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## Design of Location Algorithm for Marine Drone Aircraft Maintenance Base Station

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# Design of Location Algorithm for Marine Drone Aircraft Maintenance Base Station

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**Abstract.** In recent years, unmanned aerial vehicle Cruise search and Rescue is a research hotspot at home and abroad. Water traffic accidents in recent years have been increasing, the traditional maritime patrol is usually based on boat cruise, this mode of maritime patrol not only means heavy task, and with poor inspection effect. So UAV-based maritime cruise and emergency search and rescue system is the subject of this research. The system based on the navigation and search and rescue of two unmanned aerial protection base station, using TDMA system network technology and Wireless bridge communication technology to set up a local area network, and target water site to establish a multi-objective model, optimize the design of supporting base station location algorithm, the system realizes the unmanned, visualized and normalized monitoring and management of target waters by means of coupling the UAV, Air-base station and control terminal, and provides more detailed and accurate information for the development of cruise search and rescue work.

## 1. Introduction

With the expansion of marine development and the rapid development of the marine economy, water safety accidents have occurred frequently, and the mission of sea life rescue and maritime daily cruising has become increasingly arduous. The traditional cruising work has weak emergency response capability, lagging response, large cruising range and high cost. The drone is not only easy to operate, but also cost-effective, and its small size can be used for any area search, and can search the cruise channel comprehensively without excessive labor input. Nowadays, labor and cost saving effect are remarkable, which are also high costs. The traditional cruise mode with large demand for personnel - the unparalleled advantage of the navigation boat cruise. However, the drone cruise search and rescue has the problem of the charging life of the drone. Therefore, the author proposes to use the maritime drone aircraft insurance platform to park the cruise search and rescue drone, and to give the platform location method, and propose a new plan for the maritime cruise work.

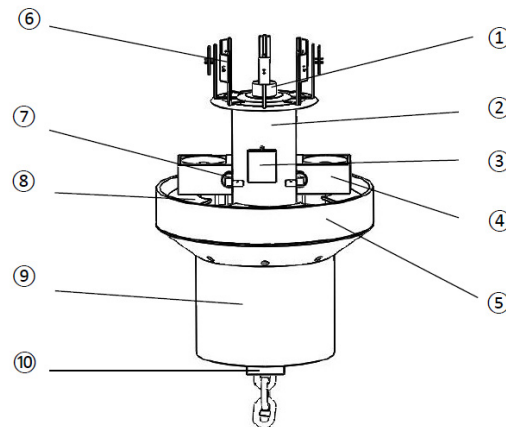
## 2. Design and performance simulation experiment of aircraft protection base station

### 2.1. Aviation support base station design

The structure of the platform is divided into upper, middle and lower layers as a whole. The predetermined horizontal maximum width is 6m and the vertical maximum height is 8.5m. The overall structure of the device is shown in Figure 1. ⑧ converts solar energy into electric energy, natural wind generates AC electric energy conversion by driving ⑥ rotation, solar panel output and alternating



current electric energy conversion rectification and filtering are connected in series, and the falling/upward path is selected as ③ charging to satisfy the use of the voltage value judgment. Man-machine cruise demand; through ① and ④ to charge the drone above the two; In case of emergency, the drone transmits a signal to ⑨ and the emergency drone at ① starts to go to the accident site; The periphery of the platform is protected against wind and waves by ⑤. The anchor chain completes the limit processing of the platform by connecting with ⑩. ② provide support for the structure, ⑦ can achieve ④ rotation for protection and release of emergency drones.



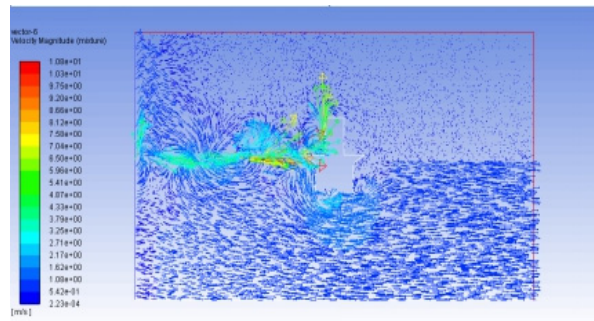
- ① Emergency drone landing platform ② Intermediate support ③ Energy storage battery  
 ④ Cruise drone landing platform ⑤ Waveproof board ⑥ Wind power generator blade  
 ⑦ Platform rotating mechanism ⑧ Solar panel  
 ⑨ Platform monitoring and control terminal ⑩ Limit device

