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Sliding Control Method of Marine Ecological Protection Robot Based on Dynamic Positioning

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Abstract

In order to improve the automatic positioning and map planning ability of marine ecological protection robot, a sliding control method of marine ecological protection robot based on dynamic positioning is proposed, using gyroscope and rangefinder as the information sensor of marine ecological protection robot, collecting the position information of marine ecological protection robot, using dynamic information measurement method to process the dynamic information of marine ecological protection robot, extracting the position tracking information of marine ecological protection robot, carrying out dynamic positioning and target path tracking according to the environment perception of marine ecological protection field, combining with robot sliding control method to design the global positioning of marine ecological protection robot, and improving the information measurement and positioning ability of marine ecological protection robot under dynamic environment. the simulation results show that the method is used to locate the marine ecological protection robot with high accuracy, the positioning error is small, the obstacle avoidance performance of the marine ecological protection robot in the positioning process is good, and the dynamic positioning control ability of the robot is strong.

Keywords

Dynamic positioning; Marine ecological protection; Robot; Sliding control.

Introduction

With the development of artificial intelligence technology, marine ecological protection robot is becoming more and more intelligent. As an important application of marine ecological protection robot, marine ecological protection robot plays an important role in artificial intelligence control. Marine ecological protection robot is influenced by obstacles interference and randomness of football situation in the process of motion positioning, which leads to poor positioning and obstacle avoidance of marine ecological protection robot. It is of great significance to design and optimize marine ecological protection robot in the design and competition of marine ecological protection robot (Cui and Zhou, 2018).

The intelligent positioning design of the marine ecological protection robot is based on the processing of the sensing information of the robot and the measurement and processing of the physical information parameters of the robot, and combines the positioning control and the characteristic resolution method of the robot to measure, track and detect the physical information parameters of the sensing robot of the robot so as to improve the positioning and path planning capability of the marine ecological protection robot. In the traditional method, the positioning methods for marine ecological protection robots mainly include fuzzy PID positioning method and robot path positioning method based on inverse integral control (Peng et al., 2017). A laser sensing fusion tracking positioning method for marine ecological protection robots based on PID neural network control is proposed in document (Matthew et al., 2017). to adjust attitude parameters and improve the robustness of the control process. However, the positioning stability and anti-interference capability of this method for marine ecological protection robots are not good (Matthew et al., 2017). Document (Abdelmalek and Samir, 2018) proposes a low-altitude sensing and positioning control method of marine ecological protection robot based on proportional-integral controller, which improves the automatic positioning effect and posture correction capability of marine ecological protection robot through adaptive feedback adjustment method of deviation correction amount (Abdelmalek and Samir, 2018). However, the physical information parameters of the robot in this method are not well measured and the environmental perception capability of marine ecological environment is not strong.

Underwater robots are the main tools for humans to understand the ocean, develop the ocean, and use the ocean. An important development direction in the future is to achieve the information interaction and autonomous collaborative operation of multiple underwater robots, to overcome the short working time and small working range of manned deep submersibles. Shortcomings, to this end, this paper designs an underwater robot experimental platform system with functions such as control, communication, and positioning, and studies the positioning accuracy and path planning of the underwater robot in the experimental system. In view of the above problems, this paper proposes a sliding control method of marine ecological protection robot based on dynamic positioning, firstly, using gyroscope and rangefinder as information sensor of marine ecological protection robot, collecting the position information of marine ecological protection robot, using dynamic information measurement method to measure the location information of marine ecological protection robot, extracting the position and pose tracking information of marine ecological protection robot, then tracking and identifying the dynamic positioning robot according to the environmental perception of marine ecological protection field, and the accelerated global positioning design of marine ecological protection robot combined with robot sliding control method. Finally, the performance of this method in improving the positioning accuracy of marine ecological protection robot is demonstrated by simulation (Abla et al., 2017).

Information Acquisition and Robot Pose Information Feature Extraction

Sensing Information Collection of Marine Ecological Protection Robots

The marine ecological protection robot's sensor system mainly includes the sensors and depth gauges required for the attitude angle, and uses them to obtain the attitude angle and depth in the water, respectively, attitude angle mining MPU6050.

The integrated three-axis gyroscope and three-axis accelerometer save a lot of packaging space. The output of each axis is composed of two registers of high 8-bit and low 8-bit. By reading sequentially, the initial value of the attitude can be obtained. Its serial transmission bit rate can reach 100kbit / s in standard mode, and it can reach 3.4 Mbit/s at the highest speed. At the same time, it integrates a 16-bit ADC. The circuit diagram is shown in Figure 1.

