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DYNAMIC POSITIONING METHODS UNDER LIMITED CONDITIONS

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The formulation of the problem of planning and controlling the movement of the vessel consists in choosing a method for forming the coordinates of a given safe path and control parameters in such a way that it moves without an emergency from the coordinates of the initial state to the final one. Usually, the movement of the vessel can be controlled at each moment of time t by the parameters u_1 (t),…, u_n(t), which make it possible to correct the movement vector when deviating from the given coordinates.

Written reckoning is of two types: simple; composite. In simple dead reckoning, the coordinates of the final point are calculated according to the known coordinates of the initial point of departure and course and navigation. Composite calculus is used when swimming is performed in several courses.

Thus, dead reckoning when determining coordinates is called a method of mathematical modeling. Its accuracy depends on the errors in calculating the value of the wind drift angle, the drift angle by the current and the presence of the drift angle during yaw during control. However, the methods of planning the coordinates of curvilinear sections of the path, considering the characteristics of the ship's turnability, have not been considered.

There are two main methods of dynamic positioning in compressed conditions: vector reckoning by the method of expert judgment and the method of mathematical modeling. To improve the accuracy of planning and performing dead reckoning in [1], the method of trajectory points (TP) was used for planning the route when maneuvering during port calls, developed in [2]. However, the method of mathematical modeling has the disadvantage that it requires calculating the parameters of the impact on the ship of external disturbances in advance [3,4], the accuracy of which is difficult to verify. In addition, the existing method of graphically calculating the drift angle during drift and current is not correct enough, since it is assumed that the direction of movement under the action of the wind does not change, but only returns in the direction of the wind by an angle α.

To improve the accuracy and efficiency of the control process, it is proposed to abandon the calculation of the parameters of external disturbances by means of drift angles. Instead, you need to represent the planned path in the form of trajectory point matrices, convenient for computer processing. In the future, the dead reckoning is carried out along a given path, as shown in Fig. 1.

TP is applied on the line of the true heading and reference points (0, 1, …i...n) are designated at the same time interval and distance, which are selected depending on the speed of movement and navigation conditions. At the moment of passing the 1st point, the expert determines the position of the vessel in a highly accurate way and promptly calculates the vector and the drift angle. The drift vector is directed to the 2nd control point and the observed point is connected to the beginning of the drift vector and the true heading to the second control point is determined, it is corrected by compass correction and compass control is performed. The sampling interval around the 2nd point is determined by the expert, and if the control and observed points coincide, this means that the displacement vector was determined correctly and external factors did not change. Therefore, the drift vector is directed to the 3rd reckoning point and the 2nd reference point is connected to the beginning of the drift vector in the third and the course is determined for further movement. If in the future the observed points coincide with the resisting ones, then we keep a certain course and speed. If there is a deviation from the line of the planned path, then the procedure should be repeated in the same way from the beginning.

The method of expert assessments differs from the method of mathematical modeling in that there is no need to calculate the parameters of external disturbances and to calculate the angles of drift from the wind, current and yaw during traffic control, which significantly increases the accuracy of movement and the efficiency of site control.

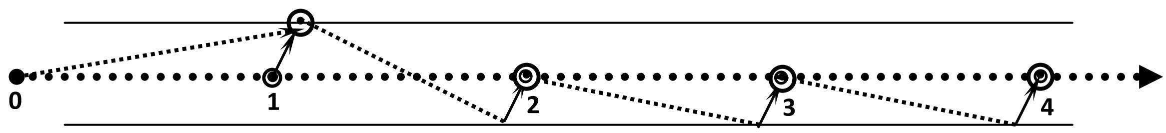

Fig.1. Graphic diagram of the choice of the vector of motion on reference points

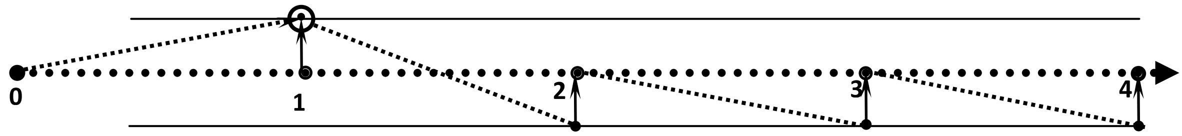

Fig.2. Graphic diagram of the choice of the vector of motion on the vector of lateral displacement

Fig. 2 determines the total vector of lateral displacement from all factors, calculates the motion vector by coordinates, which are determined by high-precision navigation tools and planned trajectory points by trajectory search and direct the vector of lateral displacement to the 2nd trajectory point. The motion vector from the observed point to the beginning of the lateral drift vector at the 2nd trajectory point is then calculated, and if the observation coordinates coincide with the control coordinates, it means that the external perturbations have not changed. Next, direct the vector of lateral demolition to the 3rd trajectory point and determine the vector of further movement. If 4 points are observed and the control point coincides, then continue the movement without changing the motion vector, and if the demolition vector appears, the procedure is repeated first.

Thus, the method of expert estimates has an advantage over the method of mathematical modeling in speed, considering all the factors acting on the vessel in full, which increases the accuracy of positioning in compressed waters. This method can be used in decision support navigation systems.

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