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Retraction

Retracted: Configuration Generation Method of Ship End Program for Ship Energy Efficiency Management Platform

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Z. Wu, "Configuration Generation Method of Ship End Program for Ship Energy Efficiency Management Platform," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 7742088, 7 pages, 2022.

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Research Article

Configuration Generation Method of Ship End Program for Ship Energy Efficiency Management Platform

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In order to solve the problem of collecting necessary data affecting fuel consumption and building an intelligent energy efficiency system, this paper makes an in-depth study on the management of cross ship energy efficiency on the basis of program configuration generation. Firstly, this paper studies three methods: technology-driven analysis, support vector machine method, and energy efficiency evaluation method. In order to improve the functions of energy management, energy efficiency analysis, and auxiliary decision-making, this paper constructs a comprehensive intelligent scheme for the best ship navigation energy efficiency from the aspects of ship operation guidance, navigation performance evaluation suggestions, and shipping management decision-making, so as to meet the higher-level management needs of interested parties for ship energy efficiency. Among them, energy efficiency online monitoring can collect energy efficiency data and serve the other three functions, mainly monitoring ship energy consumption, environment, navigation, and other parameters. Energy efficiency evaluation is based on the data collected by online monitoring, and the results of ship energy consumption are obtained by using data mining technology. Through experiments and research, under the background of green, efficient, and intelligent ships, ship shore collaboration is an effective way to improve the ship's energy efficiency management ability. Intelligent ships provide a new development path for strengthening the application service of ship energy efficiency management system.

1. Introduction

In the past 20 years, as climate change has aroused more and more concern and concern around the world, greenhouse gas emission reduction has become the consensus of all countries in the world. As the carrier of bulk commodities, ships play an important supporting role in international trade and regional economic development. However, ships are regarded as one of the most unregulated air pollution sources, and their emission control has reached a level that cannot be ignored. According to the third greenhouse gas report released in 2014, the total CO_2 emissions of the international shipping industry in 2012 were 938 million tons, accounting for 2.6% of the total global CO_2 emissions that year. If effective measures are not taken in time, it is estimated that by 2050, the total greenhouse gas emissions from the shipping industry will account for 17% of the total global emissions. In recent years, climate change has aroused widespread concern all over the world, and energy conservation and emission reduction have become the consensus of all countries in the world. The ratio of emissions to benefits adopted in the original CO_2 design index is changed to the ratio of energy conservation to benefits, emphasizing the energy conservation and emission reduction indicators of international ships. The increasing fuel cost and increasingly stringent emission regulations have brought many challenges to ship operation and optimal management. At present, ship energy efficiency has gradually changed from informatization to intelligence in the whole life cycle of ships. It is characterized by the collection, storage, and correlation analysis of data in various formats. Based on big data, pretest technology as the core, and through the integration of network information and entities, it builds an intelligent information service system integrating ship and shore, realizes the sharing of ship and shore information, breaks through information asymmetry, builds an information technology and entity integration architecture, and realizes energy efficiency management based on big data. These