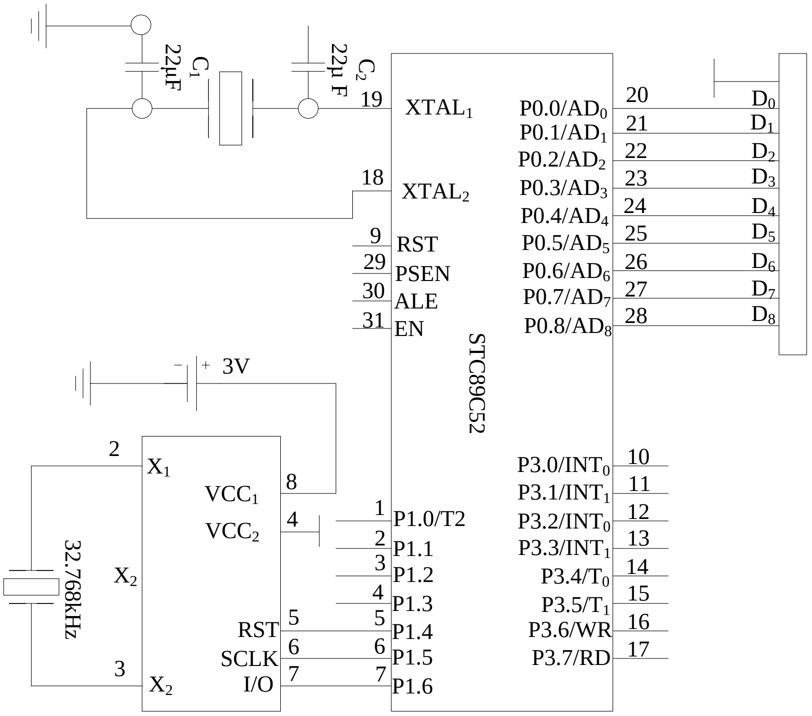

Figure 1: MPU6050 module circuit diagram.

Because the yaw angle is mainly used underwater, a magnetometer is needed to repair the gyroscope drift. The magnetometer used in this article is Honeywell's HMC5883L magnetometer. Its circuit diagram is shown in Figure 1. It is a highly integrated module with a very small volume. It can sense the geomagnetic vector to obtain the angle between the carrier and north the attitude information of the determining carrier is widely used in the fields of magnetic field detection, communication and navigation due to its low price. HMC5883L is equipped with Honeywell's patented integrated circuit, the control accuracy of the compass can reach 1-2°. It has the characteristics of high axial sensitivity and high linear accuracy. It decomposes a vector of geomagnetism into components in three directions.

The three components obtained will be used to repair the deviation in the attitude solution, as shown in the original magnetometer diagram in Figure 2.

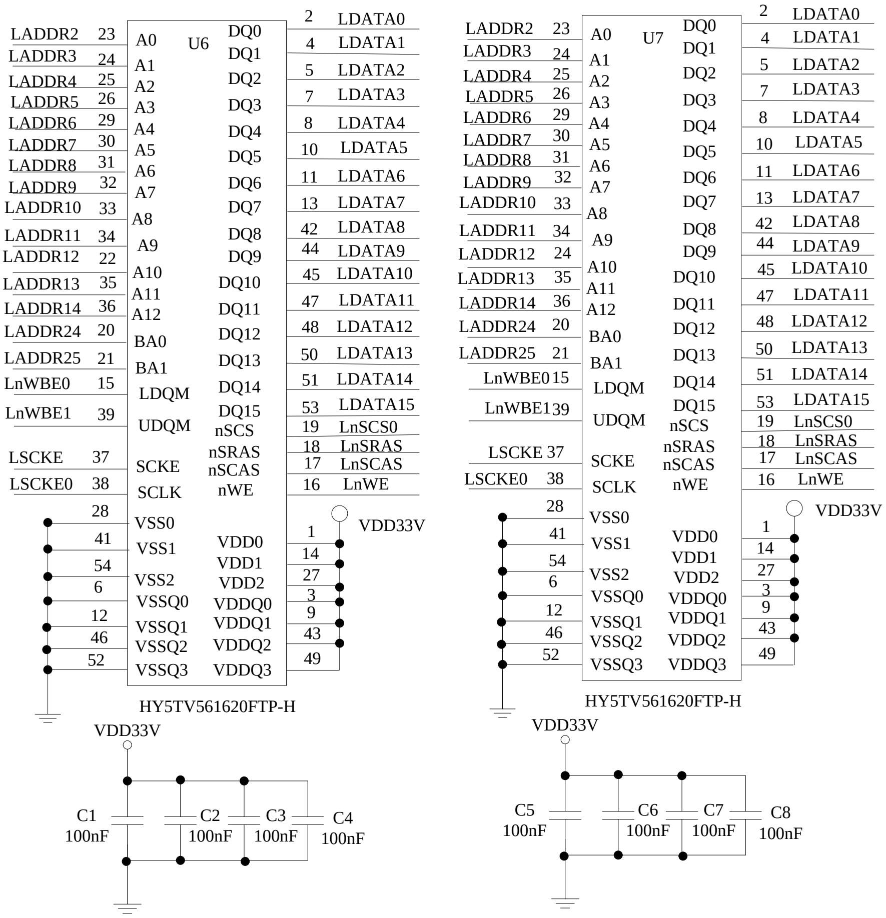

Figure 2: HMC5883L circuit diagram.

