Application of computer virtual reality technology in ship equipment assembly

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Abstract

It is known to us all that in factors of determining shipbuilding cycle, ship assembly occupies an important position in shipbuilding. In traditional shipbuilding model, front-line workers conduct assembly according to the two-dimensional drawing of marine designer. They will make mistakes inattentively, which results in the waste of manpower and material resources. At the same time, the abstraction of drawing will tend to generate deviation in the communication system between designer and ship-owner because of no concrete model object. This paper adopted a kind of technology that could use three-dimensional entity form to express ship model and assembling process-ship virtual assembly technology. The combination of virtual reality technology and ship assembly technology revealed the insufficient and defect in design, which avoided the waste of manpower and material resources during practical assembly. Through the selection and comparison of virtual assembly, we could optimize assembly technology, thus to convenient for the learning and execution of front-liner workers, enhance shipbuilding efficiency and shorten shipbuilding cycle.

Keywords: Virtual technology; Ship assembly; Digitalized shipbuilding; Three-dimensional model

1 Introduction

With the development of economy, land resources are increasingly shortening, thus varies countries in the world have converted their orientation to the ocean of rich resources. In order to occupy a place in the future resource competition, shipbuilding industry has become the basic industry that must increase development by each country. Since the modern times, the shipbuilding technology in our country makes progress year by year. However, compared with shipbuilding powerful countries, there still exist large gaps. Such kind of technology in China not only has long shipbuilding cycle, but also causes the ship-owner with less professional knowledge cannot reach a consensus with shipping firm because of the professionalization of drawing [1]. In the face of the existing problem of traditional shipbuilding industry, our specialists have constantly thrown themselves into the researches in these years. In the article Virtual Verification of Fishing Boat Total Design Scheme [2], Wang Ning from Dalian University of Technology conducted scientific research on special project "research on fishery energy conservation key technology and development of important equipment" relied on national public welfare industry. With the platform of CATTA, he studied the current situation and achievement about virtual simulation technology at home and abroad. Combined with the theory of man-machine engineering and took a fiber-glass fishing boat for prototype, he conducted research and technological development on some subject matters in virtual verification process of total fishing boat design, which was benefit for promoting constant development and progress of ship design level. In the article Ship Equipment Information Management for Ship Design and Construction [3], Wang Xuhui and Jiang Yiping conducted introduction on ship equipment in the process of total ship design and building. In addition, on this basis, they introduced the main content of informatization management of ship equipment information. Their research contents have certain referential significance on the promotion of ship enterprise competetiveness. In the article Construction and Implementing of Ship Equipment RCM Maintenance Architecture, Dai Daoqi broke through the traditional ship maintenance mode, and brought Reliability-Centered Maintenance (RCM) in Ship equipment maintenance [4]. Through continuous or periodic condition monitoring on the operation status of ship equipment, we drew a judgment on the running status of mechanical equipment and forecasted its developmental trend, thus to effectively guide maintenance activity. The innovation of its maintenance model avoided the limitation of ship planning periodical repair, which has greatly enhanced the efficiency and effectiveness of equipment maintenance, improved the reliability and usability of equipment and saved the cost ship equipment maintenance.

This paper proposed to conduct digitalized shipbuilding using virtual reality technology, and to display the assembly process of three-dimensional ship model in simulation platform. It has made up the inconvenient brought about by the two-dimensional drawing of tradetional ship industry, and avoided the potential assembly conflict and defect in practical assembly. The solution on the shortage of the professional quality of front-line workers and the non-professional background of ship has provided new research orientation for shortening shipbuilding cycle and enhancing shipbuilding technology.