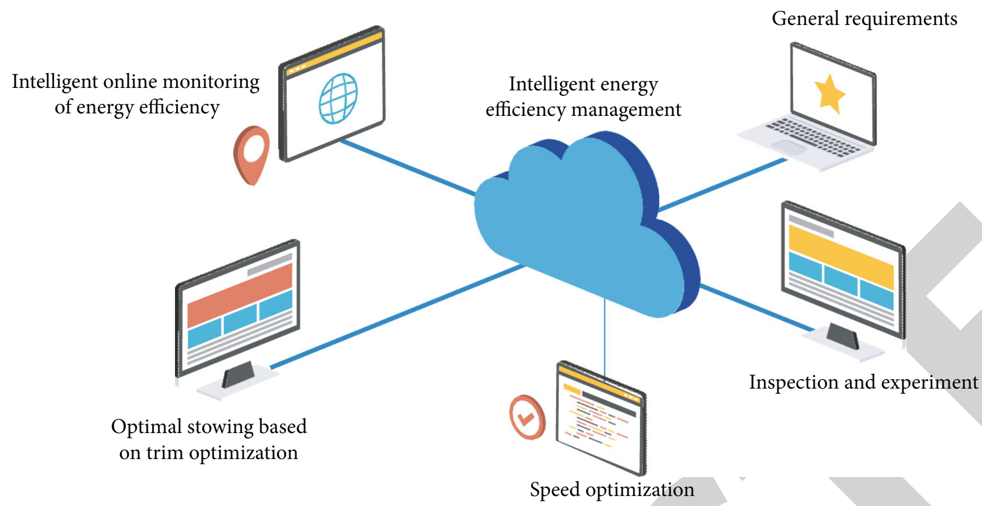

FIGURE 1: Structure diagram of ship intelligent energy efficiency management.

factors should be fully considered in the intelligent design of ships. Foreign enterprises have made rapid development in the on-line monitoring technology of ship energy efficiency and have successively launched a variety of ship energy efficiency monitoring systems. The ship energy efficiency management system developed by British RORO company using big data analysis technology and intelligent algorithm provides data-based performance management and decision-making methods to better understand the ship performance. At the same time, the module can be customized according to customer needs, and the fuel can be saved up to 15% after verification. Figure 1 shows the structure of ship intelligent energy efficiency management.

2. Literature Review

German-Galkin and Tarnapowicz believe that under the background of overall low energy efficiency in China, the monitoring and management system provided by enterprises to provide functions cannot meet the needs of ship shore information management. Therefore, the construction of the monitoring and management system should improve energy efficiency to achieve energy conservation and emission reduction, so as to achieve a reduction of carbon dioxide emissions per unit GDP of 40% in 2020 compared with 2005 [1]. Yue and Wang proposed that IMO put forward mandatory ship energy efficiency rules in order to promote energy conservation and emission reduction in the shipping industry, mainly including ship energy efficiency design index for new shipbuilding [2]. Py said that for a large number of ships in operation, energy efficiency management means such as optimizing the energy consumption of the whole ship and improving the efficiency of the power system are widely adopted by shipping enterprises [3]. Li proposed to strengthen the management of ship energy efficiency, which is also of great significance to the cost reduction and efficiency increase of the shipping industry and the intelligent management of ships. By investigating the development status of energy efficiency management technology and products at home and abroad and understanding the development trend of energy efficiency management technology, we can better promote the research and application of China's energy efficiency management system [4]. Savenkov put forward that energy efficiency, as an evaluation index, refers to the energy utilization efficiency, that is, the ratio of the energy actually playing a role to the total energy consumed in the process of energy utilization and transformation in production practice [5]. Dogra et al. proposed that ship energy efficiency is a branch of many fields of energy efficiency. For ships in operation, IMO proposed the energy efficiency operation index (EEOI) in SEEMP to measure the energy efficiency level of operating ships [6]. Casisi et al. said that the lower the EEOI index, the higher the operating energy efficiency level of the ship [7]. Atodiresei et al. put forward that ship energy efficiency management is mainly for operating ships, which refers to the use of relevant technical means to strengthen the operation management during ship navigation, including energy efficiency parameter monitoring based on sensors, intelligent evaluation of energy efficiency level, and energy efficiency management strategy development based on model analysis [8]. Jay et al. said that the ship energy efficiency integrated monitoring system launched by them analyzes the key performance parameters of the ship through data analysis technology, optimizes the performance of the whole ship, and integrates with IMO's ship energy efficiency management plan [9]. Farkas et al. said that they have developed a ship energy efficiency management system for inland ships. By collecting navigation data such as velocity, wind speed, and water depth, navigation attitude data such as ship speed, course, longitude, and latitude, and ship navigation energy consumption data, they have established a dynamic response model between ship energy efficiency and navigation environment, optimized ship speed, and improved energy efficiency [10].