The position and position parameter information of marine ecological protection robot were collected by fusion sensing technology, the position information of marine ecological protection robot was analyzed, the position information of marine ecological protection robot was collected by using gyroscope and rangefinder as marine ecological protection robot information sensor, and the position information of marine ecological protection robot was measured by dynamic measurement method:

$$\begin{aligned} S(t)=&A_I C_I(t)D(t)\cos(2\pi f_0 t+\varphi)\\ &+A_Q C_Q(t)D_Q(t)\sin(2\pi f_0 t+\varphi) \end{aligned} \quad (1)$$

In the formula, I , Q represents the target signal acquisition information from the known map, representing the marine ecological environment sensing information on the I , Q branch of the walking path of the marine ecological protection robot; A is the amplitude of the marine ecological environment information acquisition output; C is the ranging code for evaluating the dynamic obstacle; f_0 is the location despreading code under the dynamic environment; φ is the frequency carrier rate of the robot information acquisition given by the known map; f_0 is the initial phase of the robot, the robot uses the gyroscope and the rangefinder to collect the information, and the frequency spectrum characteristic of the robot is:

$$S_{C/A}(f)=\frac{T_B}{(NT_C)^2}\left|X(f)\right|^2\sum_{l=-\infty}^{\infty}\sin c^2\left(\pi T_B\left(f-\frac{l}{NT_C}\right)\right) \quad (2)$$

Wherein

$$\left|X(f)\right|^2=T_C{}^2 N\sin c^2(\pi f T_C)\left|X_{code}(f)\right|^2 \quad (3)$$

$$X_{code}(f)=\frac{1}{\sqrt{N}}\sum_{n=0}^{N-1}x_n\exp(-j2\pi f n T_c) \quad (4)$$

Wherein, T_C is the reliability parameter of two sensors, T_B is the width of the data code, N is the number of sampling frequency points of the robot in the dynamic environment, and the correlation detection method is used to obtain the robot’s locatable spatial gain in the dynamic environment as follows:

$$\begin{aligned} PG_{dB}=&10\log_{10}N-10\log_{10}\left(\left|\sin c(\pi f_J T_C)\right|^2\right)\\ &-10\log_{10}\left(\left|X_{code}(f_J)\right|^2\right)\\ &-10\log_{10}\left(\sum_{l=-\infty}^{\infty}\left|\sin c\left(\pi T_B\left(f_J-\frac{l}{NT_C}\right)\right)\right|^2\right) \end{aligned} \quad (5)$$

According to the above analysis, the frequency spectrum estimation process of the marine ecological environment ray number is carried out for the robot positioning process, and the trajectory offset component of the adjacent robot is calculated as $1/NT_C$ Hz. The position parameter of the tracking radio signal is obtained under the small adjustment of the robot terminal position and pose:

$$r(t) = s(t) + j(t) \tag{6}$$

Wherein, $s(t)$ samples the echo components of marine ecological environment in marine ecological protection robot's deviation correction workspace, including the data code and distance measurement code of robot positioning, calculate the time interval of measurement of system, obtain the inverse kinematics real-time calculation of loss component $j(t)$, use dynamic information measurement method to measure the marine ecological protection robot's positioning information, extract the bit-position tracking information of marine ecological protection robot, and get the location information of instantaneous positioning output of marine ecological protection robot:

$$\begin{aligned} Bel(x_t) &= \frac{p(z_t \left| x_t \right.)\, p(x_t \left| u_{t-1}, \cdots z_0 \right.)}{p(z_t \left| u_{t-1}, d_{0,\cdots,t-1} \right.)} \\ &= \eta\, p(z_t \left| x_t \right.) \int p(x_t \left| x_{t-1}, u_{t-1} \right.) Bel(x_{t-1}) dx_{t-1} \end{aligned} \tag{7}$$

Wherein

$$\eta = \frac{1}{p(z_t \left| u_{t-1}, d_{0,\cdots,t-1} \right.)} \tag{8}$$

The attitude control and fuzzy tracking and recognition of marine ecological protection robot are carried out according to the results of marine ecological environment sensing information collection (Tatiana et al., 2017).

Feature Extraction of Position and Posture Information of Robot

In order to complete the path planning of marine ecological protection robots and realize autonomous movement for underwater operations, real-time position information of marine ecological protection robots is needed. The robot is color-coded in the positioning. The positioning is failed due to the susceptibility to light, and the agent It is constantly moving, needs real-time dynamic positioning, uses camshift target tracking global positioning algorithm, and uses a depth gauge to calculate the robot depth. The inertial element is used to complete the attitude acquisition, and the information is displayed on the upper computer through the wireless transmission system, thereby setting up an underwater positioning platform that can display 6 degrees of freedom.