2 Virtual reality technology and its application status

2.1 DEFINITION OF VIRTUAL REALITY

Virtual reality technology is firstly put forward by American VPL Research Inc., which is the outcome of the combination of multiple advanced technologies, like computer, micro-electronics, simulation and sensor measurement. It can constructs an environment that is same or extremely similar to real world by using calculator on computer, thus to have people communicate in virtual environment through virtual device [5, 6]. Virtual reality system is mainly made up of five parts: virtual engine, input/output device, software and database, user and task, of which virtual engine and I/O device are the core parts. They finish virtual task through the following composition relationship, as shown in Figure 1:

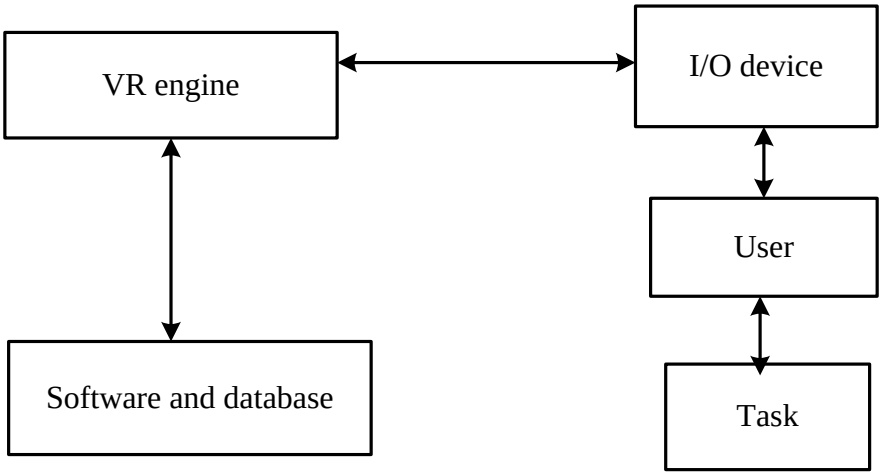

FIGURE 1 Constituent part of virtual reality system

2.2 THE APPLICATION OF VIRTUAL REALITY TECHNOLOGY IN ENGINEERING FIELD

The application of virtual reality technology in engineering industry mainly reflects in two aspects: product appearance structural design, and determination of the optimization of products assembly. The design of product appearance structure is also divided into three aspects: virtual manufacturing technology centered on design, virtual manufacturing technology centered on production and virtual manufacturing technology centered on control.

3 Ship assembly technology and digitalized shipbuilding technology

3.1 SHIP ASSEMBLY TECHNOLOGY

The hull is a complex structural body. In the process of ship building, assembly technology almost occupies half of the whole shipbuilding process, thus it is the key link of determining shipbuilding cycle. Traditional ship assembly is generally divided into preassembly, general assembly and shipway assembly. Each stage will appear some problems of rework caused by unqualified production design, wrong assembly sequence, etc, thus prolongs the whole shipbuilding cycle and cause severe waste of manpower and material resources. It is the vital disadvantage of the development of shipbuilding industry in today of resource shortage and competition intensification [7, 8].

In order to shorten shipbuilding cycle and reduce shipbuilding cost, shipbuilding industry strives to make a breakthrough in assembly technology. Based on foreign advanced shipbuilding technology and combined with practical status of China's shipbuilding industry, we conducted practical analysis, experience summary, etc, and conducted constant technology improvement on shipbuilding. According to the differences of shipbuilding model in each stage, China's shipbuilding model is roughly divided into traditional shipbuilding model, modern shipbuilding model and future shipbuilding model.

3.2 DIGITALIZED SHIPBUILDING TECHNOLOGY

Digitalized shipbuilding technology refers to comprehensively applied informatization technology, advanced digitalized manufacturing technology, advanced shipbuilding technology and modern shipbuilding model to each stage and aspect of whole life cycle, like ship design, manufacture, test, experiment and management and maintenance, under the premise of integrated various of knowledge during shipbuilding and with digitalized modeling and simulation for light spot.

It can be said that, in recent years, no matter the civil ship or military ship, digitalized shipbuilding technology has played an important role in method and tool of ship design. It plays powerful effect, especially in improving quality, lowering cost and shortening delivery time. The future shipbuilding industry belongs to digitalized shipbuilding technology, which determines the success or failure of shipbuilding enterprise reform in a certain extent.

