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Research on Design and Development of Marine Fishery Comprehensive Scientific Survey Vessel for Multi-level Marine Fishery Resources Development

Ning Wang[1], Xiaojun Hou[2], Jikun Ma[3], Bingbing Yuan[1], Fuyan Xin[1, *]

[1] Yellow Sea Fisheries Research Institute, Qingdao, 266071, China

[2] China Ship Scientific Research Center, 214082, China

[3] Sanya Yazhou Bay Technology City Development and Construction Co., LTD, Sanya, 572000, China

*Corresponding author's e-mail: xinfy@ysfri.ac.cn

Abstract

This paper develops a multi-level marine fishery resource system using computer resource technology. The system's innovation is that the hull is positioned on the ship-borne marine remote sensing fishery survey and fishing objects and other processing functions. After combining the computer big data multi-level marine fishery resource technology, through the verification of the scientific algorithm model, it is verified that the multi-level marine fishery resource development system can significantly improve the fishing objects of fishery survey carried by ocean remote sensing and can effectively improve the exploration of new resources. Furthermore, monitoring fishery status can conduct accurate positioning research on marine fish migration patterns, fishery formation mechanism, fishery speed prediction, and marine fishery resources. Development is important.

Keywords

Marine Fishery Resources; Marine Fishery Comprehensive Scientific Survey Vessel; Resource Development and Utilization; Fishing Situation Monitoring.

1. Introduction

This paper designs a 3,000-ton main engine power of about 2,700 kilowatts, a cruising range of 10,000 nautical miles, and a self-sustaining force of 60 days. It meets the requirements of the sea area in the total navigation area (except the ice-free area) and has a comprehensive global navigation capability in the Yellow Sea and the Bohai Sea and the ocean fishery resources and environment. The Marine Fishery Comprehensive Scientific Survey Vessel, whose technical level and survey capability have reached the domestic leading and advanced international level, provides a necessary platform for a scientific survey of marine fishery and high-tech research and development in China. This paper designs a leading domestic ship type that sets up anti-rolling tanks and is equipped with a DP-1 dynamic positioning system to ensure the cost-effectiveness and cost-effectiveness of the ship. Corresponding vibration and noise reduction measures are taken to meet the requirements of comprehensive scientific investigations[1]. The hull can conduct three-dimensional, real-time, synchronous detection, analysis, and processing of comprehensive elements such as marine fishery resources, hydrology, physics, chemistry, acoustics, remote sensing, and other comprehensive elements within a wide range of water depths in the Yellow Sea and the Bohai Sea and the oceans

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(except the de-icing area). Examine data acquisition, sample fidelity sampling, on-site analysis capabilities, and sea-based data system integration and information transmission capabilities.

The main functions of this ship are as follows:

(1) Fishery resources survey function: bottom trawling, variable water layer trawl, longline fishing, squid fishing survey, and acoustic fishery resource assessment.

(2) Fishery environment investigation function: It has the investigation and analysis function of primary productivity, plankton, benthic organism, water body, and sedimentary physical and chemical environment parameters.

(3) Ship-based remote sensing information receiving and processing functions: It can receive remote sensing satellites such as Fengyun-3, MODIS, NPP, etc., and can obtain real-time fishery information such as sea surface temperature, chlorophyll, and meteorological cloud images.

(4) Experimental research on new fishing gear and fishing methods: It can field test various types of fishing gear and methods and undertake the task of selective and standardized field testing of offshore fishing gear.

2. Hull Structure Design

The 3000-ton Marine Fishery Comprehensive Scientific Survey Vessel is the essential equipment of Chinese marine fishery scientific research and technology, representing comprehensive Chinese strength in developing and utilizing marine fishery resources. The scientific laboratory, equipped with many sophisticated survey instruments and equipment and detection and capture tools, has extremely high requirements on the ship's load capacity, environmental vibration, noise, operating space, and safety [2]. Therefore, in the structural design stage, the weight control, static/dynamic performance, and space utilization of the structure should be taken as the focus of the structural design. Given the above points, in order to obtain a high-quality structural design scheme, the following key technologies must be independently developed and applied in the design stage:

2.1 Security Design Technology

The ship needs to work in far-reaching seas for a long time, and the risk of encountering severe sea conditions such as storms is high. It must be ensured that the structure has sufficient strength, stiffness, and stability under the ultimate load to resist structural damage and deformation. Therefore, ensuring the reliability of the design method in terms of structural safety is the basis of structural design.