**FIGURE 1.** Aircraft protection base station structure design.

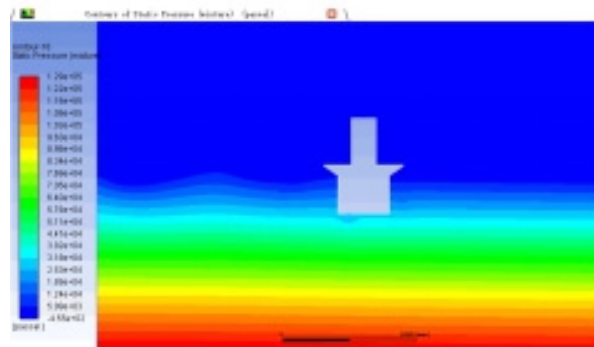
## 2.2. Aviation support base station stability simulation analysis

Aimed at simulating the force of the platform in the sea wave, the platform is simulated by Fluent software. The air traffic control base station is at a flow rate of 5 kn, a wave height of 1.5 m, a wavelength of 10 m, and a wind speed of 6 m/s. As shown, the wave speed remains in the range of 1~2m/s before the wave contacts the aircraft carrier base station. After tapping the platform, the sea wave speed can reach the speed range of 7~10m/s. The simulation analysis of the volume fraction of the aircraft base station is shown in Figure 2. After the air defense base station is subjected to the wave power of the wave, the pressure distribution is as shown in Figure 3. The pressure distribution of the aircraft base station is still in a parallel band shape. Therefore, the pressure change caused by the wave beat is not obvious, and the platform can be stabilized.

According to the above analysis results, the aircraft carrier base station can guarantee basic stability in working sea conditions. The stabilization system consisting of the anchor chain and the fixed device can improve the stability of the base station and reduce the impact of the base station on the take-off and landing of the drone due to the sway under wind and wave conditions.



**FIGURE 2.** Wave speed vector.



**FIGURE 3.** Pressure distribution diagram when subjected to waves.

### 3. Research on Location Algorithm of Air Defense Base Station

#### 3.1 Analysis of Factors Affecting Site Selection of Air Defense Base Stations

The site selection of aviation insurance base stations is an important issue in the operation of the system. There are many influencing factors in this problem, including two aspects: cost factor and efficiency factor.

For the maritime sector, the site selection planning of the aircraft protection base station is an important asset expenditure, which often involves the construction of the aircraft protection base station and the modification of the drone purchase, which is costly. Therefore, the cost factor is the primary consideration. Sometimes it is a one-time cost of expenditure (purchase), while sometimes it is a long-term fixed expenditure (maintenance). In addition, there is a continuous cost of expenditure such as labor costs.

As the core functional facility of maritime cruise, the airlift base station is a factor that must be considered when selecting a site. How to choose the location layout can bring the shortest time to the accident location for cruise search, which is the key issue of this paper. At the same time, due to cost reasons, after a decision, the location of the aircraft protection base station will not be changed for a long time in the future. Therefore, the site selection should be based on the frequency of accidents in the historical waters of each region, hydrometeorology (wind, Waves, eddies, visibility, temperature, water temperature).

#### 3.2 Establishment of basic model for site selection of aircraft insurance base stations

Taking the Yangtze River waters as an example, a partial water network map can be represented by  $T=(J, E)$ . The bad points and the aggregate vertices of the accident point are represented by elements in the set of  $J=\{j\}$ ; from the bad point or adjacent The distance from the accident point  $j_a$  to  $j_b$  is represented by the elements in the set  $E=\{e_{j_a}, e_{j_b}\}$ , and the positions (km) of  $j_a$  and  $j_b$  can be represented by  $(x_a, y_a)$  and  $(x_b, y_b)$ ; The deployment point number of the aircraft protection base station;  $T$  has  $N$  nodes,  $N$  adjacent accident points or bad points, which can be obtained:

$$\begin{aligned} 1 \leq m, \quad n \leq N \\ 1 < m+n \leq N \end{aligned} \quad 1)$$

In addition, another 0-1 matrix can be added to indicate the cruise search and rescue range for all base stations in order to solve the problem using the 0-1 plan, where element  $x_{ij}$  indicates that base station  $i$  has jurisdiction over the incident or the bad point, and a value of 1 indicates that a jurisdiction exists. A value of 0 means no jurisdiction. As shown in formula (2).

