Optimization of Bulbous Bow of a 42m Trawler and Experimental Study on Ship Model Resistance

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ABSTRACT

The resistance performance of ships has great significance in saving energy consumption and realizing the development of the green ships. In this paper, a 42m trawler is selected as the research object, and the effects of bulbous bow with different length, width and height on the hull resistance performance are studied by comparing the results of numerical simulation and model test. Through multi scheme optimization, several groups of spherical bow lines with better resistance performance are obtained, and the reliability of the spherical bow optimization method used in this paper is fully verified by model test. It provides a detailed reference for the design of the bow shape of fishing vessels in the future.

KEY WORDS: optimization of fishing vessel type; resistance performance; energy saving; experimental study

INTRODUCTION

Trawlers are the most numerous of all kinds of fishing vessels. The research on trawlers with excellent resistance performance is of great significance to the energy saving and emission reduction of fishing vessels, and it is also conducive to the development of green ships (Guo, 2012). The bow line has a great influence on the ship resistance. If the size, shape and position of the bulbous bow match the hull line reasonably, it will play a significant role in reducing the total resistance of the hull (Yan, 2018). The main reason is that in a certain speed range, if the bulbous bow size is selected properly, the wave generated by bulbous bow and the wave generated by the hull may have a favorable interference effect, the wave height of the composite wave will be reduced, and the wave making resistance of the bow will be significantly reduced, thus reducing the total resistance of the hull (Ying, 2007). At present, the commercial software STAR-CCM+ is widely used in the research of resistance performance in the world, but its element division, calculation parameters setting and other factors will affect the final calculation results (Zhang, 2020). The deviation of free surface modeling, turbulence modeling, boundary conditions and model discretization from the reality also makes the calculation accuracy uncertain (Wilson et al., 2001).

In order to solve this problem, this paper selects a 42 m trawler which is a classic type of offshore fishing vessel in Zhoushan Islands of China for research. According to Zhao (2012) and Zhang (2018), the length of bulbous bow has obvious influence on ship resistance. Based on that research, this paper compares other optimization schemes, and carries out numerical simulation on the resistance of several trawler models with bulbous bow of different sizes to study the influence of bulbous bow of different length, width and height on the ship resistance performance. The numerical simulation is mainly based on STAR-CCM+ software, the resistance of the ship model reduced according to the scale ratio is simulated by computer, and the pool test is carried out by the ship model of corresponding size (Niklas, 2019), and the calculated resistance value is compared with the test value, so as to verify the feasibility and reliability of the resistance calculation by STAR-CCM+ software.

CASE STUDY SHIP AND MODEL SHIP

The scale of the ship model used in the preliminary numerical simulation is selected according to the scale ratio $\lambda = 1:10$, and the two ship data are presented in Table 1. The body lines of the case study ship and model ship are presented in Fig. 1.