Construction of Operational Rules System of Ship-borne Integrated Radar Electronic Countermeasure System against Air

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Abstract: In order to give full play to the equipment and technical advantages of the ship-borne integrated radar electronic countermeasures system in air combat, it is necessary to establish a scientific operational rules system to assist commanders in operational command decision-making. This paper analyses the contents and characteristics of the anti-air combat rules of the ship-borne integrated radar electronic countermeasures system, and puts forward the method of establishing the anti-air combat rules system of the ship-borne integrated radar electronic countermeasures system from three aspects: the triggering of the combat scene, the formation of the combat rules and the system operation under the specific scenario, and gives an application example for the ship-borne integrated radar electronic countermeasures system. The implementation of resource scheduling and the scientific and flexible decision-making of commanders provide reference.

Ship-borne integrated radar ECM system breaks the traditional single-device partition boundaries, can give full play to the advantages of multi-device cooperative work, and realize the unified processing of multi-sensor information and the partial sharing and comprehensive utilization of information[1]. Whether we can make scientific and timely command decisions in anti-air combat according to the actual operational tasks to give full play to its equipment and technical advantages will affect the operational effectiveness, and even directly determine the success or failure of the operation. Because of the randomness of the situation and the contingency of command in the actual combat process, only some principled command suggestions and manual judgments can not meet the requirements of rapid and correct decision-making[2]. It is necessary to study the construction of operational rules of Ship-borne integrated radar electronic warfare system in anti-air combat, which has important guiding significance and practical significance for the research on the application of Ship-borne integrated radar electronic warfare system in anti-air combat.

1. The Content of Operational Rules System of Ship-Borne Integrated Radar Electronic Countermeasure System Against Air

1.1. Specific Composition of Rules System.

The fundamental purpose of implementing the air combat rules of Ship-borne integrated radar electronic countermeasures system is to provide the commander with the basis for command decision-making, and the optimal performance of command decision-making should be automatic response, that is, the commander draws the conclusion of battle situation judgement according to the rules of battle situation judgement according to the battle situation judgement task of Ship-borne integrated radar electronic countermeasures system itself and according to the system. Operational rules implement command and decision-making [3]. Therefore, the operational rules of Ship-borne integrated radar ECM system against air should have the intelligence to choose the next action according to the current perceived operational situation, which is equivalent to giving the commander the "instinct" to respond to the specific relevant battlefield situation by the various information equipment of Ship-borne integrated radar ECM system, and this "instinct" through a clear ship-borne integrated mine. To express and implement the system of operational rules of

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electronic countermeasures system against air.

There are two kinds of rules in the rules system of anti-air combat of Ship-borne integrated radar electronic countermeasures system: one is the commander's automatic decision-making rules according to the specific combat situation and combat scene, which describe the commanding ability of the commander; the other is the adaptive behavior control rules of the information equipment of Ship-borne integrated radar electronic countermeasures system, which is the response to the system. Capability description.

1.2. Elements of Rule System.

Although the anti-air combat rules of Ship-borne integrated radar ECM system have abundant attributes, the main elements of the rules include time elements, space elements, frequency domain elements, interaction elements and subordinate elements.

(1)Time element

The time element in the air combat rules of Ship-borne integrated radar ECM system mainly refers to the relative time element, which is used to restrict the time of specific operations in the air combat situation, such as how many seconds after the jamming target can be transferred to the air detection task when the integrated jamming equipment carries out the jamming and the air target detection task at the same time.

(2) Spatial Elements

Spatial elements are mainly used to restrict the working space of sensors in the system. The behavior, activity and decision-making of Ship-borne integrated radar ECM system are based on different spatial position information such as range, distance, velocity, elevation angle and azimuth angle. For example, in the process of resource scheduling, the types and quantities of sensor resources are determined according to the scope of combat airspace.

(3) Frequency Domain Elements

Frequency domain elements are mainly used to determine the operating frequency range of each sensor in the system, and to divide the frequency bands when carrying out different combat tasks. For example, in the process of air combat resource scheduling, according to the situation of electronic interference and electromagnetic environment, sensors working in the best frequency band are selected for early warning detection, electronic countermeasures or weapon use support.

(4) Interactive elements

It mainly refers to the use and guidance interaction of sensor resources in the system. It mainly describes the specific working modes of each sensor resource, the compatibility (which working modes can work at the same time) and exclusion (which working modes can not work at the same time), and takes into account the communication between the system and the warship command and control system as well as the combat environment. Reciprocal. For example, when terminal integrated anti-missile, the jamming equipment and active detection equipment should be selected.