2.2 Comfort Design Technology

Comfort is mainly reflected in vibration noise and clear floor height in hull structure. The vibration of the hull structure is directly related to the cabin noise and the radiated noise generated by the structure in the water, while the minimum clear height requirement directly limits the height of the muscular structure.

On the one hand, the ship is equipped with many sophisticated survey instruments and detection equipment. The harmful vibration of the hull will affect the regular operation of the instruments, reduce the use accuracy and shorten the service life, and the resulting cabin noise and underwater noise will directly affect the scientific research personnel. The working and living state and the regular operation of the detection equipment [3]. On the other hand, many instruments and equipment must be equipped with a complex power control system, which inevitably produces a large number of structural solid openings, which endanger the safety of the structure itself. The most effective way to compensate for the structural loss is to increase the height of the components. However, the requirement of minimum clear height has seriously restricted this conventional approach, and other effective reinforcement methods must be found. Therefore, the comforting structure design technology is a strong guarantee for the realization of ship functions.

Volume 9 Issue 9, 2023
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2.3 Technological Design Technology

The craftsmanship of the hull structure design will directly affect the shipyard's construction progress and construction quality. The design separated from the shipyard's process system will bring great operational difficulties and safety risks to on-site construction, resulting in a substantial increase in construction costs. Hudong Zhonghua Shipyard built the ship. It has already formed inherent craftsmanship and production model in the hull structure's connection form and construction details. If the hull structure design does not pay sufficient attention to the craft characteristics of the shipyard, the shipyard will not be able to play the role effectively. The production capacity and construction advantages will indirectly affect the cooperation between the design unit and the construction plant [4]. Therefore, the structural design technology combined with the current state of the shipyard's technology is fundamental to the construction quality of the ship.

2.4 Lightweight Design Technology

As an essential component of the design displacement, the weight of the hull structure will directly affect the load capacity and various performance indicators of the ship. Since the construction of the hull structure runs through the entire shipbuilding cycle, the amount of steel and the total amount of welds will affect the construction cost of the shipyard. Moreover, have a direct impact. The ship is equipped with a variety of large-scale nets, fishing tackles and supporting winches, and lifting equipment, so the control of the center of gravity of the hull structure is more important, how to achieve the overall requirements and the conditions of structural safety, comfort and craftsmanship. The lightweight structure is an important goal of structure design. Therefore, effective and reliable structural lightweight design technology is the key to improving the project economy.

3. System Innovation Technology

3.1 Special Installation System

Optimal arrangement method of longline system suitable for Marine Fishery Comprehensive Scientific Survey Vessel.

The main technical scheme of the arrangement method is as follows:

The superstructure is arranged in the front part of the ship.

The rear end wall of the superstructure is located behind the midship.

The two sides of the superstructure are not provided with fore-and-aft penetrations for arranging the dry rope winding duct and the wire pulley.See Figure 1.