Wireless data communication is used between the host computer and the robot to achieve two-way data sharing and real-time stable data transmission. The flowchart of the communication between the host computer and the NRF sends information. Similarly, the NRF uses the same mode for the host computer to send information. The communication process is mainly based on the global visual positioning to obtain the global position coordinates in real time, sending coordinates to the underwater robot, and at the same time, sending the self attitude angle information obtained by the underwater robot to the upper computer.

In order to ensure the effective transmission of coordinate information and attitude information, relevant communication protocols must be designed. In this paper, the protocol frames are self-made, and the rules of the information are divided into two categories, sending mode and receiving mode:

In the sending mode, the upper computer sends the coordinates to the underwater robot. The frame header uses AAAA as the middle 16-bit function word command, and the frame end ends with 0D.

In the receiving mode, the underwater robot returns the real-time attitude angle to the host computer, and the frame header uses AAAF the middle is a 16-bit function word command, and the end of the frame ends with 0D. After the data frame is specified, if the normal communication mode is used, the transmission and reception modes need to be switched continuously. Therefore, this article uses its advanced function to carry user data using response packets, which can realize two-way transmission of data in real time, eliminating frequent switching, thereby making communication more convenient.

The location control of marine ecological protection robot is carried out by using the shortest path optimization in the environment where there are obstacles, and the dynamic conduction function $H_i(\bullet) = \sum_{r=1}^{N} H_i(r)$ of the horizontal space position of marine ecological protection robot is solved. According to the trajectory component of marine ecological protection robot motion, the characteristic distribution frequency is obtained to meet $f_j = f_0$, and the signal component expression of location is changed to:

$$\begin{aligned} J_I(nT_B) &= \frac{\sqrt{2}}{S} \frac{1}{T_B} \int_{(n-1)T_B}^{nT_B} j_I(t) dt \\ &= \frac{2\sqrt{J}}{ST_B} \sum_{i=(n-1)N}^{nN-1} c_i \int_{iT_C}^{(i+1)T_C} \cos\varphi_j dt \\ &= \frac{2\sqrt{J}}{SN} \cos\varphi_j \sum_{i=(n-1)N}^{nN-1} c_i \end{aligned} \tag{9}$$

The minimum characteristics of inverse kinematics model of marine ecological protection robot are as follows:

$$\Delta E = -\eta\left[\left(\frac{\partial E}{\partial \omega}\right)^2 + \left(\frac{\partial E}{\partial b}\right)^2\right] \tag{10}$$

Let the vector distribution set fg of the trajectory on both sides of the 180° meridian of the marine ecological protection robot be the set of any S point at g, indicating the moment of inertia of the sensor reducer of the marine ecological protection robot, and the vector model is $d_{1,} d_2, \ldots, d$. If $C_o(x^*) = 0$, the spatial position correction error of marine ecological protection robot is satisfied:

$$Y(P, Q, \beta) = Y\left[red(P, Q, \beta), Q, \beta\right] \tag{11}$$

Using the successive separation method, the output characteristic quantity of marine ecological environment sensing positioning of marine ecological protection robot is abbreviated as:

$$J_I(nT_B) = \frac{2\sqrt{J}}{SN}\cos\varphi_j \sum_{i=0}^{N-1} c_i \tag{12}$$

Based on the spatial spectrum estimation of the robot's position and pose information acquisition results based on the marine ecological protection robot information sensor (Fakhar et al., 2018), that is $\Delta f \neq 0$, the spatial beam-beam localization of the robot is carried out with the beamforming method, and the output spatial gain spectral component expression of the robot positioning is obtained as follows:

$$\begin{aligned} J_I(nT_B) &= \frac{\sqrt{2}}{S}\frac{1}{T_B}\int_{(n-1)T_B}^{nT_B} j_I(t) \\ &= \frac{2\sqrt{J}}{ST_B}\sum_{i=(n-1)N}^{nN-1} c_i \int_{iT_C}^{(i+1)T_C} \cos\left(2\pi\Delta f t + \varphi_j\right)dt \\ &= \frac{2\sqrt{J}}{SN}\sin c\left(\pi\Delta f T_C\right)\sum_{i=(n-1)N}^{nN-1} c_i \cos\left[2\pi\Delta f T_C\left(nN + i + \frac{1}{2}\right) + \varphi_j\right] \end{aligned} \tag{13}$$

Where, $\sin c(x) = \sin(x)/x$. The position and posture tracking information of marine ecological protection robot is taken, and dynamic positioning and robot tracking recognition are carried out according to the environmental perception of marine ecological protection site (Sun et al., 2017).