3. Method

3.1. Technology-Driven Analysis. With the continuous development and application of information, sensing, communication, artificial intelligence, and other enabling technologies, the ship energy efficiency management

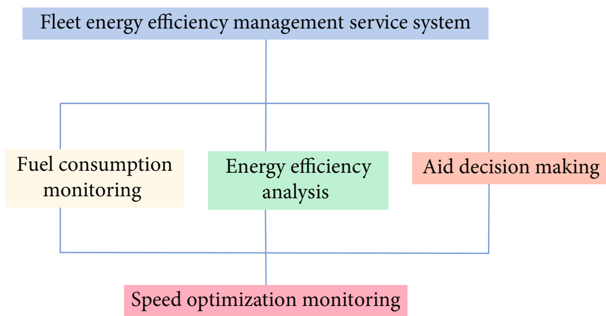

FIGURE 2: Fleet energy efficiency management service system.

technology is promoted to be applied on board. With the deepening of automation and intelligence, the ship energy efficiency management plan will continue to be informationized and digitized and gradually form a ship intelligent energy efficiency management system with certain decision-making ability [11]. The shipowner has also put forward the demand for compliance and digital transformation and built a ship shore coordinated energy efficiency management system. This paper constructs a ship energy efficiency management big data system based on ship shore collaboration, which can monitor and analyze energy efficiency data of ocean going ships in real time at the shore end. Rolls-Royce's Energy Management system also has two interfaces: onboard interface and onshore interface. With the help of the display of the onboard interface, the crew can better understand the ship performance [12]. See the following Figure 2, fleet energy efficiency management service system. Its database analyzes the global industry data of more than 55000 ships and can integrate various data sources, such as AIS, noon reports, and automated signals. Various data sources can be combined with highly accurate ship performance models to provide suggestions for improving ship performance. As a part of NAPA Fleet Intelligence, NAPA Fleet Intelligence obtains the main functions of speed route optimization and related maps and weather information from the web page. Eniram has put forward solutions for energy efficiency optimization from three aspects: fleet efficiency, navigation efficiency, and single ship efficiency, and developed corresponding optimization services and application software [13]. At present, the domestic research on building an overall and comprehensive ship energy efficiency management system at the shore end is still in the development stage. Therefore, it is meaningful and necessary to establish a ship shore cooperative ship energy efficiency management system [14]. If the ship has only a single main engine, a shaftless generator (PTO), and does not consider the energy-saving reduction of auxiliary machinery of PTI and innovative power technology, the energy-saving reduction of innovative energy efficiency technology for propulsion, and the correction factors of different ship types, formula (1) can be simplified as follows:

$$\text{EEDI} = (\text{PME} * \text{CF, ME} * \text{SCFME}) + (\text{PAE} * \text{CF, AE} * \text{SCFAE}). \tag{1}$$

When the ship has only a single main engine, a shaft generator (PTO), and no PTI, formula (2) can be simplified as follows:

$$\begin{aligned}\text{EEDI} = {} & (\text{PME} * \text{CF, ME} * \text{SCFME}) \\ & + (0.75 * \text{PPTO} * \text{CF, ME} * \text{SCFME}).\end{aligned} \tag{2}$$

For ships with main engine power rate ≥ 10000 kW, the power formula (3) is as follows:

$$\text{PAE} = 0.025 * \text{MCRME} + 250\text{kW}. \tag{3}$$

For ships with main engine power rate less than 10000 kW, the power formula (4) is as follows:

$$\text{PAE} = 0.05 * \text{MCRME}. \tag{4}$$

PAE is the auxiliary engine power necessary for sailing with Vref under the design load [15]. It includes power required for propulsion machinery/systems and life (such as main engine pump, navigation system and equipment, and accommodation on board) on board but does not include power for nonpropulsion machinery/systems (such as side thruster, cargo pump, cargo lifting equipment, ballast pump, cargo maintenance such as refrigerator and cargo space ventilator, etc.) [16].

Once the construction of the ship is completed, the energy efficiency formula of the actual ship can be calculated with the following formula:

