

Analysis on the Operational Characteristics of Shipborne Integrated Radio Frequency System

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Abstract. The shipborne integrated RF system of new technology, new design concept with radar, communication and electronic warfare integration function, breaking the traditional single slice device segmentation, can give full play to the advantages of multi device collaborative work. On the basis of international typical shipborne integrated RF system, based on introducing the concept, task and composition of Shipborne integrated radio frequency system, analyzes its air combat task framework, combined with technical characteristics of focus on the analysis of the integrated RF system of air combat use characteristics, reference and practical significance of the development trend study on foreign naval shipboard integrated RF system and its operational characteristics.

Introduction

Modern information warfare has from the past single platform, single weapon confrontation to systematic confrontation, systematic confrontation transformation. early warning function, Weapon information support function, Information warfare and other functions of ship platform is mainly realized by radar, communication and electronic warfare. in actual combat, relying solely on a certain information equipment or the simple superposition of a variety of information equipment, It is difficult to give full play to the operational effectiveness of information equipment, It is necessary to combine different kinds of information devices in different ways, constitute a comprehensive integrated information system, to achieve strong information superiority and information warfare force.

As a new type of electronic information system of new concepts, shipborne integrated RF system has been developing rapidly in recent years, a few countries headed by the United States have been developed and made great progress, in October 2013 the United States Navy's Zumwalt-class destroyer DDG 1000 has launched, the destroyer is equipped with advanced Multifunctional radio frequency system(AMRFS), It integrates radar, electronic warfare, communications and other equipment integration, installed in the ship superstructure, which also marks the official carrier integrated RF system from the stage of theoretical research into the practical application stage. To achieve the integration of functional integration of Shipborne integrated RF system in according to the actual combat task can give full play to its equipment and technical advantages of air combat, will affect the combat effectiveness is good or bad, even directly determines the result of operations, therefore, the shipborne integrated RF system in air combat using characteristic research has important practical significance.

General Concepts

All the time, Since the surface ships carry out anti-air action missions, Regardless of early warning detection, weapons information security, or electronic warfare air defense anti-missile, which uses a large number of independently developed RF sensors and independently distributed across the shipboard information system, to Complete the required functions. RF sensor

resources for each independent use only by the special function of the corresponding, and each corresponding function are realized by RF front-end, respective power supply, processor, modular degree is low, which weight, volume, power consumption is very large, and has low reliability, difficult to improve, It is difficult to adapt to the requirements of the future information warfare on surface ships air combat. in order to solve this problem, It is necessary to carry out the modular design and functional integration of the RF sensors[1], In order to realize the comprehensive processing and comprehensive application. and the Shipboard integrated RF system can be a good solution to these problems

Shipborne integrated RF system is a kind of radar, electronic warfare, communications and other equipment for the integration of function of combat system In order to meet the requirements of modern information warfare system and systematic confrontation, which replaces a large number of scattered antenna aperture on the surface ship platform with the distributed multi - function aperture, the RF sensor system the system framework is modular, open and reconfigurable, through the function of control and resource management scheduling algorithm, Comprehensive realization of radar, electronic warfare and communications, navigation, identification and other radio frequency functions[2].

The main mission of shipboard integrated RF system can be summarized as:

- (1) to the sea target and far, short-range air target detection and recognition of early warning;
- (2) to Provide information support for Ship to ship missiles and guns to sea combat, Air defense and antimissile operation, Short-range air defense weapons and terminal air defense weapons.
- (3) electronic reconnaissance, electronic intelligence gathering, active jamming and passive jamming.

Composition and Division of Air-To-Air Combat Missions

General Composition of Shipboard Integrated RF System. Shipborne integrated RF system has integrated functions of radar, communication and electronic warfare, breaking the traditional single slice device segmentation, can give full play to the advantages of multiple devices to work together, which realizes the function of unified processing of multi-sensor information and flat sharing and comprehensive utilization of information. Based on the typical foreign integrated RF system (including the existing shipboard and airborne) comprehensive analysis of Shipborne integrated RF system generally consists of radar, communications, electronic warfare, identification and comprehensive information processing, resource scheduling, integrated display and control equipment composition, as shown in figure 1.

Air Combat Mission Division of Shipboard Integrated Radio Frequency System. For surface ships, which faces a variety and quantity of enemy threats when carry out on air combat missions, combat task is very urgent and with High degree of concurrency, the use of system resources in high demand, therefore, research on shipborne integrated RF system for air combat characteristics must be based on specific air combat missions.

The successful completion of air combat needs to be established based on finding target, target recognition, fire-fighting and electronic jamming to threat targets and other tactical actions, It is necessary to carry out the information security of each sensor equipment in shipboard integrated radio frequency system, to achieve the rational allocation of resources to air combat, to the combat mission reasonable decomposition, closed cycle generally follow the four links "Reconnaissance-identification-strike-assessment" , from the integrated RF system resource use angle, "Reconnaissance and identification" belongs to the class of sensor equipment security situation awareness of combat missions, and "strike and assessment" belongs to the weapon system and related equipment to ensure the sensor combat mission. Therefore, the shipborne integrated RF system to air operations as the target level task, which consists of three sub tasks,

such as situation awareness combat mission, weapon information support task, and electronic warfare task, the sub task includes the corresponding tactical task and resource allocation task. As shown in fig. 2.

