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Multi-Decision Model of Target Radar Based on Distributed Optimization Genetic Algorithm: Supply Chain Coordination Perspective

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Abstract: When the target number exceeds the processing capacity of the single radar and the command capacity of the commander, and the normal air handling cannot be guaranteed, how to properly distribute the radar mission of the radar network to ensure the completion of the combat mission is a problem worthy of further study. In order to solve this problem, the method of classification command is proposed. The threat index of the target is analyzed and quantified, and the target is classified by fuzzy clustering method. According to the performance, function and characteristics of each radar, the radar of radar network is classified. Analyze and quantify the matching index of radar class and target class, and establish a classification command decision model for radar network detection of multiple batches of targets.

1. Introduction

In modern warfare, air supremacy has always been the focus of competition between the two sides. In order to seize the air supremacy, the two sides must inevitably send a large amount of air power, which makes the air situation very complicated. At the same time, it may be successful [1].

Hundreds of targets have appeared in the air. This is the main force for acquiring air intelligence - radar, due to the limitations of its equipment handling capacity and command capacity of the commander, especially in the radar network, each of which is fighting, lacking uniform coordination and division of labor, each Radars need to deal with a large amount of airborne intelligence, causing the radar to be overwhelmed and unable to complete combat missions. Therefore, how to properly distribute the radar's detection mission, reduce the load of each radar and improve the detection efficiency of the radar network to ensure the normal combat mission is a problem worthy of study [2].

2. Target classification method

2.1. Quantification of target threat index

The target threat index is a quantification of the extent of the target threat. For radar targets, the target threat level is determined by factors such as the distance, altitude, speed, and intensity of electronic interference. The degree of threat to each of these factors is called distance threat index, high threat index, Speed Threat Index and Interference Threat Index. The distance of the target from the radar network is different, and the degree of threat is different. The greater the distance, the smaller the threat is formed, and vice versa. Generally, when the target distance r is large enough to a certain degree r2, it can be considered that the target does not pose a threat, and the threat index is 0; when the target distance r is small to a certain degree r1 [3], it is considered that the target has broken through the defense line, and then defense is impossible. The threat index is 1; when r1 < r < r2, as the target distance decreases, the target threat level gradually increases and increases exponentially. Due to the influence of ground clutter, earth curvature, terrain fluctuations and other factors, low-altitude (ultra-low altitude) airspace is a blind spot for most radar detection. When the target is low-altitude, the radar is difficult to find the target. Therefore, low-altitude targets pose a great threat to radar. The usual method is to use low-altitude blind radar to perform low-altitude blinding. In foreign countries, the detection distance of low-altitude blind radar is usually set at 40km to 80km, and the current low-altitude aircraft can operate at a height of 50m to 100m from the ground. The relationship between the radar line of sight d (km), the height of the antenna frame H (m), and the target height h (m): d = 4. 12 (h + H) [4], at the average antenna erection height, when the target flying height is low at 120m, it is difficult for the radar to find the target. The threat index is 1. When the target height is greater than 4 600m, the radar can basically find the target within the normal detection range.

2.2. Target classification method

With the various threat indices of the target, the target can be classified by: Establishing the target threat index matrix according to the various target threat indices mentioned above, and then using the fuzzy clustering method for cluster analysis, taking the appropriate valve the value λ divides the target into the appropriate number of "target classes". There are 1 batch of targets in the detection range of the radar network.

3. Radar classification method

The classification of radar is mainly based on the following considerations: (1) The detection range of conventional radar is not very significant and can be made without distinction; (2) Electronic interference and low-altitude targets are the main targets that pose a threat to radar detection performance. The anti-interference performance and low-altitude detection performance determine the ability of the radar to find targets in the interference and the ability to detect low-altitude targets, which must be considered. (3) The position of the radar in the radar network, which may be called location, determines the order of the targets and the length of the warning time; (4) the classification of radar, only for the needs of operational command, do not need to care about the technical details of the radar. Therefore, the radar to which the radar network belongs can be classified according to the positional advantage of the radar, the anti-interference performance and the low-altitude detection performance.

4. Classified command decision model

4.1. Matching index between target class and radar class

In theory, assigning target classes to radars with superior performance indicators will undoubtedly achieve better detection results. However, this is bound to cause the radar-based detection task with superior performance indicators to be too heavy to complete the task, and the radar class with poor performance indicators is idle and useless. This is not realistic, and it also violates the purpose of classification command. Therefore, consider the method of segmentation to calculate the degree of matching between the target class and the radar class. The matching between the target class and the radar class should be considered as follows: the target class with a large distance threat index matches the radar class with a large positional advantage index; the target class with a high threat index is matched to the radar class with good low-altitude detection performance; The large target class is matched to the radar class with large positional advantage index; the target class with large interference threat index is matched to the radar class with large anti-interference performance index.

4.2. Classified command decision model

The distance matching index, the high matching index, the speed matching index and the interference matching index between the target class and the radar class are established above. In order to divide the target class into the radar class to achieve the purpose of the classification command decision, the final allocation must be Satisfaction: All target classes are assigned, and the target class and the radar class are matched as much as possible, so that the sum of the matching indexes of the target class and the radar class is as large as possible under the final allocation, and each radar class The detection mission is basically balanced, and there is no excessive situation in which a certain radar task is excessively heavy.

5. Conclusions

This paper proposes a method of classification command, quantifies various factors involved, establishes a classification command decision model for radar network detection of multiple batches of targets, and gives a simple example to further illustrate this classification command method. For operational command decisions, there are often many uncertain factors that are difficult to describe with precise mathematical language. To quantify these factors, the ability is only close to the real situation, and it is impossible to achieve complete accuracy. The work done in this paper is only a preliminary result, and it needs to be revised and improved continuously in the future command practice.

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