(5) Subordinate elements

It mainly refers to the clear description of the corresponding relationship between the sensors and the weapon system in the system. One is the exclusive sensor, mainly refers to a certain weapon system, can only have a specific sensor to support its combat mission; the other is a variety of sensors, mainly refers to two or more sensors can be used to support the use of a certain weapon system, but it is necessary to identify which is the priority support sensor, which is to take into account the support sensor. For example, when to invoke the active detection function of jamming equipment when the active detection radio frequency resources can not be taken into account when the end-to-air detection task is executed.

2. Characteristic of Operational Rules System of Ship-Borne Integrated Radar Electronic Countermeasure System against Air

2.1. Style Formatting.

Style formatting refers to describing the rules of automatic decision-making and self-adaptive behavior control of sensors' actions in the anti-air combat of Ship-borne integrated radar ECM system with relatively fixed structure. On the one hand, the knowledge acquisition and description of anti-air combat of Ship-borne integrated radar ECM system are constrained by formatting specification, that is, the requirement phase. Professional military personnel abstract and refine their own non-formatted operational experience and related principles, and concretely translate them into clear operational rules. On the other hand, the formatted expression method conforms to the cognitive thinking and usage habits of operational commanders, operators and software developers, so as to facilitate identification, mastery, improvement and conceptual model to mathematics. The transformation of the model and the formatted style are helpful to avoid the omission in partitioning and describing the problem space[4].

2.2. Driving Scenarioization.

The operational rules of Ship-borne integrated radar ECM system against air are the hierarchical description of the scientific command of sensors in the system for specific operational tasks and operational space. The research of operational rules must be based on certain operational tasks, operational space, operational objects and operational forces. Otherwise, airborne integrated radar ECM system against air will be empty talked about. Operational rules are like water without source and wood without foundation. Therefore, the "scenario" here mainly refers to the specific action or interaction sequence made by the relevant resource sensors in a specific combat situation. Scene-based operational rules help to divide the continuous combat process of Ship-borne integrated radar electronic countermeasures system into several action or interaction segments, and to specify the specific scenario through rule constraints. The situation carries on the specific correspondence. At the same time, the scene-driven operation rules are also helpful to the formatting of their rules.

2.3. Rule Constraints.

The restraint of the air combat rules of Ship-borne integrated radar ECM system refers to the restraint of how the system conducts command and decision-making in a certain combat situation and environment. Therefore, the rule system must be clear about what must be done, what can be done and what is prohibited in a specific scenario. The restraint of the rules is mainly embodied in the line of sensors of the system under specific combat conditions. The basic basis, direction and scope of dynamic change are limited to reach a logical relationship of predetermined degree[5].

2.4. Scene Triggering.

Scene triggering of air combat rules in Ship-borne integrated radar ECM system is based on the constraints of scenario-driven combat rules. Each battle scene in the battle rules should have clear triggering conditions, and each battle rule should have corresponding battle decision-making actions. At the same time, each sensor in the system must have corresponding battle actions.

2.5. Standardization of writing.

Code of wording is required by most rules, especially operational rules. When formulating operational rules of Ship-borne integrated radar electronic countermeasures system against air, the expression method of operational rules should be clearly defined, and the accepted and ambiguous concepts, terms, symbols and grammar should be adopted. Only in the environment defined by general grammar and semantics, can military experts of Ship-borne integrated radar electronic countermeasures system and commanders, operators and software developers of integrated radio frequency system communicate effectively with each other in different fields of system-related systems, so as to reach a consensus of cognition and description.

2.6. System Expansibility.

The expansion of the system mainly includes two meanings. One is to customize the automatic decision-making rules and the adaptive behavior control rules of the sensors in the system for the command of the ship-borne integrated radar electronic countermeasures system in air combat according to the specific needs of the operational commanders and operators. This is also to ensure that the ship-borne integrated radar electronic countermeasures system can meet the needs of the users. The important guarantee for the incremental improvement and upgrading of the air combat rule base is to modify and supplement the semantic environment of the air combat rules of the ship-borne integrated radar electronic countermeasures system according to the needs. Extensibility is conducive to the acquisition, maintenance and improvement of relevant operational knowledge.

3. Examples of Rules Driven by Operational Scene

There are three main factors to consider in formulating combat rules of Ship-borne integrated radar electronic countermeasures system based on combat scenarios: first, under what conditions should this rule be applied, that is, the application trigger conditions of combat scenarios; second, the combat principles of Ship-borne integrated radar electronic countermeasures system for specific combat scenarios, that is, what specific combat rules are; and third, how to apply them. This rule refers to the action of operational entities in a certain order of logical rules in a specific combat scenario.