Marine Ecological Protection Robot Positioning Optimization

Dynamic Tracking and Identification of Marine Ecological Protection Robot

On the basis of completing the marine ecological protection robot experimental platform system, using existing research algorithms, it is easy to find a path for the robot to reach the target point, and it can be completely guaranteed to be safe and meet certain performance requirements, Such as the shortest distance and collision-free path. But the global environment has the problem that the information is not completely known or the environment information is incomplete, or even the environment is completely unknown. Therefore, path planning can only be performed based on the robot's predicted and prior information. Therefore, in this chapter, an improved ant colony algorithm is designed to plan the optimal path for the underwater robot. At the same time, the optimal path planning method provides a guarantee for the autonomous movement of the underwater robot. The complexity of the underwater environment is of great significance for the study of complex paths.

The path planning of marine ecological protection robots not only allows each marine ecological protection robot to find one of the above optimal paths, but also requires that the path designed for the underwater robot does not occur with other static or dynamic obstacles during movement Contact and collision, try to keep the original desired direction to reach the target point, and need to adjust in real time to find a path that meets the requirements according to the continuous change of the environmental information in the water. At the same time, in order to better verify the reliability and practicability of the platform, the underwater robot has a certain learning ability in path planning, and realizes the stable operation of marine ecological protection robots.

Based on the position information of marine ecological protection robot using gyroscope and rangefinder as the information sensor of marine ecological protection robot (Yao et al., 2016), the positioning optimization design of marine ecological protection robot is carried out, the position and posture tracking information of marine ecological protection robot is extracted, the dynamic positioning and robot tracking identification are carried out according to the environmental perception of marine ecological protection site, and the GPS trajectory map of marine ecological environment fusion tracking and positioning plan of marine ecological protection robot is constructed:

$$\begin{aligned} J_I(nT_B) &= A\cos\left(n \times 2\pi\Delta f T_B\right) - B\sin\left(n \times 2\pi\Delta f T_B\right) \\ &= C\cos\left(n \times 2\pi\Delta f T_B - \theta\right) \end{aligned} \tag{14}$$

Wherein

$$\begin{aligned} A &= \frac{2\sqrt{J}}{SN}\sin c\left(\pi\Delta f T_C\right) \times \sum_{i=0}^{N-1} c_i \cos\left[2\pi\Delta f T_C\left(i + \frac{1}{2}\right) + \varphi_j\right] \\ B &= \frac{2\sqrt{J}}{SN}\sin c\left(\pi\Delta f T_C\right) \times \sum_{i=0}^{N-1} c_i \sin\left[2\pi\Delta f T_C\left(i + \frac{1}{2}\right) + \varphi_j\right] \end{aligned} \tag{15}$$

$$C = \sqrt{A^2 + B^2}\ , \quad \theta = \arctan\left(\frac{B}{A}\right) \tag{16}$$

The frequency spectrum of the current position of the marine ecological protection robot is a fixed value independent of the l . When $\Delta f \neq nR_b$, the position of the robot end tool in the corresponding time period is C and the position at the t moment is $2\pi\Delta fT_B$. Considering the effect of the odometer increment on the location, the modified characteristic component of the dynamic positioning capability matrix is:

$$\left(C_s/N_0\right)_{eff}=\frac{1}{\frac{1}{\left(C_s/N_0\right)}+\frac{C_i/C_s}{QR_c}} \tag{17}$$

Calculate the credibility of odometer measurement and marine ecological environment observation, and get the output gain of robot target location information processing as follows:

$$Q=\frac{\int_{-\infty}^{\infty}\left|H_R\left(f\right)\right|^2G_s\left(f\right)df}{R_c\int_{-\infty}^{\infty}\left|H_R\left(f\right)\right|^2G_i\left(f\right)G_s\left(f\right)df} \tag{18}$$

According to the dynamic positioning capability matrix correction results, the collected marine ecological environment sensing information is processed by beamforming (Jie et al., 2017), and the poses are modified as:

$$\begin{aligned}s\left(t\right)=&\frac{S}{\sqrt{2}}d\left(t\right)c\left(t\right)\cos\left(2\pi f_0t\right)\\&+\frac{S}{\sqrt{2}}d\left(t\right)c\left(t\right)\sin\left(2\pi f_0t\right)\end{aligned} \tag{19}$$

$$j\left(t\right)=\sqrt{2J}\cos\left(2\pi f_jt+\phi_j\right) \tag{20}$$

The S and J are the location track and the target position of the marine ecological protection robot in the limited Morrey space, and the $d\left(t\right)=\pm1$ indicates the obstacle position, and the spatial beamforming method is used to obtain the location information of the robot as follows:

$$\begin{aligned}J_I\left(nT_B\right)&=\frac{\sqrt{2}}{S}\frac{1}{T_B}\int_{(n-1)T_B}^{nT_B}j_I\left(t\right)\\&=\frac{2\sqrt{J}}{ST_B}\sum_{i=(n-1)N}^{nN-1}c_i\int_{iT_C}^{(i+1)T_C}\cos\left(2\pi\Delta ft+\varphi_j\right)dt\end{aligned} \tag{21}$$

$$\begin{aligned}J_Q\left(nT_B\right)&=\frac{\sqrt{2}}{S}\frac{1}{T_B}\int_{(n-1)T_B}^{nT_B}j_Q\left(t\right)\\&=-\frac{2\sqrt{J}}{ST_B}\sum_{i=(n-1)N}^{nN-1}c_i\int_{iT_C}^{(i+1)T_C}\sin\left(2\pi\Delta ft+\varphi_j\right)dt\end{aligned} \tag{22}$$

Based on the beamforming and unscented Kalman filter estimation results, combined with the array analysis method, the robot's marine ecological environment sensing fusion tracking target positioning and information processing (Xu et al., 2018).

