Radar Network Threat Estimation Based on Beidou

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Abstract. Networking radar can make full use of resources and due to the advantages of single radar, making the detection, localization, tracking, identification, and other aspects of the threat of judgment performance has been greatly improved. With the gradual improvement of the Beidou system, powerful communication capability allows the network radar is no longer restricted to a particular area, not only to share information on a larger, more determine the best threat by Compass system according to the battlefield situation.

Introduction

In the air defense operations, a fire unit and firepower cluster want to fight the many types of aircraft, multi-level sorties, target group multi-directional, means its target of attacks and attacks also vary how the threat level based on the target and anti-aircraft fire units responsible for the tactical mission, multi-objective decision-making, which is to solve the problem set fire shooting in, is a major problem throughout the fire control system.

With the gradual improvement of the Beidou system, we can use the short message function, as the ministries linking radars in radar ties in order to achieve the best judgment threat. Due to the current Beidou short message communication capacity is limited, radar network outranking method can be used to achieve the target group's threat to judge decisions.

Order Method Decision Fundamentals

Pecking order fado objective decision making is the decision-making factor in the objective function, the weighting coefficient by the decision-makers to develop targeted by the decision system decision factors based on objective indicators each, are compared to obtain excellent multi-target sequence function, then excellent the size of the ordinal number of the target sequence queuing, and ultimately by the decision maker or decision system based on the optimal decision rules and battlefield situations, make decisions on objective judgment, determine one or more programs.

Let the decision to consider the question as follows:

$$\max F(x) \quad x \in R$$

R is a finite number of (N) set targets.

$$F(x) = [\, f_1(x)\, f_2(x) .... f_m(x)]^T$$

Which is the objective function, there are M, may quantitatively analyze the target level of threat

Definitions 1:

$$a_{ijl} = \begin{Bmatrix} 1 & f_l(x_i) > f_l(x_j) \\ 0.5 & f_l(x_i) \cong f_l(x_j) \\ 0 & f_l(x_i) < f_l(x_j) \end{Bmatrix}$$

$$a_{ij} = \sum_{l \in M} a_{ijl} \qquad i, j \in N, i \neq j, l \in M$$

aij is the objective function that the i-th and j-th target goal of mutual comparative advantages resulting ordinal number.

Definitions 2:

$$K_i = \sum_{j=N} a_{ij} \quad i \in N$$

$$H_j = \sum_{i=N} a_{ij} \quad j \in N$$

Property :

$$\begin{cases} a_{ijl} + a_{ijl} = 1 \\ a_{ij} + a_{ji} = m \end{cases}$$

$$T = \sum_{i \in N} K_i = \sum_{j \in N}^{n} H_j = n(n-1)\frac{m}{2}$$

$$H_i + K_i = m(n-1) = G$$

Ki is the i-th target compared with the other goals of the two resulting total Order Number, Hi is the total number of inferior order. The merits of the order can be arranged according to the size of the programs Ki values. If the optimal solution, the optimal solution will be the top surface, if there is an optimal solution, it came in the final surface must be the worst solution.

Optimum Order Method decision-making process

Setting the objective function

The objective function is the decision-making functions, different objectives and targets are not the same, in air defense operations, usually organic species, altitude, speed, route and other shortcuts. And in the radar network coverage, the level of defense was needed to defend not the same, such as command posts, military airport defense level is generally higher. Overall, the threat level enemy target size is determined by many factors, both qualitative and quantitative factors and partly, in the threat assessment must be considered to join the people's preference information when necessary. Such as battlefield commanders feel the threat level of a target is very large, it can be considered to improve its position in the sort of threat, so that the priority will be to destroy anti-aircraft fire. These are available through Compass functions to achieve short message, the decision will be passed to the command staff of each radar network in order to better achieve the threat of judgment.

Multi-objective decision-making process

First, the i-th respectively determined goals and objectives of the j-th objective function compared with each other resulting in superior aij ordinal sequence, and then find the i-th target compared to the other goals of the two resulting outranking the total number Ki.

The merits of the order can be arranged according to the size of the programs Ki values. If the optimal solution, the optimal solution will be the top surface, if there is an optimal solution, can be seen from the optimum theorem in the front row will be non-inferior solution. Seen multiple targets Ki sorted according to the merits (threat level).

Air defense network of fire mission is to protect the land, and have to self-defense, to protect the safety position, so according to the sequence and battlefield commanders circumstances given decision-making system, while the tasks have to consider that, on balance, to judge decision making. And then passed to the network of ministries radar by Compass system.

The weighting coefficient

In the above analysis, a plurality of decision factors are equally, namely that the role of multiple factors in the decision-making system performance is exactly the same, but in practice the influence of various factors are not identical, a number of factors need to be considered in the decision-making The relative importance of the system in a multi-objective decision-making system, the right to re-index factor is important. Its size reflects the importance of each index factor with

respect to the decision-making system. Index heavy weight factors, both objective side of the property, there are subjective attributes side. Threatened systems in terms of judgment, it is necessary to complete the air defense operations of combat missions, but also to protect their own safety, that the object and air defense systems to defend itself suffered the level of threat to an overall judgment, which is an indicator of the weight of the objective factors properties. However, it must be noted that in addition to the decision-making factor weight by objective property effects, but also by policy makers such as battlefield experience, understanding impact combat missions, tactical quality and accomplishment in itself a subjective factor, which is the weight of subjective factors indicators factors. Therefore, to determine the weight of index factors principle should be: an objective attribute index factor mainly take into account subjective factors attribute index. As in the above judgment decisions threat models, the carrying of weapons, the importance of the velocity vector considered to be larger than the other factors, and the weights according to the importance of decision factors, fix the weighting coefficients.

The objective function：

$$F(x) = [\, f_1(x)\, f_2(x) .... f_m(x)]^T$$

Corresponding weight coefficient：

$$\lambda = [\lambda_1, \lambda_2, ...\lambda_m]^T$$

The total number of weighted ordered：

$$K'_i = \sum_{i \in M} \lambda_i \sum_{j \in N}^{n} a_{ij}$$

The adjustment of human decision-making based on Beidou System

Practical applications, the weighting factor is not immutable. We need to constantly adjust the battlefield situation. More needs to be considered from a global battlefield, in the past to achieve this requirement is very difficult. And now the weighting coefficients can be sent via short messages sent to ministries radar, enabling decision-makers or manual intervention system in accordance with the guidelines and best method battlefield situation, adjust the weighting coefficients.

Summary

Order Method multi - objective decision fully into account the objectives of decision factors, the objective function by the decision-makers to develop goals, while the relative importance of indicators based on the introduction of a weighting factor, to ensure that the requirements of the main decision-making factors. Order Method without complex tedious mathematical modeling, computational simple and quick, the objective function indicators (such as performance advantages and disadvantages, attack strength, etc.) without quantization processing, able to use the equipment in the current artillery command automation system, outranking France is also timely to join multi-objective decision makers of human intervention factors were adjusted to conform to the current command and decision-making features. Beidou system is currently limited communication capacity, maximum efficiency can play a functional short message communication using outranking method, in order to achieve optimum networking radar threat evaluation. With the gradual development of the Beidou system, expanding the communication capacity, will use the network radar is growing.

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