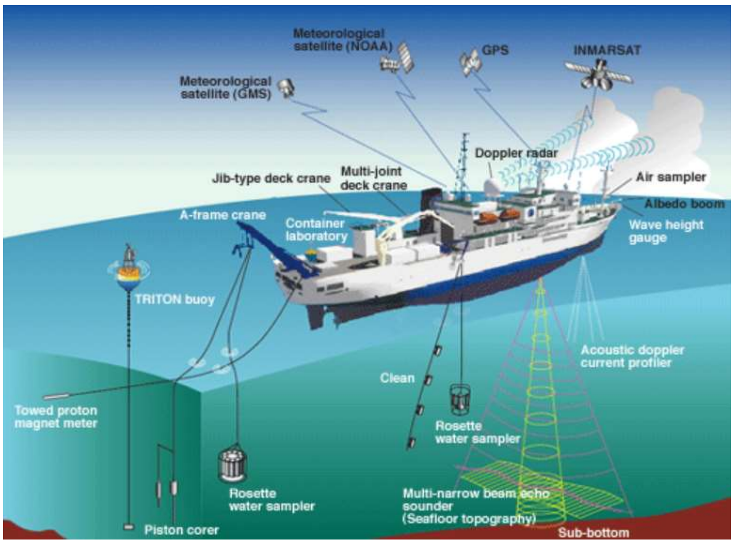

Figure 1. Structure diagram of marine fishery comprehensive scientific survey vessel

ISSN: 2414-1895 DOI: 10.6919/ICJE.202309_9(9).0019

Large passage opening. All components of the longline system are located in the open area aft of the ship's main deck, behind the aft wall of the superstructure. The ship's longline fishing system mainly includes a dry line, rope take-up machine, rope throwing machine, dry rope take-up duct, one-way guide wheel, and three-way guide wheel [5]. The rope casting machine is arranged at the rear end of the exposed area of the main deck, and the rope take-up machine is arranged at the front end of the exposed area of the main deck; the three-way guide wheel is arranged at the side of the front end of the exposed area of the main deck; On the route between the rope take-up machine and the rope thrower and on the route between the rope take-up machine and the three-way guide wheel. The ship has a DP1 dynamic positioning system, which controls the ship's orientation during longline reeling operations. The dynamic location system has a control station in the longline reeling area.

By arranging the reeling machine of the longline fishing system in the open area at the stern of the main deck, the superstructure in the middle and front part does not need to set up a significant passage opening through the fore and aft on the side for arranging the dry-line reeling duct and wire wheel, which ensures the overall integrity of the superstructure and is conducive to the maximum utilization of the interior cabins of the superstructure.

Integrated design of scientific investigation instruments and equipment.

The ship has portable equipment that does not require fixed installation, such as large-volume water sampling filters, vertical plankton trawls, plankton aquifer trawls (multi-networking), sediment samplers, multi-tube columnar samplers, multi-parameter temperature and salinity (CTD) measurement, and water collection system. These instruments and equipment are usually stored in the deck storage room or directly placed in the cabinets on the deck. When they need to be used, they are transferred to the ship's side by the crane on the ship or directly by the scientific research personnel and collected by winches, A-frames, etc. Place the device in the marine environment for sampling operations.

According to the functional requirements of the onboard laboratory, some instruments and equipment belong the equipment that needs to be fixedly installed in the laboratory, such as the stereomicroscope and the upright microscope installed in the fishery resources laboratory; the navigation surface installed in the marine physical and chemical laboratory Seawater parameter automatic collection, processing, and analysis system, liquid nitrogen cryopreservation system, pure water manufacturing device; continuous flow analyzer, portable phytoplankton flow cytometer, chlorophyll analyzer, and watercolor three-element measuring instrument installed in the environmental biology laboratory; Electronic fish body automatic measuring instrument installed in fishery biology laboratory; fiber optic compass and motion sensor, acoustic instrument synchronizer, side-scan sonar system, shallow formation profile system installed in acoustic image assessment and remote sensing laboratory. In order to stably carry these instruments and equipment on the ship, stainless steel grooves and mooring rings are reserved on the laboratory wall and the tabletop of the test bench for securing the instruments and equipment, as shown in Figure 2 below.

Due to the turbulent water flow on the surface of the hull during the sailing of the ship, it is difficult to meet the operating environment of the three sets of instruments and equipment: the EK80 acoustic evaluation system, the ship-borne Doppler current meter (ADCP shallow sea), and the ship-borne Doppler current meter (ADCP deep sea). It is required that the traditional fixed installation method on the bottom of the ship will not be able to exert the maximum working efficiency and working accuracy of the instrument and equipment, so it cannot be directly installed on the bottom of the hull. In order to reduce or avoid the influence of hull disturbance and air bubbles in the water flow on the working accuracy of the instrument, it is extended out of the bottom of the hull for a certain distance. Therefore, a method of carrying and installing a detection instrument cabin was also adopted on the previous scientific research ship [6]. This instrument cabin adopts It is a fixed installation method, similar to the rudder blade connected to the hull through the shaft body. But in this way, not only the actual draught of the ship is increased, but the bigger drawback is that its maintenance must be carried out in the dock. In order to overcome the defects of the above installation methods and ensure the

Volume 9 Issue 9, 2023
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accuracy of the survey and test data, we solve this problem by integrating the three sets of instruments and equipment on the lifting fin moving system.