3.1. Triggering Conditions for Application of Operational Scene.

The triggering conditions of the application of Ship-borne integrated radar electronic countermeasures system to air combat scenarios mainly refer to the aggregation of the space elements of combat situation related to the system to air. At this time, the space elements of combat situation mainly include the action status, action and attributes of sensors in the system, the attributes of battlefield environment and the influence on combat operations, and the enemy combat forces that influence the command and decision-making. Action status, action and attributes, etc. Therefore, the formulation of triggering conditions for air combat scenarios of Ship-borne integrated radar electronic countermeasures system involves many factors and is difficult to segment and define. It is a complex system engineering. The triggering terms and values of different sensors in the system are different. Therefore, when selecting the triggering terms, it is necessary to analyze all the factors that may affect the next action of integrated radio frequency system, and give the operational sections. Point selection ensures that condition items, especially some key items which have great influence on command decision-making, can not be omitted. On the basis of guaranteeing complete condition items, conflict of operational rules should be avoided. That is to say, in the same scenario, the same condition selection values can not trigger different scenarios. Taking the scenario of missile terminal guidance signal found in short-range combat zone as an example, Table 1 shows the triggering of this scenario. All the conditions required for a scenario, in which "--" means that this item does not consider its value in this scenario.

3.2. Specific Operational Rules.

Firstly, it should be pointed out that the combat rules have certain subjectivity. It is a summary of the principles of how to implement combat operations in a specific combat scenario. Specifically, when the combat situation of Ship-borne integrated radar electronic countermeasures system is known, the primary criterion of resource scheduling in the system is to ensure the completion of combat tasks, while for resources. As far as volume planning is concerned, dispatching methods are not unique and resource allocation is not unique. What dispatching methods and approaches are adopted on earth, which are related to the tactical intentions of commanders, operational priorities and even commanding habits of commanders. Therefore, the operational rules of Ship-borne integrated radar electronic countermeasures system based on specific operational scenarios must fully integrate relevant military experts and commanders. Commander's opinions and comprehensive refinement of various operational principles determine that there are no so-called perfect operational rules in the principle of command because of the unpredictability of the air combat operations of the ship-borne integrated radar electronic countermeasures system. Only reasonable operational rules and operational rules satisfying specific operational mission tasks are available. According to Table 1, when the missile terminal system is found in the short-range combat zone. When guiding radar signals are used, three operational rules can be obtained according to the combat situation and known conditions of both sides of the enemy and ourselves given in the scene.

Operational Rule 1: Electronic reconnaissance equipment finds the terminal guidance radar signal and immediately implements centroid jamming.

This operational rule mainly considers the characteristics of ECM operation. According to the requirements of centroid jamming operation, when the terminal guidance radar signal suddenly appears at close range of the platform, the success rate of anti-missile can be greatly improved by implementing centroid jamming immediately.

Rule 2: Full-time active detection of short-range air targets is guaranteed.

The operational rules are mainly based on the characteristics of observation organizations. When the electronic reconnaissance equipment finds the terminal guidance radar signal, it means that high-threat targets appear in close range of the combat platform. At this time, as an active detection equipment, the primary task is to find targets, so as to provide the basis for the next hard weapons fight.

Operational Rule 3: When the threat target enters the optimal combat distance of hard weapons, the system gives priority to providing weapon information support.

This operational rule is mainly based on the international customary practice and commander's command habits. When the threat target enters the combat range of hard weapons, because the electronic reconnaissance equipment has found the radar signal of missile terminal guidance, it can implement both electronic countermeasure and hard weapon countermeasure. However, due to the limited time and resources of short-range anti-missile, when there is a conflict of resources, the rules are clear: the system gives priority to the provision of weapon information security.

Table 1 Application trigger conditions for combat scenarios

Scene name	Detection of Missile Terminal Guidance Radar Signal Scene by Electronic Reconnaissance Equipment in Short Range Warring Zone
Scene number	******
Scene description	The system finds the radar signal of missile terminal guidance in short range combat zone
Combat entity	Ship-borne Integrated Radar Electronic Countermeasure System
Current action	Air combat
Self-capability	Full-time, omnidirectional and full-frequency reconnaissance capability of electronic reconnaissance equipment
	Passive over-the-horizon reconnaissance capability of correlation sensors in the system
Location of Short Range War Zone	Within XX km
State of each sensor in the system	Ability to work at any time and switch status
Enemy forces	Missile
Enemy Tactical Action	————
Enemy position	air target
Target azimuth	————
Target distance	Regardless of distance
Existing operational targets	No known target exists in the short range zone of engagement
Environmental situation	The density of electromagnetic signal meets the working requirements of the system

3.3. Systematic Operations in Specific Scenarios.

Operational action of Ship-borne integrated radio frequency system in specific scenarios refers to the space elements of combat situation at the meta-level. That is to say, at the level of warship platform and tactical anti-air combat, the operational action of Ship-borne integrated radar electronic countermeasures system is the smallest unit behavior that can not be further decomposed. It mainly includes the basic actions of sensors in the system (such as search, tracking, guidance, etc.). Interaction between sensors and command and control systems (such as guidance handover, system control, resource scheduling, etc.)[6]. These operations start and end according to the pre-defined logical starting conditions and relations, thus forming the event flow of the systematic anti-air operations, and under the control and scheduling of the general operational rules, forming the operational sequence gradually unfolding over time, and finally achieving the command and control of the systematic anti-air operations. According to the specific combat scenarios and the operational rules given in Table 1, the systematic operations in the specific scenarios are shown in Figure 1. Fig. 1 shows the specific response actions of the ship-borne integrated radar ECM system according to the current situation conditions in this scenario.