Marine Ecological Protection Robot Obstacle Avoidance and Positioning Output

According to the environmental perception of marine ecological protection site, dynamic positioning and robot tracking recognition are carried out (Zhu et al., 2016). The state measurement equation of the spatial position of the moving path is analyzed in combination with the robot sliding control method as follows:

$$X_{k+1}=\Phi_{k+1,k}X_k+G_{k+1,k}U_k+\Gamma_{k+1,k}\eta_k \tag{23}$$

$$Z_{k+1}=HX_{k+1}+V_{k+1} \tag{24}$$

Wherein, $X_{k+1}=\left[\varepsilon_{k+1}\quad W_{k+1}^1\quad W_{k+1}^2\quad W_{k+1}^3\right]^T$ is $k+1$ time marine ecological protection robot moving path information acquisition weight coefficient (Yuan and Wang, 2016). When each element of the path distribution tends to be infinite, the azimuth deviation generated by the marine ecological protection robot under the real-time regulation of the continuous path is as follows:

$$\begin{aligned}KL=&\sum_{i=1}^{m+a}\frac{1}{N}\ln\frac{1}{Nw_d^i(H)}\\&+\sum_{i=1}^{N-m-a}\frac{1}{N}\ln\frac{1}{N}\ln\frac{1}{Nw_d^i(H)}+0\end{aligned} \tag{25}$$

$$\sum_{i=1}^{m}n_i=\sum_{i=1}^{N}=N \tag{26}$$

In Cartesian space, the estimation range is subjected to particle scattering points, and the marine environment is perceived by adaptive adjustment of mechanical driving parameters, and the moving path planning of marine ecological protection robot is carried out in intelligent spatial scheduling system.

$$\mathbf{q}_1=[q_1,\cdots,q_7]^T\equiv[\theta_4,\cdots,\theta_{10}]^T \tag{27}$$

Using the linear parameter adjustment method of the dynamics, the position measurement of the robot is estimated, and the iterative expression is obtained as follows:

$$P_{ij}(k)=\frac{(l_j(k)-l_i(k))\eta_{ij}(k)}{\sum_{j\in N_i(k)}(l_j(k)-l_i(k))\eta_{ij}(k)} \tag{28}$$

Wherein:

$$j\in N_i(k),N_i(k)=\{\left\|x_j(k)-x_i(k)\right\|<r_d(k)\} \tag{29}$$

The $\eta_{ij}(k)$ is the regression coefficient of the robot's precise position estimation. According to the observational modified odometer increment information, the robot's physical information parameter measurement tracking is carried out in the space of 6 degrees of freedom (Liu et al., 2015). Based on the adaptive pose tracking method, the inverse Jacobian matrix of robot positioning is obtained as follows:

$$^{i-1}T_i = \begin{bmatrix} c\theta_i & -s\theta_i & 0 & a_{i-1} \\ s\theta_i c\alpha_{i-1} & c\theta_i c\alpha_{i-1} & -s\alpha_{i-1} & -d_i s\alpha_{i-1} \\ s\theta_i s\alpha_{i-1} & c\theta_i s\alpha_{i-1} & c\alpha_{i-1} & d_i c\alpha_{i-1} \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (30)$$

In the formula, s denotes the sine of taking the angle θ and c denotes the cosine of taking the angle θ. Add a rotation error in the initial motion trajectory plane, combined with SLAM algorithm to achieve obstacle avoidance and positioning of marine ecological protection robot (Cao et al., 2016).

Simulation Experiment and Result Analysis

Experiment of realizing a marine ecological protection robot to a target point in an obstacle-free underwater environment. While using the improved ant colony method to achieve the semi-circle movement of the underwater robot, the direction angle also changed from -180 degrees to 0 degrees. The sampling points in the experiment include the starting point and end point of the underwater robot during the operation, and several tangent points of the underwater robot at the semicircle tangent. This verifies that the underwater robot can effectively complete the path planning when there are no obstacles. Figure 3 shows several locations during the obstacle-free path planning of the underwater robot. In the obstacle-free path planning, the real-time trajectory recording process of the underwater robot is shown in Figure 3.

