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LETTER TO THE EDITOR

Under the Influence of Environmental and Climatic Factors, Sailing Vessel Windward Section Adjustment Algorithm

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It is of great practical value to adjust the best sailing section for sailing against the wind according to the changing environment and climate of the competition field, so as to promote the scientific training of sailing athletes and improve the performance of the race. Therefore, an algorithm for windward section adjustment of sailing boats under the influence of environmental and climatic factors is proposed. According to the environmental and climatic factors, that is, the influence of sea wind, wave and current on the sailing ship's course and speed; The model of environmental and climatic factors is constructed, and the adjustment decision of upwind sailing section is put forward. Simulation test results show that this method can effectively solve the problem of optimal section adjustment in windward running of sailing boats in direct sailing competition under the influence of environmental and climatic factors, can effectively guide sailing athletes to carry out scientific training, and has good theoretical significance and wide application.

Building protection; Toxic chemical materials; Sedimentary process; Simulation

1 Introduction

Marine environmental and climatic factors often have a curious effect on sailing events. Can be roughly divided into three categories: the first category is restricted, such as the storm has limited the major important sailing competitions, athletes sailing under the above 35℃ high temperature heat to heat shock. The second category is performance. For example, contrary wind makes sailing boat straight run result decreases, downwind makes sailing boat straight run result increases, additional contrary wind can make sailing boat circumnavigate result increases. The third category is the impact of the athletes sailing physical exertion. Low humidity, for example, is good for the performance of a sailer. Humidity slants when big a few, be helpful for sailboat athlete to produce explosive force, but go against again sailboat athlete perspiration, can affect the endurance of athlete.

Xun Ji, Chunfu Shao published an article entitled “modeling and analysis of free flow velocity of heavy rain environmental traffic flow based on geomagnetic detection data” in the journal of Ekoloji (issue 107,2019).In this paper, the difference of free velocity between normal and rainstorm weather was analyzed using geomagnetic sounding data and meteorological data. On the basis of matching data, the free flow velocity evolution model with rainfall intensity in heavy rain is established by using fitting model. The evolution model is suitable for rainstorm weather, but few studies have been done. Then the rate of decrease of free flow velocity is studied. The results show that the free velocity decreases with the increase of rainfall intensity. When the rainfall intensity reached 2.2mm /min, the free flow velocity decreased by more than 40%. Moreover, an inflection point was

found in the relationship between free velocity and storm intensity. The research results of this paper lay a foundation for studying the impact of heavy rain on urban traffic congestion.

Literature (Luo et al. 2017) to a model for the experimental platform of 1.2 m long, in the control program into the application for circular arc form windsurfing and simplify the improved control algorithm, respectively, of the horizontal wind with the wind, the wind model test under three kinds of wind conditions, in addition to tack against the wind the wind when abnormal return, test results and simulation results highly fit. In view of the abnormal turning, the control strategy of turning the sail in advance is improved. The test results show that the abnormal turning disappears, the ship changing process is accelerated, and the full wind direction automatic sailing is completed. The experimental results show that the simplified control algorithm combined with the improved control strategy is feasible for the application of the curving sail.

Literature (Du et al. 2018) given the sailing alone when navigating in offshore crew experience unable to obtain the optimal route for long distances, based on the research of relevant route planning, considering the wind field of the inhomogeneity of route planning, the influence of the sailing time to be shortest as the goal, set up open waters sailing route planning model, and design of the adaptive genetic algorithm for solving. An example of a 28 - foot single - keeled sailboat is given to demonstrate the feasibility of the model and the validity of the algorithm.

In view of the above problems, this paper proposes an algorithm for windward sailing section adjustment under the influence of environmental and climatic factors.