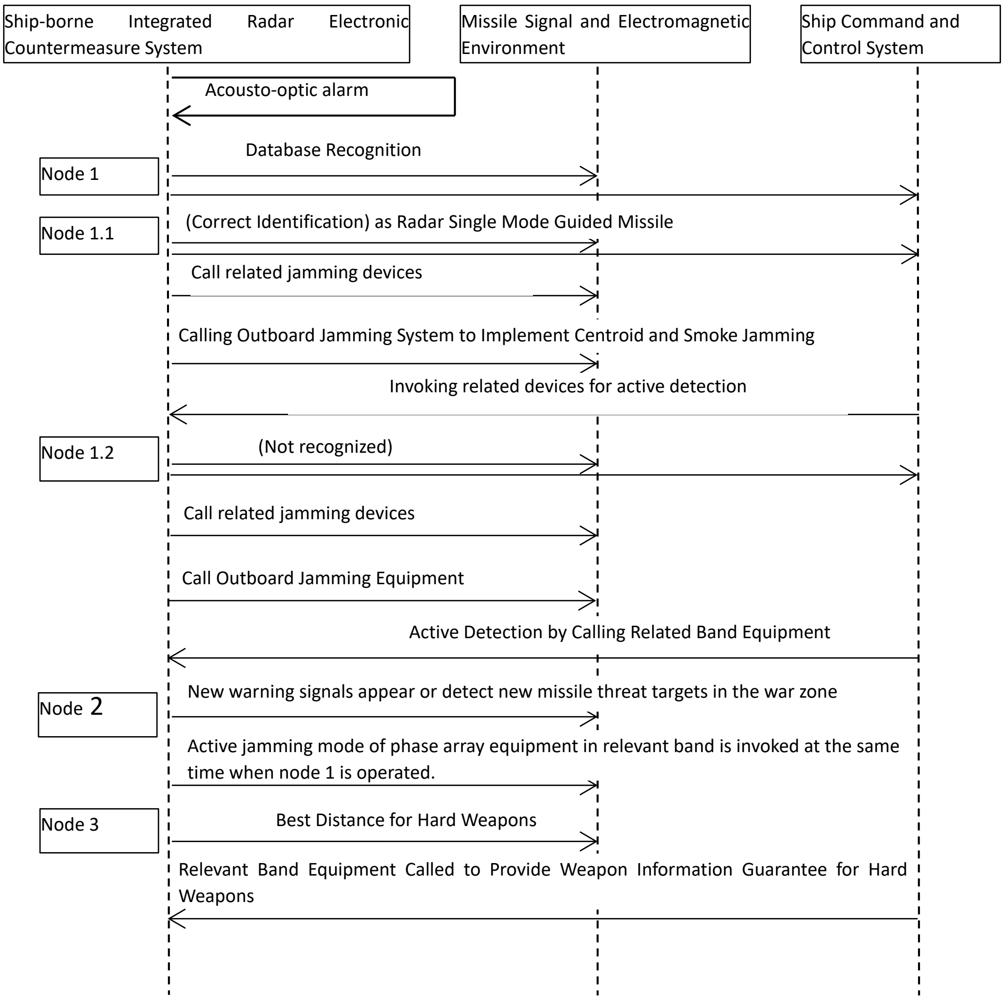

Figure 1. Missile terminal guidance radar signal scene found in short range combat zone

4. Conclusion

Ship-borne integrated radar ECM system is an information system of new technology and design concept. Scientific and reasonable resource scheduling is an important way to give full play to its equipment and technical advantages. The operational rules based on specific combat scenarios are applied to the ship-borne integrated radar ECM system, which makes the system resource scheduling more pertinent, flexible and flexible, and makes the commander more flexible. Command decision-making laid the foundation. The next step is to analyze and calculate the effect of system resource scheduling under different operational rules in combination with specific operational scenarios, and give the completion degree of resource scheduling tasks under the guidance of different rules, so as to further improve the operational rules and refine the operational conditions of rules, which has important reference significance for improving the operational capability of Ship-borne integrated radar electronic countermeasures system.

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