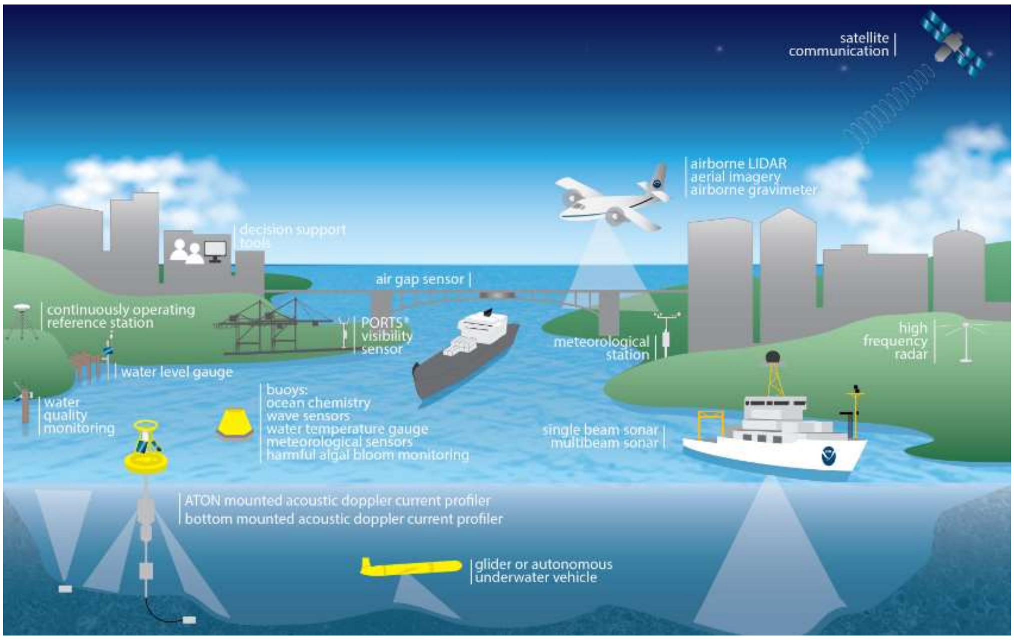

Figure 2. Diagram of inboard instruments and equipment

The lifting fin moving system has the characteristics of high precision, high reliability, low maintenance and low energy consumption. At the same time, it adopts a unique locking and positioning system, which can greatly improve the working accuracy of scientific research instruments and can effectively protect scientific research instruments; A camera can be set inside the board to monitor the environmental status around the fin. Loading scientific instruments through the lifting fin system can greatly improve the working efficiency of the instrument and the working accuracy of the instrument, and ensure the accuracy of the survey and test data. The ship adopts a single fin system. The structure mainly includes the main fin structure (including the water circulation structure), auxiliary structures such as fin guide rails in the hull shaft, fin lifting and recovery drive and control system, fin locking and positioning mechanism, the bottom of the fin plate adopts a detachable design, etc. See Figure 3 below.

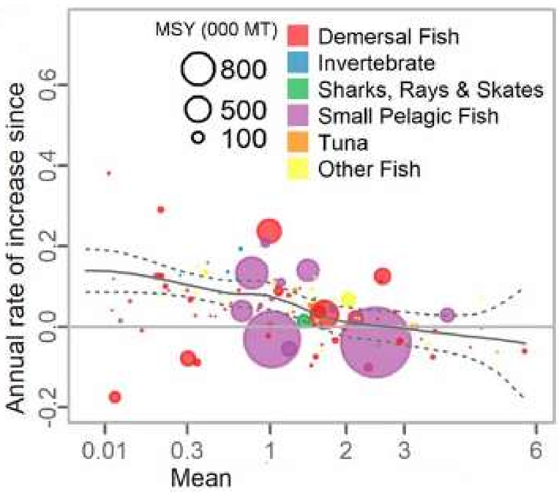

Figure 3. Design of the lift fin moving system

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3.2 Turbine System

Vibration and noise reduction control technology in engine room and auxiliary engine room.