2 Idea Description

Sailing race relies on the athletes to adjust control strategies constantly according to the different wind direction, wave and current at sea, so as to reach the destination in the shortest time (Zhang et al. 2017). Therefore, how to correctly adjust the best windward section of a sailboat according to the Marine environmental and climatic factors is an important link to improve the racing results. Sailing on the sea is greatly influenced by the random disturbance of the Marine environment and climate factors (such as waves, wind and current, etc.). The Marine environment and climate system is a system with complex environment and incomplete (fuzzy and uncertain) information (Zhou and Wang 2018). Yu Haifeng, ocean currents, waves based on the existing application environment under the condition of constant basic climate factors, such as sailing path planning method based on fuzzy comprehensive evaluation, on the basis of sailing boat windward segment under the influence of climate factors proposed adjustment algorithm, used in sailing against the wind line sailing, adjustment and planning for the optimal road segment.(Mi et al 2015) The simulation results show that this method can effectively solve the problem of optimal windward section adjustment of sailing competition under the influence of simulated real track environment and climate.

In this paper, the sailing vessel sailing straight line is taken as the basic condition. The process is as follows.

2.1 Environmental and climatic factors model of direct flight arena

The sailing competition venue is relatively simple. It is held on a wide sea with a fixed starting line and finishing line, and sailing within a certain width of channel (Ding et al. 2015). A two-dimensional coordinate system is established in the sailing area, as shown in figure 1. The initial point is placed at the origin P_0, and the target point is a certain point on the Y-axis P_n. (Ellison et al., 2018)The sea area between the starting point and the target point of the sailboat is evenly divided into n sailing sections. The value of variable n is determined

according to the sailing distance $L$and experience, and the channel width is set as 2W.

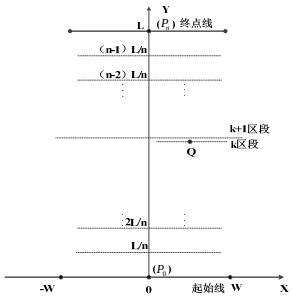

Fig. 1 Schematic diagram of environmental and climatic factors in sailing course of direct sailing

The membership function of a moving object, namely the position probability distribution function, is established, which contains the current position, velocity, velocity direction and other motion information of the object to represent the distance from the target point. Each section is rasterized to find the best heading point on the best windward section and the section boundary.

It is assumed that the sailing vessel sailing against the wind will receive the changing parameters of the competition field environmental and climatic factors at point Q in section k, from the receiving point Q to the target point P_n. Based on the new parameters of the competition field environmental and climatic factors, the sailing vessel will conduct the optimization and adjustment of the windward section again. The Q points to sections k and $k+1$ can be used as new special sections to find the best windward section of the boundary. Other receiving points are planned in a similar way.

2.2 Sailing in the wind section of the adjustment decision

After establishing the environmental and climatic factors model of direct flight track, the fuzzy comprehensive evaluation method was adopted to carry out the search process of specific windward section. In the adjustment decision of sailing vessel in windward section, the most important influencing factors are two: whether to make its speed maximum in the shortest path in a certain direction, and whether to get closer to or reach the target in a given direction. (Gunduz et al., 2019)Therefore, these two factors are taken as the basis for comprehensive evaluation. For a certain driving direction, the comprehensive evaluation value is defined as the weighted sum of the membership function values of the driving time and distance from the current sub section k-1 of the sailboat to a certain direction of the next sub section k. The size of this sum reflects the degree to which sailing in this windward section is beneficial for the sailboat to reach the target after taking into account both speed and approach to the target. Therefore, the windward section adjustment decision takes the section $P_{i,j}$ with the least comprehensive evaluation value as the next movement direction. At the same time, a limitation must be satisfied: that is, sailing in this direction to the next windward section must not exceed the channel width.

The calculation formula of the comprehensive evaluation function $EV_{i,j}$ for the windward sailing section adjustment decision in the direction of $P_{k,j}$ in section k is defined as:

$$EV_{k,j} = \mu_1 T_{k,j} + \mu_2 \eta Z\left(x_{k,j}, y_{k,j}\right) \tag{1}$$

Where, $T_{k,j}$ is the time it takes for the sailing boat to finish the section k against the wind. Considering the real-time changes of wind, wave and flow, the sailing boat does not move at a uniform speed.