$$x_{ij} = \begin{cases} 1 \\ 0 \end{cases} \quad 2)$$

Selecting a reasonable route for each base station, when assigning jurisdiction and search rescue for the deployment point of the aircraft protection base station, requires obtaining the shortest route from the standby point to all accident points or bad points, according to the shortest route algorithm, candidate points and accident points. Or the distance between the bad points can be defined as the shortest line, as shown in equations (3) ~ (4).

$$l_{ij} = x_{ij} \cdot e_{ij} \quad 3)$$

$$S = \sum_{i=1}^m \sum_{j=1}^n x_{ij} \cdot l_{ij} \quad 4)$$

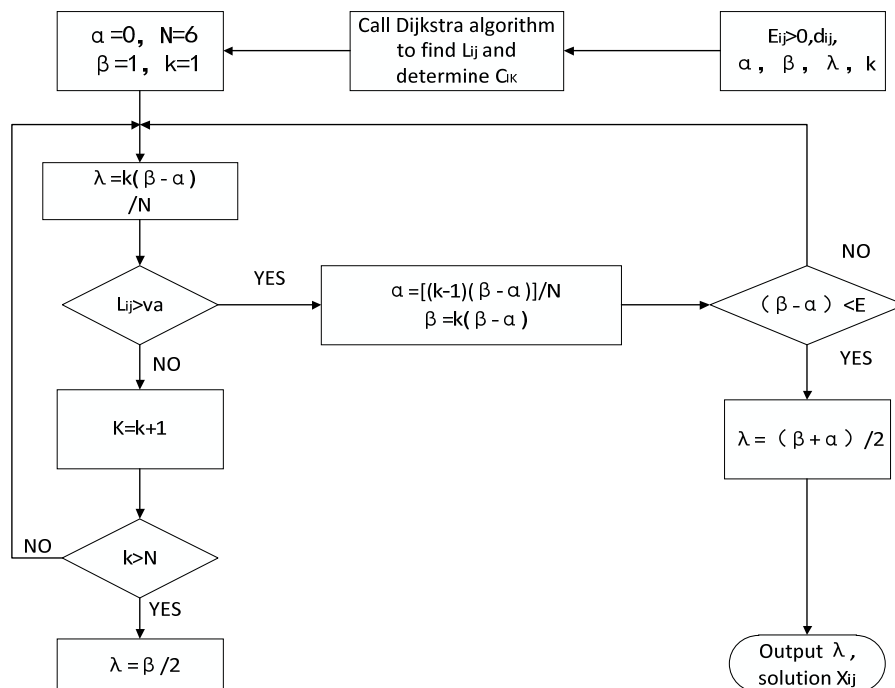
Within the formula: The total distance or each path is  $S$  (km); The minimum distance between the bad point or the accident point  $j$  and the base station point  $i$  is  $l_{ij}$  (km).

Economic goals should also be taken into account in order to minimize operating and maintenance costs when put into use. This is related to the distance from the maintenance point to the base station layout point. Suppose  $k$  is the maintenance point number. Therefore, the economic weight of the corresponding path can be calculated, as shown in equation (5).

$$c_{ik} = d_{ik} \times x_{ik} \quad 5)$$

### 3.3. Algorithm design

Under the condition that the precision exceeds the interval length, the approximate interval  $[\alpha, \beta]$  can be obtained (this interval is not large), and the output after the assignment is the optimal solution that can satisfy this condition. It can be determined based on the formula (4) under the conditions obtained. At this time, single-objective optimization will replace the original dual-objective optimization, and the two-dimensional  $m \times n$  matrix, that is, the correspondence between the deployment point of the aircraft protection base station and the accident point (bad point) can be obtained based on the existing MAT-Lab. The specific flow chart is shown in Figure 4.



**FIGURE 4.** Flow chart of location optimization algorithm.

Empirical verification: the workload of each base station is different, and the timeliness and economy can be better satisfied by using this algorithm for site selection, thus providing a suitable alternative location for decision-making. Compared with the split layout, the algorithm adopted in this paper has more pertinence, and has certain reference value for improving the cruise efficiency of UAV.

#### 4. Conclusion

Based Aiming at the low efficiency of maritime cruise, in order to solve this problem, this paper studies an aviation protection base station which can charge UAV in different waters. This paper discusses the composition of base station and its location algorithm, and proves its practicability through testing. This research has certain reference significance for solving the problem of cruise energy supply of UAV and positioning of navigation base station in the field of water transportation.

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