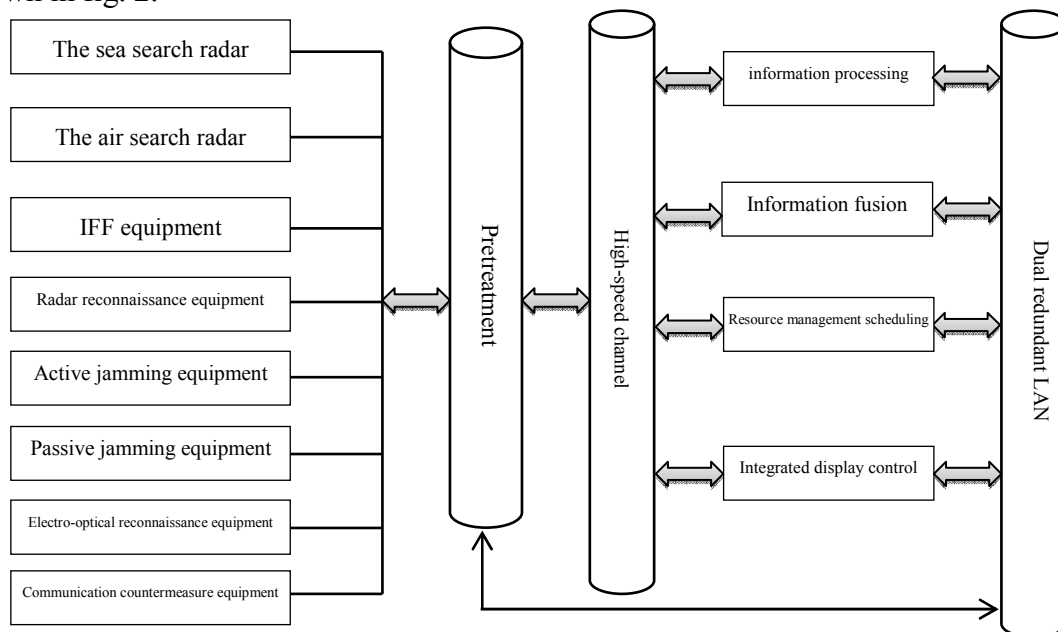


Figure 1. Composition of Shipborne integrated RF system

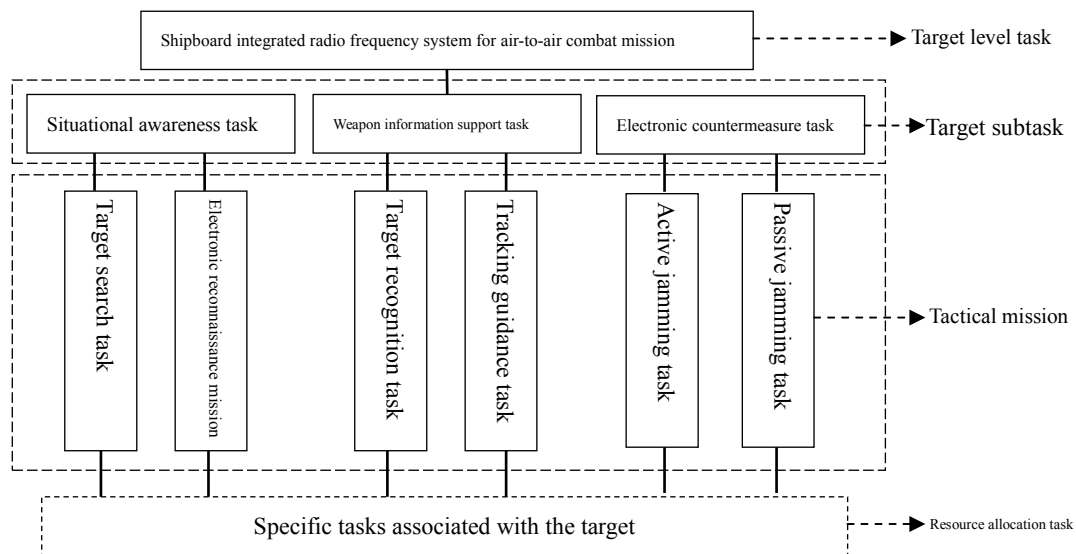


Figure 2. frame of air combat task for shipborne integrated radio frequency system

Operational Characteristics

Anti-air action is one of the main operational modes of surface ships, which mainly protects against enemy aircraft and anti-ship missiles, which is a kind of passive, defensive operations, which is one of the most complex and the most important battle style in the naval warfare, mainly around the fight against enemy aircraft or missile launches. Shipboard integrated radio frequency system for air combat also focuses on against the enemy aircraft or anti-ship missile, as a comprehensive carrier integrated RF system itself, in the implementation of air combat has the following characteristics:

Multiple Sensors to Guide Each Other, Strong Ability to Execute Multiple Tasks Simultaneously. Shipborne integrated RF system integrated with different frequency and

different distance of air and sea search radar, the main effect of different airspace radar, such as VHF radar range, mainly in the remote search for warning, while the L band, S band, C band and X band radar with frequency band increase the role of the corresponding distance is smaller, while search tracking accuracy increases, by guiding the working mode of the radar system, can realize multi sensor system for shipborne RF air guide each other, such as through VHF radar in L band, S band and C band radar guidance, reduce the L and S band, C band radar time resource consumption, for the L band, S band and C band radar equipment to complete other tactical tasks (weapon against information security, such as pre IFF) Leave more time energy resources to improve the ability to multitask.