$Z\left(x_{k,j}, y_{k,j}\right)$ is the membership function of sailing to $\left(x_{k,j}, y_{k,j}\right)$ positions, and n represents the distance from the target point. μ_1 and μ_2 are weighted coefficients, μ_1 is positive, μ_2 is negative, and $\mu_1 + \mu_2 = 1$; As the sailing time in an upwind section is less, the better. When sailing towards and closer to the target point, the membership function value of sailboat relative to the target point is the maximum, so η is negative.

Based on the above analysis steps, the sailing ship windward section adjustment algorithm is realized under the influence of environmental and climatic factors.

3 Results

In order to verify the performance of the sailing vessel windward section adjustment algorithm under the influence of environmental and climatic factors in this paper, the algorithm was tested by MATLAB7.0 software. The following conclusions are obtained:

In the windward sailing stage, the sailing speed is small, and the course Angle formed between the relative wind and the course is an acute Angle, and the size of the relative wind speed is equal to the real wind speed. Before the sail section is adjusted, the sailors adjust the streamline mast along the wind direction according to the actual wind direction at that time, so as to reduce the interference of the mast on the sail wing and increase the overall thrust of the sail wing. Comprehensive sports training, sports physiology and other related knowledge, considering the wind sailing, sailing athletes physical condition is good, and athletes psychological also is relatively high, so the wind sail phase of the course can be as the choice of segment area to make adjustments in a timely manner, the sailing boat sail wing overall thrust coefficient is bigger also, help sailing against the wind speed. Through verification, the algorithm in this paper can adjust the windward section of sailing vessel in time when the environmental and climatic factors change.

4 Conclusion

This paper presents an algorithm for windward section adjustment of sailboats under the influence of environmental factors. According to the environmental and climatic factors, such as wave, current and wind, an environmental and climatic factor model is constructed, and an effective decision-making scheme of sailing vessel windward section adjustment is given. Simulation results show that the proposed algorithm can provide scientific guidance for sailing athletes to adjust tactics in windward section when environmental and climatic factors change.

References

Chen BQ, Luo YJ (2017) The Characteristic of Public Cognition of Smog and Its Structural Constraints. Journal of Huzhou Teachers College, 5(1):551-513.

Ellison, M., Calinescu, R., & Paige, R. F. (2018). Evaluating Cloud Database Migration Options Using Workload Models. Journal of Cloud Computing 7(1).

Gunduz, S., Aslanova, F., & Abdullah, K. S. H. (2019). Poultry Waste Management Techniques in Urban Agriculture and its Implications: A Case Study of Tripoli, Libya. Ekoloji 28: 4077-4084.

Jing W, Chang I S, Yilihamu Q, et al (2017) Study on the practice of public participation in environmental impact assessment by environmental non-governmental organizations in China. Renewable & Sustainable Energy Reviews, 749(3):86-200.

Liu N, Xu WY, Xiao Q, et al (2018) Study on the role of non - profit environmental organizations in prevention and control of smog from the perspective of environmental ethics. Inner Mongolia Environmental Sciences, 3(4):256-258.

Lührs N, Jager N W, Challies E, et al (2018) How Participatory Should Environmental Governance Be? Testing the Applicability of the Vroom-Yetton-Jago Model in Public Environmental Decision-Making. Environmental Management, 61(2):249-262.

Mi C, Shen Y, Mi WJ, Huang YF (2015) Ship identification algorithm based on 3d point cloud for automated ship loaders. Journal of Coastal Research (73):28-34.

Moon K, Blackman D, Brewer T D, et al (2017) Environmental governance for urgent and uncertain problems. Biological Invasions, 19(3):785-797.

Schoon M, York A, Sullivan A, et al (2017) The emergence of an environmental governance network: the case of the Arizona borderlands. Regional Environmental Change, 17(3):1-13.

Zhang Y, Wang M, Jin GH, et al (2017) Vulnerability Assessment of Urban Atmospheric Environment under Influence of Human Activities. Journal of Jilin University (Science Edition), 12(4):23-25.