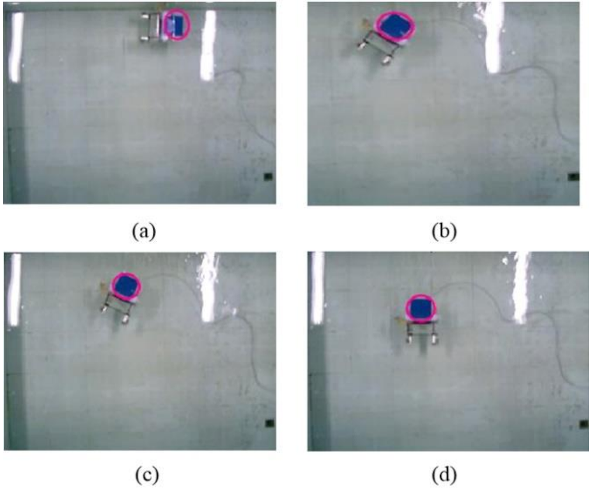

Figure 3: Experimental process diagram of barrier-free path planning for marine ecological protection robots.

The experimental platform adds two adjacent obstacles. When the robot meets the obstacles, the optimal path is bypassed to reach the target point through the designed algorithm. In this set of experiments, due to the closeness of the obstacles, only two obstacles can be chosen to bypass. Figure 4 shows the process of the robot reaching the target point with the optimal path. Real-time recording of the trajectory of the marine ecological protection robot through the host computer is shown in the Figure 4.

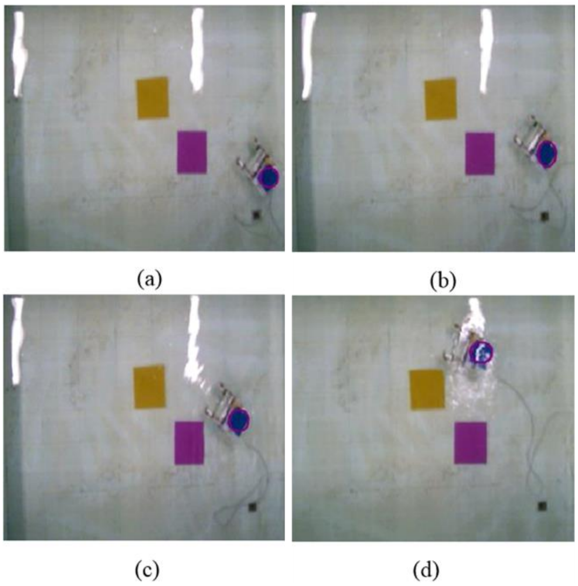

Figure 4: Experimental process diagram.

From the above experimental results, it can be seen that the improved algorithm proposed in this paper can achieve effective path planning and avoid obstacles for marine ecological protection robots, ensure that underwater robots reach the target point in different environments, overcome the slow initial convergence of the ant colony algorithm, and are extremely easy The problem of local optimization. At the same time, it can be verified that the underwater global positioning platform can obtain the accurate underwater robot position and pose angle in real time, which proves the feasibility of the algorithm.

Table 1: Spatial distribution of marine Ecological conservation robots

Guidepost	Probability Center	Measured center	Error spacing
1	(-43, 43)	(-7, 14)	4.35
2	(23.4, 21.7)	(15, 15.4)	5.45
3	(32, 45)	(24, 120)	5.32
4	(147.6, 356.7)	(15, 146)	5.36
5	(4, -4.6)	(112, -34)	6.56
6	(12.1, 13.4)	(33.1, 14.4)	5.43

In order to test the application performance of this method in realizing the intelligent positioning of marine ecological protection robot, the marine ecological protection robot used in the experiment is ARJDLH type robot, the marine ecological protection robot information sensor is marine ecological environment rangefinder (SICKLMS111), the algorithm is designed with Matlab 7, and the sampling time interval of marine ecological environment sensing information of marine ecological protection robot is 0.24s. If the control parameter q=4, b_2=b_{-2}=1, b_1=b_{-1}=2, b_0=0 the flexible control moment of the robot is, M_p=1.6×10^4 kg and the rotational inertia is 1.585KN. The map spatial distribution of the constructed marine ecological protection robot is shown in Table 1.

According to the above simulation environment and parameter setting, the positioning design of marine ecological protection robot is carried out, and the position information of marine ecological protection robot is collected by using marine ecological protection robot information sensor. In the open source robot platform CARMEN, the information collection result is shown in Figure 5.