This ship is a marine fishery comprehensive scientific survey ship, which has high requirements for vibration and noise. For this reason, the main equipment of this ship's engine room adopts the most advanced vibration and noise reduction measures in the world. At present, the vibration isolation measures of mechanical equipment on board mainly include damping vibration isolation, single-layer vibration isolation, double-layer vibration isolation and floating raft vibration isolation. After the actual ship adopts the above measures, the vibration and noise level of the ship is effectively reduced.

The main engine of the ship (1 set) adopts single-layer vibration isolation, the design total vibration level drop (10Hz~10kHz) is ≥15dB, and the actual total vibration level drop (10Hz~10kHz) is reduced by 18dB; the main generator sets (2 sets) use double-layer Vibration isolation, the design total vibration level drop (10Hz~10kHz) ≥ 30dB, the actual vibration isolation effect is reduced by 35dB; the pump set adopts vibration isolation floating raft, the design total vibration level drop (10Hz~10kHz) ≥ 35dB, the actual ship measurement The total vibration level drop (10Hz~10kHz) is ≥40dB. The vibration reduction effect of the actual ship is better than the requirements of the design specification.

Design of energy-saving and high-efficiency main propulsion system.

The ship is equipped with a fuel-saving energy-saving system, so that the controllable propeller control system adds another control mode, namely the fuel-saving control mode, on the basis of the traditional constant speed control mode and joint control mode [7]. It can automatically control the speed and pitch of the main engine according to the speed and resistance of the ship, so that the rotation speed of the main engine and the pitch ratio are properly matched.

Table 1. Fuel consumption of each control mode at different speeds (kg/h)

Mode speed (kn)	2.0	4.0	6.0	8.0	10.0	11.0	12.0	12.5	13.0	13.5
Constant speed mode	14.1	62.7	91.4	127.6	233.1	256.8	296.4	314.4	349.2	367.5
Joint control mode	15.9	29.9	55.1	97.5	181.1	223.6	270.5	299.5	329.7	362.5
Fuel saving mode	6.7	16.0	36.0	86.7	176.3	222.7	270.3	299.5	329.7	362.3

3.3 Electrical System

The ship's electrical system includes 2 diesel generators, 1 shaft generator, main switchboard and emergency switchboard. The power system of the ship needs to be designed to meet the power system requirements under all operating conditions: sailing conditions, entry and exit conditions, operating conditions, DP conditions, berthing conditions, and emergency conditions. The ship's power system calculation combined with the selection of diesel generator sets and main engines, the ship has determined that two 550kW diesel generators and one 1000kW shaft generator constitute the main power station, and one 250kW diesel generator constitutes an emergency and berthing power station. The generators of the power station can be divided into: any one diesel generator set is on the grid, the shaft generator set is on the grid, 2 diesel generators are paralleled on the grid, and the 2-diesel generator sets and the shaft generator set are divided into power supply. Through the power station control system, the power station conditions can be cut off manually and automatically. When the main power supply fails, the emergency generator automatically starts within a certain period of time, and supplies power to the emergency load through the emergency switchboard. When parked, the emergency generator can be switched to the parked generator mode, and reverse power is supplied through the tie switch of the emergency switchboard on the main board to provide power supply for the parked load (Figure 4).

The touch screen is used for power station monitoring, displaying the power station switch status, unit running status, generator parameters and alarm indication. When there is an alarm, the buzzer will sound, and the touch screen will issue an alarm indication. The setting of the system not only meets the requirements of the ship's automated power station AUT-0, but also ensures the safety of power supply under various working conditions of the ship and the convenience of management and operation of the engine room personnel. Technical Support.