Multi Band Cooperative Detection, with High Tracking Accuracy. Surface ship air detection can be generally divided into three areas, such as remote area, central area and near area, the detection ability of different detection equipment is different in different operational areas, and the adaptability to the same environment is different. Therefore, in actual combat, will give full play to the function of the detection equipment advantages, mutual cooperation, avoid weaknesses, providing favorable air situation for the next step of tactical decision of ships, because of Shipborne integrated RF system of multi sensor information unified processing, open all the detection information sharing system, the task system extracts the measurement information on demand, which has laid a solid foundation for the mutual cooperation of the detection devices in the system. For example, when the remote air alert detection, Due to the longer wavelength in the VHF radar, air detection is not easy to be disturbed, which can be used for cooperative tracking to help eliminate interference when other radars (S band, C band, etc.) are affected by the active jamming in the integrated RF system, to improve the tracking accuracy and track continuity. In the implementation of weapon information support, multi band radar can be used for cooperative detection, through joint detection, video integration, fusion and so on, reducing the radar multipath blind spot detection, improving the detection capability and track target continuity, to achieve accurate acquisition and tracking of radar target information under complex electromagnetic environment.

Coordination of Active Detection and Passive Detection, with Strong Detection and Protection Ability. As the active detection equipment, radar can automatically detect the target, accurate determination of target space position, automatic tracking and aiming, which is an indispensable weapon in command and operation, the biggest threat is jamming and anti-radiation missile attack;

As the passive detection equipment, Electronic warfare reconnaissance equipment can passively receive the target radiation signal, has good concealment and the role of distance, is less effected by electromagnetic interference, but which can only get the orientation information of the target signal, and can't get the distance information. The shipborne integrated RF system with radar equipment, and electronic warfare equipment, When the radar detects the target, through the coordination of electronic warfare equipment, which can secretly monitor the entire electromagnetic environment, in the premise of smooth communication, the use of distance information, ensure the radar boot in the best time for detection, and electronic warfare equipment can interfere with enemy's anti-radiation missile radar seeker, which greatly improve the combat effectiveness of weapon system and self-protection ability.

Multi-Source Data Fusion, Strong Ability to Identify Air Targets. The ability to identify air targets is the primary indicator to measure the strength of surface ship to air combat, however, the most difficult problem for radar to detect the air target is that the recognition ability is not high. Once the radar detects the target, the most urgent problem is to accurately determine the target characteristics, and shipborne integrated RF system organically integrates radar, communications, electronic warfare and other detection equipment, through real-time multi-source data fusion, shipborne integrated RF system on the target recognition ability help to compensate for the lack of radar. At the same time, the IFF, ESM electronic reconnaissance and

radar data fusion and coordination based on identification function, combined with the results of radar reconnaissance, separation results, comprehensive utilization of target RCS feature and motion feature, enemy characteristics, electromagnetic radiation characteristics, comprehensive target recognition ability greatly improved system.

Multi Sensor Integration, High Demand for Resource Allocation Scheduling. The main advantage of Shipborne integrated RF system is "integration", and whether the system can give full play to its equipment and technical superiority lies in the use of "integration", the system contains radar, communications, electronic warfare, IFF and other resources, in the specific scene and mission requirements, according to the type and number of sensors in the system, structure, function and characteristic, choose the sensor related, available, build a multi sensor combination matched with specific tasks. For a combat mission, there may be a variety of sensors in the system to provide resource protection for the implementation of the combat mission, it is necessary to consider how to choose the best strategy for the use of sensors from the multi sensor strategy to match the task, on the basis of static and reasonable resource allocation, the task scheduling and conflict resolution should be carried out in time. Therefore, in order to maintain the continuity of the combat command and give full play to the technical advantages of the integrated RF system, it requires a high degree of resource allocation and scheduling within the system.

Conclusion

As a new ship borne information warfare system, the shipborne integrated radio frequency system has the advantages of advanced ideas and equipment technology, it is not enough to rely solely on equipment and technology to make full use of its combat effectiveness, but also to analyze the operational characteristics of the specific operational tasks. Only by fully mastering the technical characteristics, application features of the system can we make reasonable operation, the research and application of Shipborne integrated radio frequency system of the world Navy is just beginning, in this paper, the operational characteristics of shipboard integrated RF system are analyzed, which is of great reference and practical significance for the research of the development trend and operational characteristics of the naval shipboard integrated radio frequency system.

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