$$\text{EEDI} = P * \frac{\text{SFC}}{\text{DWT}} * V. \tag{5}$$

3.2. Support Vector Machine Method. The developed smart ship energy efficiency system (SEMOS system) can reduce ship operation, improve ship performance, and reduce operation cost through performance analysis, fault diagnosis, speed optimization, and other functions. However, these ship energy efficiency management systems only provide services for ships at the ship end, a set of ship energy efficiency management systems only serve one ship, and there are very few energy efficiency management systems for comprehensive control of ships and even fleets at the shore end [17]. Intelligent ship is a kind of ship that automatically perceives and obtains the information data of the ship itself, marine environment, logistics, port, etc., by using technologies such as sensor, communication, Internet of Things, and Internet, and realizes intelligent operation for ship operation, management, maintenance, and transportation based on automatic control, big data analysis, and computer technology. CCS has launched ship energy efficiency acquisition and monitoring software, online intelligent management system, and CCS-OTA trim optimization software. Among them, the ship energy efficiency collection and monitoring software can collect relevant energy efficiency data such as fuel change records, sailing mileage, arrival and departure time and name, and cargo capacity during a single voyage (leg) [18]. Based on the monitoring results, it can also make statistical analysis of data and generate ship energy efficiency data collection reports that meet the requirements of different regulations. The ship energy efficiency online intelligent

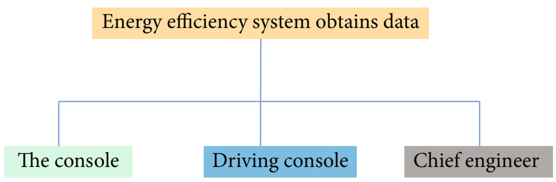

Figure 3: Data acquisition requirements of energy efficiency system.

management system includes ship end version and shore-based version software. It has certain intelligent energy efficiency management functions and has been installed and used in more than 100 ships. The trim optimization software needs to input ship speed, draft, and other parameters in the interface, so that it can put forward operation suggestions for the optimal trim [19]. The data server collects the operating parameters of the main engine, auxiliary engine, and boiler, especially the parameters related to the combustion state and load, as well as the parameters such as shaft power, fuel flow, oil tank level, environmental parameters, ship attitude, ship position, and satellite positioning. As shown in Figure 3 below, the data processing and algorithm of the energy efficiency system are required to be set in the form of web server. The centralized control console, driving control console, Captain, chief engineer, and even mobile terminals can log in using the browser. The energy efficiency system can exchange data with the shore-based system through the ship communication system.

3.3. Energy Efficiency Information Evaluation. The operation process of the shore end energy efficiency management system is as follows: (1) preprocess the navigation data, energy efficiency data, engine room data, situational awareness data, etc., sent from the ship end back to the shore end in real time, delete the missing, abnormal, duplicate, and other data caused by the data transmission process, obtain effective data that can be used for ship energy efficiency analysis, and classify and store the energy efficiency data of different nature and categories in the database of the corresponding ship type; (2) evaluate the ship's energy efficiency system, and calculate EEOI and other energy efficiency indicators. After that, data mining is carried out, and the ship energy efficiency evaluation model for the same type of ships under the same conditions is established through the generated EEOI and ship navigation data, such as speed and fuel consumption, and self-training and updating are carried out continuously according to the latest data; (3) according to the energy efficiency evaluation model generated after a period of training, relevant auxiliary decision-making suggestions are pushed to the ship end, all information is integrated, and the ship energy efficiency information is displayed centrally through the shore end energy efficiency management system. For ships of different power types, the main energy consuming equipment is different.

For traditional ships, the main engine, generator set, and marine boiler are the main energy consuming equipment. The main monitoring contents are equipment oil consumption (or gas consumption) and main engine speed and shaft

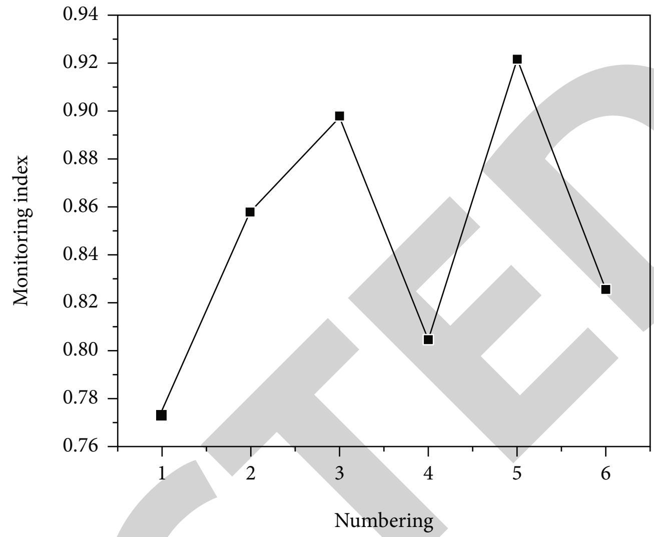

Figure 4: Status monitoring effect.