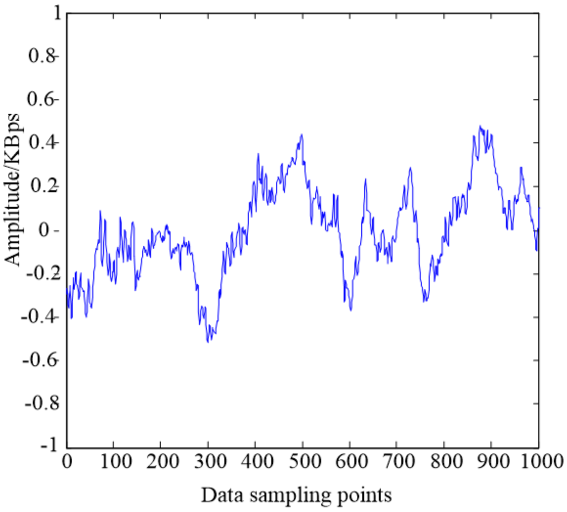

Figure 5: Marine ecological environment sensing information acquisition results of marine ecological protection robot.

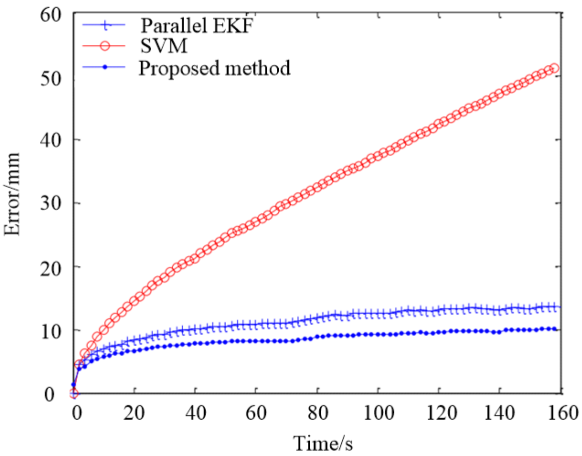

Figure 6: Estimated results of the robot's aerial projection.

Taking the marine ecological environment sensing information of the marine ecological protection robot as the input, the position and posture tracking information of the marine ecological protection robot is extracted, and the dynamic positioning and the tracking identification of the robot are carried out according to the environmental perception of the marine ecological protection site, and the result of the estimation of the robot's altitude is shown in Figure 6.

According to the results of the robot's navigation level calculation, the positioning of the marine ecological protection robot is carried out, and the real track and the positioning track output of the marine ecological protection robot are obtained as shown in Figure 7.

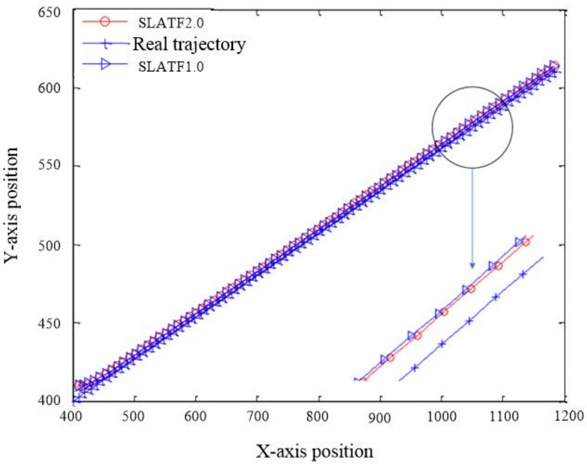

Figure 7: Real trajectory and positioning trajectory output of marine ecological protection robot.

The analysis Figure 7 shows that the trajectory tracking ability of the marine ecological protection robot using this method is strong, the positioning error is small, and the positioning error of the different methods is tested. the comparison results are shown in table 2. the analysis table 2 shows that the obstacle avoidance performance of the marine ecological protection robot in this paper is better and the dynamic positioning control ability of the robot is stronger.

Table 2: Comparison of positioning errors

Iterations	Proposed method	Fuzzy PID	Adaptive inversion integral
100	0.054	0.265	0.176
200	0.042	0.1434	0.165
300	0.016	0.076	0.076
400	0.004	0.054	0.065

Conclusions

This paper mainly designs two-dimensional path planning algorithms. Since underwater is a three-dimensional environment, it is necessary to further improve the algorithm to realize path planning in 3D environment. At the same time, only the path planning of a single marine ecological protection robot is considered in the article. In a complex system, multiple underwater robots need to cooperate to complete the task. This involves the information interaction and autonomous collaborative control of multiple marine ecological protection robots.

The intelligent control design of marine ecological protection robot, combined with obstacle avoidance control and map planning method of marine ecological protection robot, improve the intelligent positioning control ability of marine ecological protection robot, this paper proposes a sliding control method of marine ecological protection robot based on dynamic positioning, using gyroscope and rangefinder as the information sensor of marine ecological protection robot, collecting the position information of marine ecological protection robot, using dynamic information measurement method to measure the location information of marine ecological protection robot, extracting the position tracking information of marine ecological protection robot, carrying out dynamic positioning and tracking of robot according to the field environment perception of marine ecological protection, combining with robot control method to design the global positioning of marine ecological protection robot, improving the measurement and positioning ability of marine ecological protection robot under the dynamic environment protection robot. The research shows that the method has high stability and low positioning error, which improves the marine information perception of marine ecological protection robot.

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