4 Establishment of three-dimensional model of marine engine room subsection

4.1 APPROACHES AND TOOLS OF THREE-DIMENSIONAL MODELING OF MARINE ENGINE ROOM SUBSECTION

Among world shipbuilding field, the earliest ship drawings were all hand painted, which were not only of heavy workload and low efficiency, but also consumed a mass of

manpower and material resources for amending when error appeared. To a large extent, it prolonged the cycle of shipbuilding and hand drawing was not benefit for technology. Shipbuilding industry began to get rid of the era of hand painted drawings until the appearance of CAD/CAM system software.

The reasons why CAD is widely applied to shipbuilding industry are that, on the one hand, with the rapid development of science and technology, many new technologies have integrated into various software systems. A series of design software like CAD has made ship design more simple and convenient and ship design ideas wider. On the other hand, compared with traditional design approaches, CAD software is more intelligent, efficient and environmentally friendly.

SB3DS ship body design software independently researched and developed by Shanghai technical study based on CAD/CAM system was adopted in this paper for modeling. This software has added many new functions based on the intrinsic function of CAD. Especially on the design of ship piping system, the behavior of Sb3ds was extremely outstanding, which has basically solved the problem of difficult piping system design. The specific module function of Sb3ds is shown in Figure 2:

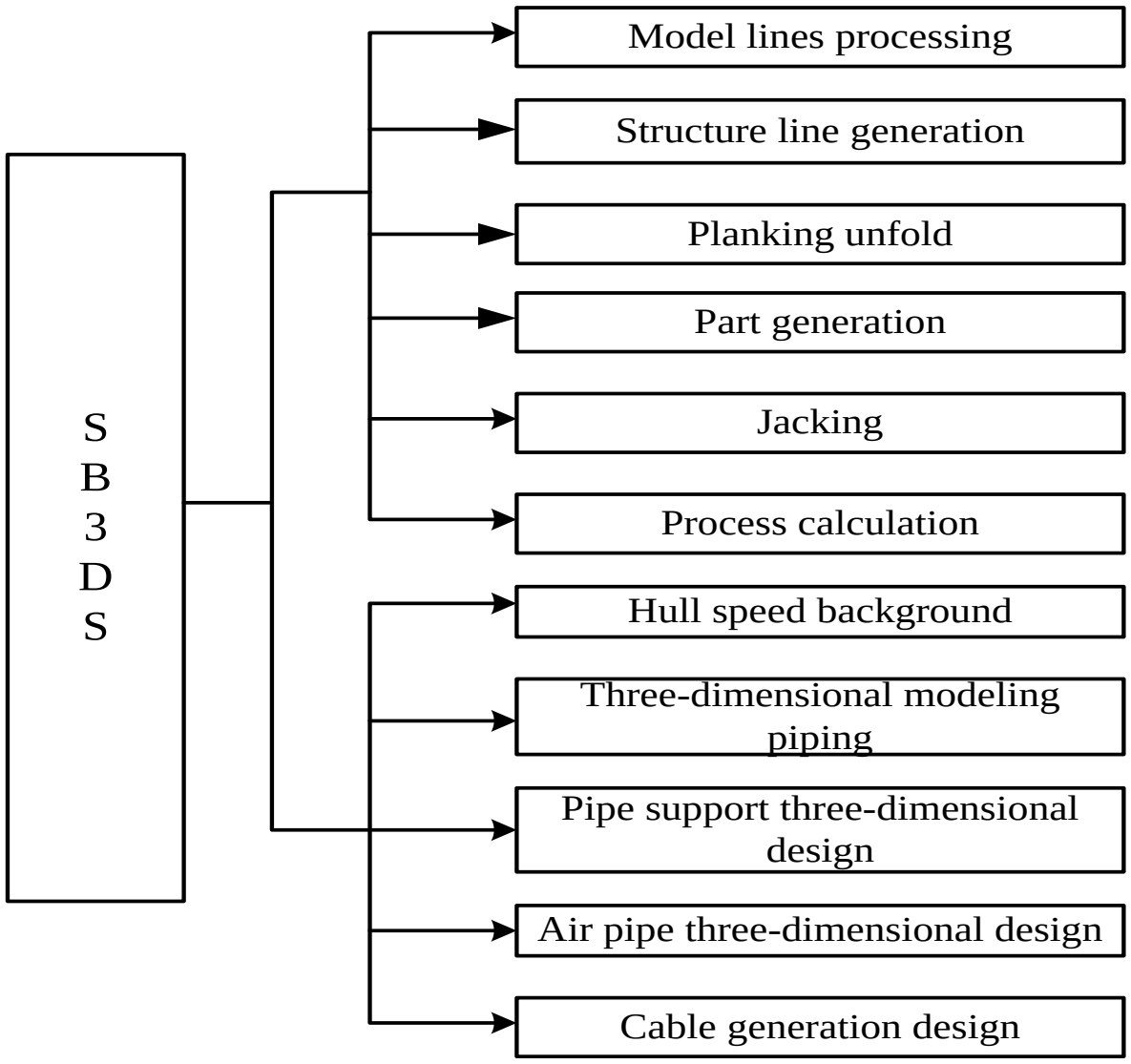

FIGURE 2 Sb3ds system module structure

4.2 MODELING PROCEDURE