power. The gas engine needs to monitor the LNG concentration to ensure the safety of ship operation. Monitor energy consumption equipment, and monitor the operating parameters of main engine, auxiliary engine, boiler, shaft power meter, flowmeter, log, global positioning system, electronic inclinometer, anemometer, depth sounder, oil tank (tank) level gauge, and other equipment [20]. For hybrid, pure electric, and other new energy ships, it is also necessary to monitor the status of battery, super capacitor, and other energy storage devices. The monitoring effect is shown in Figure 4.

As shown in Figure 5, the data sensing service of ship shore collaboration is an effective collection of the information of the whole ship sensing equipment (such as sensors), controllers, signal acquisition equipment, and data acquisition equipment and helps to break through the problems of incomplete collection, isolated analysis, and isolated optimization of single ship energy efficiency data signals in the current ship end ship energy efficiency management system. The interactive support of data communication services for ship shore information helps to improve the problems of untimely performance evaluation, inaccurate auxiliary decision-making suggestions, and delayed push messages at the shore end in the current ship operation process. The ship side platform is deployed on every ship that needs services, while the shore-based platform is built on the application server of the shore side ship energy efficiency system, and the corresponding services and push functions are integrated in a modular manner. The ship end platform integrates the ship end energy efficiency acquisition unit, ship end data transmission unit, and ship end energy efficiency management unit to provide an operating environment for the ship end energy efficiency management application. The shore platform is based on the ship shore satellite data communication to realize the summary of energy efficiency data and complete reproduction of ship end status. The shore end platform stores the ship operation data from multiple data sources, develops the application of big data technology for ship energy efficiency information, realizes the functions of

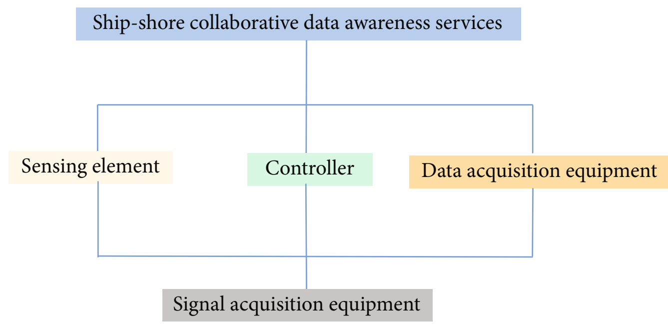

FIGURE 5: Data awareness service of ship shore collaboration.

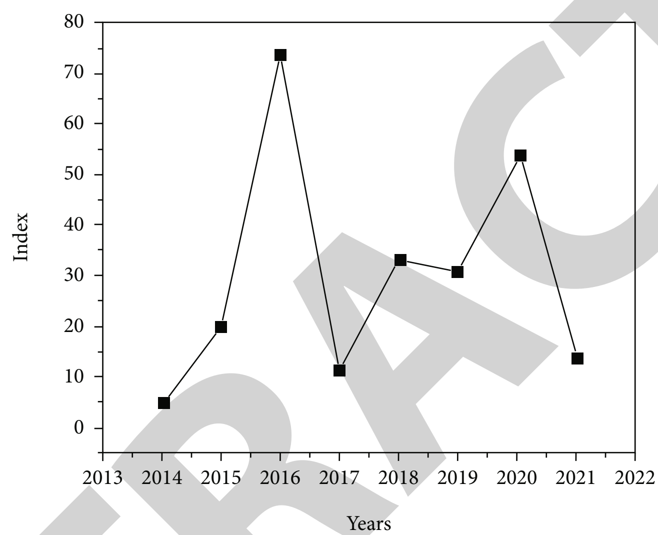

FIGURE 6: Combination effect of mature ship design technology and intelligent energy efficiency technology.

data processing, data mining and evaluation, navigation analysis, auxiliary decision-making, etc., realizes the development of digital solutions, and realizes the safe, reliable, and efficient remote comprehensive management of energy efficiency information of onboard ships.