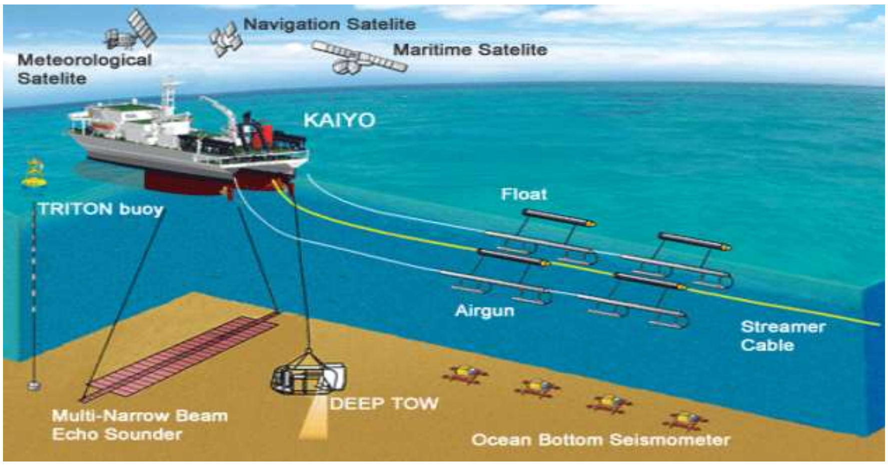

Figure 4. Working Mode of Marine Fishery Comprehensive Scientific Survey Vessel

3.4 Advanced Information Integration System

The 3,000-ton marine fishery comprehensive scientific survey ship has digital integration of navigation information, clustered ship communication network, and intelligent ship management, which effectively improves the task execution capability of the marine fishery comprehensive scientific survey ship, builds a ship-shore network information management system, and realizes marine The perception of important data such as the water surface dynamics and water operations of the fishery comprehensive scientific survey ship's sailing operation is the remote intelligent management and dispatch command for the subsequent shore-based center ships [8]. The ship information integrated management platform is shown in Figure 5.

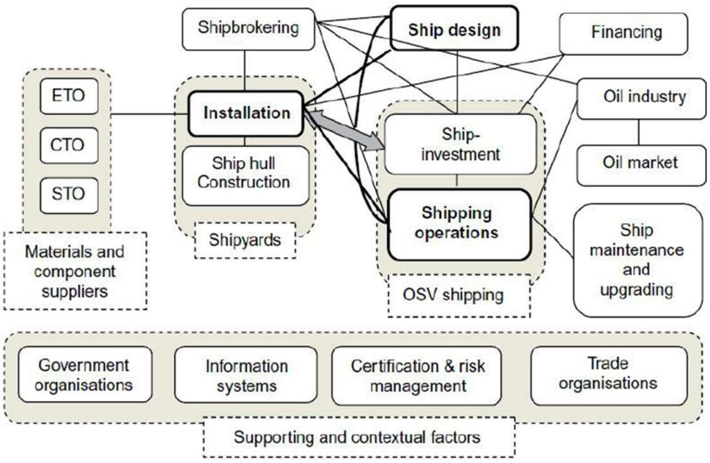

Figure 5. Architecture of Ship Information Integration System

4. Conclusion

The system adopts vibration and noise reduction measures such as double-layer vibration isolation of generator sets, vibration isolation and floating rafts of pump sets, noise reduction and noise reduction of engine room fans and cabins, and meets the latest specifications of MSC337 (91) "Shipboard Noise Level Rules". The stern tube lubricating oil uses non-polluting bio-oil to avoid leakage and pollution of the stern tube lubricating oil; the installed ballast water treatment system can meet the D-2 treatment requirements of IMO, and at the same time, to meet the requirements of some ballast water management conventions Special requirements for ballast water management by non-Parties.

According to the needs of scientific research operations, the lifting fin system can be extended by 0.8 meters or 2.5 meters from the bottom of the ship to avoid the influence of water bubbles and the boundary layer of the hull on the acoustic research equipment, improve the measurement accuracy, and ensure the quality of scientific research data.

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