In the initial stage of modeling, according to the marine engine room structure and operating principle of ship design drawing, and the relation of their mutual position, we did a full understanding on the cohesive relation among equipment parts and preliminarily planned modeling approach. Then we obtained the chartlet of hull, equipment and piping system by photographing or other methods. In addition, we established model in3dsmax and conducted animation. At last, we imported the established model and animation to VRP for further optimizing process, thus to make it more vivid. The modeling process is shown in Figure 3:

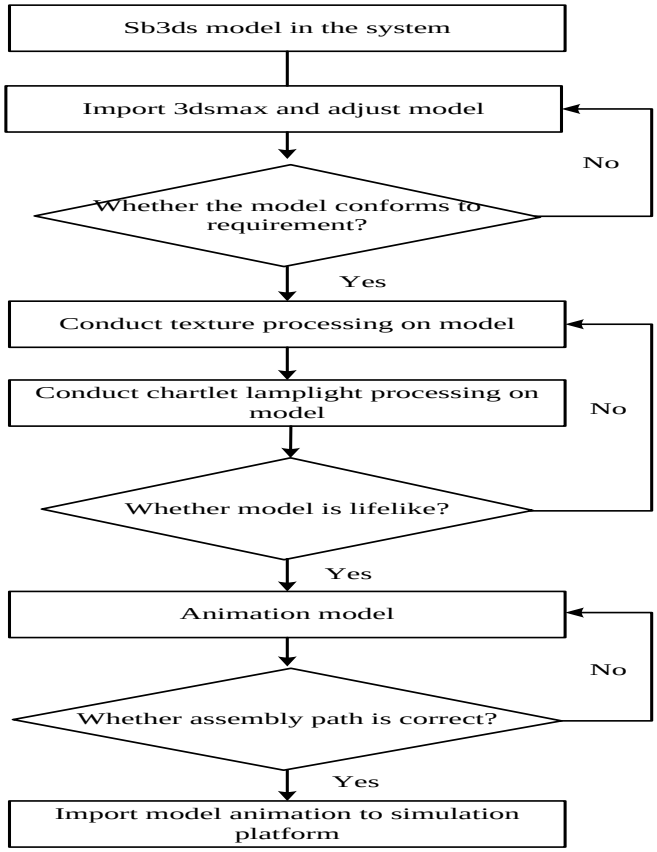

FIGURE 3 Flow chart of modeling

5 Conclusion

With the development of ocean industry economy, and in order to take the lead in the future ocean resource development, countries compete against each other and put lots of research and development technologies into shipbuilding industry. Though China has made great progress in this aspect, but compared with world shipbuilding power, the gap is still large. In order to keep up with or even surpass world shipbuilding power, we must increase the application of informatization technology and realize digitalized shipbuilding. The powerful effect of virtual reality technology also appears in other fields [9]. Therefore, the adoption of virtual reality technology is imperative. Through the analysis on the existing problems of digitalized shipbuilding technology and traditional ship assembly technology, this paper put forward the necessity of the application of virtual assembly technology in shipbuilding industry, designed the technical lines and implementation procedure in virtual assembly simulation process. To a large extent, they have provided referential experience and practice reference for China's shipbuilding enterprises, and played powerful impelling action on the booming of China's shipbuilding industry.

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