Dynamic debris tracking model about the lost plane's wreckage debris

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Abstract. In the paper, we research how to locate the crash area of the lost plane. We take ocean currents, wind-driven currents etc. into consideration. Defining the best searching radius $R = f_s E$, we can obtain the best searching area. Wreckages are moving, we renew the searching area using *MATLAB*. And we color these circle areas. Where there is a deeper color, there is a higher possibility to find the black box. After confirming the site of the black box, we finally find *the full-time joint search model by parallel scanning* is the best strategy.

Introduction

It has been a difficult problem about how to search for wreckages of the lost plane. With the rapid development of the transport, more and more people would like to travel around the world. But the News about the airplane crashes hurt our heart. It is known to us, the lost Malaysian flight MH370 is still haven't been found yet Typically, although many countries have fielded their teams to search for the lost Malaysian flight MH370, it is still haven't been found yet. Therefore, it's a big challenge to search for a lost plane.

In practical situation, we must take ocean currents, wind-driven currents etc. into consideration. Wreckages will be carried along by waters. We need satellite to locate the wreckages and renew the searching area.

The best searching radius R

At first, we learn some expressions. The total water current consists of the wind on the sea and the ocean current. The point where can be located by the satellite or any other technique, we call it the reference point. If there are many targets, every target stands for a reference point. Then all the reference point can be connected to be the reference line. Then we calculate the *Total Probable Error of Position* E. It's a standard that can measure the uncertainty of the target and the navigability of searching facilities. It can also influence the size of the search area.

$$E = \sqrt{X^2 + Y^2 + D_e^2}$$
$$X = Fix_e + DR_e$$
$$Y = Fix_e + DR_e$$
$$D_e = \frac{D_e L + D_e R + RL}{2} \quad (1)$$

Where X means the initial position error, Y means the error of searching facilities, D_e means the error of drifting.

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$$X = Fix_e + DR_e$$
$$Y = Fix_e + DR_e$$
$$D_e = \frac{D_e L + D_e R + RL}{2} \quad (2)$$

If we calculate *the total probable error of position* E, then we can work out the best searching radius R. In addition, f_s is a safety factor, which is concerned with searching times.

Table 1. safety factors and searching times

searching times	f_s
1	1.1
2	1.6
3	2
4	2.3
5	2.5

$$R = f_s E \quad (3)$$

The Best Searching Strategy

Because the model is considered to be lost to the point of the crash site, and the satellite and other searching equipment can provide the sporadic location to help search. Thus, we get the followed steps when we calculate the best searching area.

Step1：

We set the lose-contact point as the first basic point, and the new-found position is the second basic point. Then, we will get the third one, the forth one and so on. Every basis point attached to a precision radius. Within the radius, the probability of finding the black box at any point is the same.

Step2：

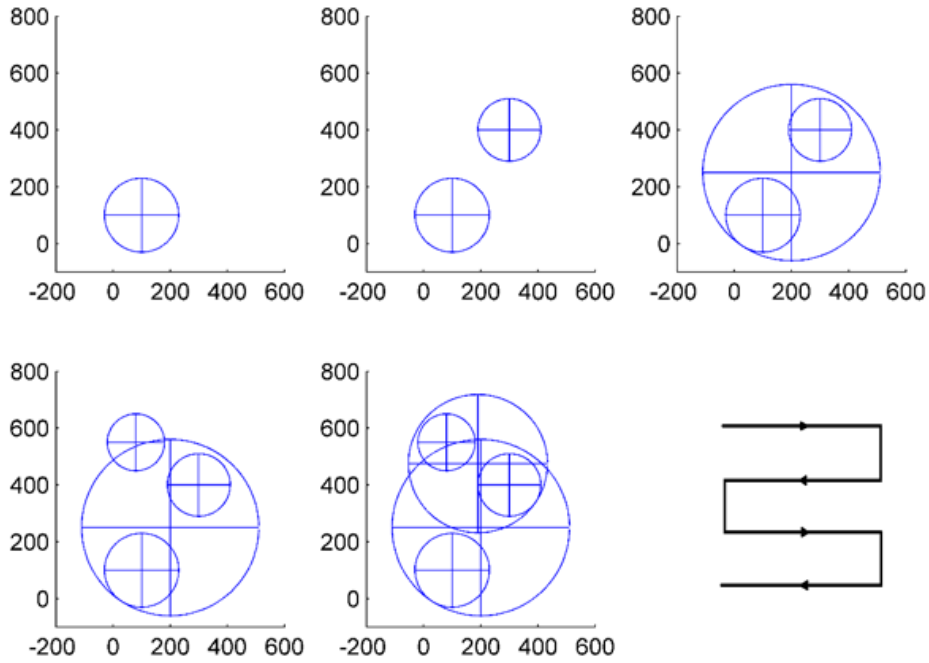
We set the searching center in the middle of the attachment of two points. According to the parameters of the two points, we can use the formula $R = f_s E$ to get the best searching radius. Based on these, we can ensure the best searching area.

Step3：

If there is a new basic point, we can rework the step2.

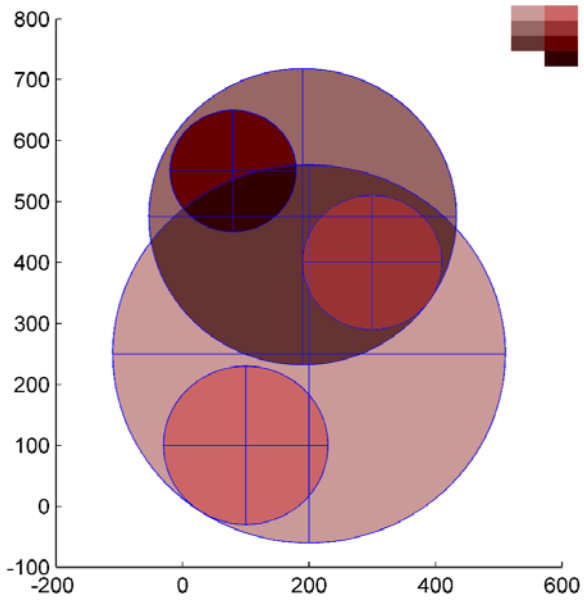
Once the best searching strategy is selected, we need to search and rescue immediately. We must take the climate and geography into consider while searching in the area. It's an important thing to choose the appropriate searching means, in order that we can achieve the best searching result. There are many searching modes. Referring to the books, we know that the parallel glance searching mode fits the situation that need to search a large area evenly. In the parallel glance searching mode, search line parallels to the width of the rectangle, which is also the hypothetic direction of the lost plane. We use *MATLAB* and the initial conditions to get the first random point, and we assume that the random point is the place where the plane loses contact. We draw the picture to express it. After a period of time, we assume that we carry out the second searching, and we have located the second reference point. But two points don't coincide due to the ocean current. The first point is distant to the second, and the radius of the circle that has the same possibility is different. We draw the second circle. After consult material, we can ascertain the first best searching area. When the third reference point is ascertained, restart the above steps.

Figure 1. the best searching strategy



The simulation only considers the situation that there are three basic points. If there are more points, the methods is the same. According to the relation between the circles, we color these circle areas. Where there is a deeper color, there is a higher possibility to find the black box.

Figure 2. the possibility of the crash area



Conclusion

It has been a heated topic about the safety problem of the airplane. If there is a crash happened, we must locate the crash area as fast as we can. The paper provide a method about how to calculate the searching radius and renew the searching area. Many practical factors are unavoidable, we must take them into account. By simulation, we can find the best searching strategy.

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