4. Results and Analysis

The energy efficiency analysis mainly calculates the EEOI, CO_2 emission index, and other energy efficiency indicators of the ship during navigation. With the support of big data technology, machine learning, data mining, and other technologies, analyze the efficiency of ship equipment, find the potential of ship energy conservation from ship operation, evaluate the current energy efficiency status of ship operation, provide auxiliary decisions, and provide efficient and green energy efficiency management suggestions for ship operation companies. According to different fleets of different companies, statistical comparison of fleet energy efficiency indicators and comparison of ship energy efficiency indicators are provided to set carbon emission targets. Based on the online intelligent management system of ship energy efficiency of China Classification Society (CCS), the key points that should be paid attention to in ship design are analyzed, so that the traditional mature ship design technology can be organically combined with intelligent energy efficiency technology. The energy efficiency effect after combination is shown in Figure 6. At the same time, it also provides a data basis for future research on the relationship between ship energy consumption and sea conditions, energy consuming equipment through data fitting, and other analysis methods.

At the shore end, it realizes the integration of multiple ship energy efficiency data, online monitoring and storage of multisource data information, ship energy efficiency evaluation, and ship operation carbon intensity index analysis, establishes a ship energy consumption model, and provides auxiliary decision-making suggestions for optimizing ship operation energy consumption, which improves the efficiency of shipping companies' energy efficiency management of the fleet and reduces ship operation energy consumption. At the same time, it also provides technical support and data accumulation for other aspects of ship big data application in the future, creating new value. Among them, energy efficiency online monitoring can collect energy efficiency data and serve the other three functions, mainly monitoring ship energy consumption, environment, navigation, and other parameters. The energy efficiency evaluation is based on the data collected by on-line monitoring, and the data mining technology is used to obtain the ship energy consumption status. Energy consumption optimization gives the ship the best reference values such as speed, route, and trim, so as to improve the energy efficiency of ship operation. The energy efficiency auxiliary function mainly provides logs and reports that meet the requirements of IMO and maritime departments. It can be seen that ship online energy efficiency monitoring, intelligent energy efficiency evaluation, and energy efficiency optimization control research are the key technologies of ship energy efficiency management.

5. Conclusion

The ship intelligent energy efficiency system can reduce the ship energy consumption and meet the requirements of classification society, international organization of Civil Affairs (IMO), and EU rules, which is conducive to energy conservation, emission reduction, and environmental protection. Therefore, reducing greenhouse gas emissions and improving the utilization of fossil energy have become the common responsibility of human beings all over the world. Under the background of green, efficient, and intelligent ships, ship shore collaboration is an effective way to improve the ship energy efficiency management capability. Intelligent ships provide a new development path for strengthening the application service of ship energy efficiency management system. To meet the needs of ship owners for ship operation compliance and digital transformation, it is necessary to build a ship shore coordinated energy efficiency management system to realize the seamless connection between the ship side energy efficiency management system and the shore side energy efficiency management system. Energy efficiency online intelligent monitoring is one of the basic functions of intelligent energy efficiency management system. Online intelligent monitoring means to monitor the main energy consuming equipment on board and the navigation status of the ship, collect, transmit, store, and analyze data, and evaluate and alarm relevant technical indicators such as ship energy efficiency and energy consumption. Through key technologies such as data analysis, data mining, and intelligent optimization, combined with big data processing and simulation optimization, this paper establishes a data model and process analysis for the historical data of the ship, so as to realize the synchronous monitoring of energy consuming equipment on the ship and shore during the navigation. Further, it can automatically generate reports that meet the requirements of EU MRV and IMO through early warning of ship position, speed, course, time required for oil switching and other factors, and real-time energy efficiency data. The system also meets the i-ship (E) additional mark requirements of China Classification Society. Therefore, on-line monitoring of ship energy efficiency is an important part of on-line intelligent monitoring of energy efficiency, and it is also the research foundation for intelligent evaluation and optimization of energy efficiency. The data is continuously iterated and upgraded to make it consistent with the actual operation characteristics of the ship, provide decision-making advice support for ship operation, provide strong support for the iterative optimization of subsequent ship types, and help the optimization and upgrading of new ship types.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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