offshore intelligent motion platform. Its functions includes intelligence collection, surveillance, reconnaissance, armed protection, mine sweeping, anti submarine, accurate strike, search and rescue, navigation and hydrogeological survey. Comparing with the manned ship, the unmanned yacht has many prominent tactical and technical features. It has small physical, good concealment, high speed, flexible maneuver and no danger of casualties. In the future asymmetric three-dimensional war, unmanned yacht will achieve such as mine sweeping, electronic information warfare, intelligence reconnaissance and surveillance (ISR), counter-terrorism. Unmanned boats will play an important role in the detection and prediction of the harsh sea conditions (such as sea wind, huge waves, tropical storms, sea fog, etc.). In a highly dynamic and unpredictable marine environment, in order to achieve high autonomy, unmanned boats need flexible and reliable operating performance, accurate and fast control to ensure the safety of other ships and their own. At the same time, from the viewpoint of strengthening the adaptability and intelligence of the unmanned craft and improving the performance of the unmanned yacht, the control system should also have a good function of self-adaptive and self-learning. Therefore, it is necessary to introduce artificial intelligence to design the intelligent navigation control system for unmanned craft.

[Business background]

The intelligent obstacle avoidance system for water surface unmanned craft is the main part of the navigation control system of the water surface unmanned boat. It is very important to ensure the self-adaptive ability of the unmanned yacht. By using the carrier detection sensor (video, radar, sonar, ultrasonic and so on), the information of the obstacles (static and dynamic) can be obtained, and the reasonable and effective avoidance calculation is studied. The method is of great application value.

[Problem description]

In order to improve the autonomous ability of the unmanned craft and the autonomy of the unmanned craft to make it with highly adaptive ability for emergency, it needs to avoid obstacles. It involves two aspects, one is the perception problem of obstacles: The first is applying current sensing devices to real-time perceive obstacles in front, and calculating the possibility of influencing their own route; The second is the path re-planning problem of obstacle avoidance, which use the acquired obstacle information and path planning algorithm. It is reasonable and effective to avoid obstacles and return to the original route.

[User expectations]

(1) When the system is running in the simulation state, it can introduce in sea conditions and

weather conditions, and simulate the setting of obstacles.

(2) The system has the ability to circumvent the static obstacles of a single typical surface, such as a ship at anchor. As far as possible, under the premise of keeping the original speed, it can plan the real path, evade obstacles and return to the scheduled route.

(3) The system has the capability of dynamic evasion of a typical dynamic obstacle (non-confrontational movement, such as a fixed route, a ship running at high speed).

[Expected economic effect]

29% of the earth's surface is land and 71% of it is the ocean. Experts point out that coastal surveying and mapping, maritime search and rescue, offshore patrol, anti-smuggling, protection of waterways, and maritime areas, ports, bridges, wharves, oil drilling platforms, etc. are expected to be given to unmanned craft in the future. Therefore, with the development of unmanned aerial vehicles and unmanned vehicles on the ground, in the vast ocean and river water, unmanned craft will also usher in a good era of its development. It is preliminarily estimated that the size of the market will be over trillion dollars. The application of the scheme will bring more than ten million economic benefits to the team.

[Technical path]

1. Obstacle perception: (1) video based image processing technology, (2) radar signal filtering technology, (3) photoelectric sensor ranging technology.
2. Obstacle avoidance planning: the mainstream path planning algorithm can be adopted.

[Technical indicators]

Under the three level simulation sea condition, the evasion ability based on image recognition is not less than 95%, and the evasion ability based on radar signal is not less than 90%. At the same time, the planning algorithm produces optimal results (time, path) when avoiding obstacles is reasonably.

[User data preparation]

Users will provide different groups of data (including 2km range radar data, forward image data, ship's position data, etc.) in different climatic conditions (sunny day, raining day) and different obstacles (static and dynamic). Some are used as simulation training and the other are used as evaluation. If other sensors are used, the user can simulate the relevant data according to the hardware characteristics.

[Standard Submission]

Participants are invited to design a set of software and hardware solutions to meet the above requirements from the perspective of system development.

1. The hardware scheme is accurately marked.
2. The obstacle recognition algorithm, evasion algorithm and feasibility analysis are proposed.
3. The system can simulate and operate.

[Task list]

1. Project documentation

2. Execution code
3. System source code

[Reference tool]

OpenCPN

[Reference data]

www.opencpn.org

[Data interface]

None