Numerical Study on Factors Affecting Wake Field of Twin-skeg Type Ship With Large Breadth and Shallow Draught

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ABSTRACT

It is difficult to predict the nominal wake field and optimize the stern shape of the twin-skeg type ship with large breadth and shallow draught due to the huge peak and gradient of the wake field behind the skegs, which is usually the main reason for cavitation deteriorate of the propeller and violent vibration of the stern structure. Besides the model experiment, it is necessary to construct a numerical method with enough accuracy to predict and analyze the wake field of this type ship to meet the requirement of engineering application. Additionally, it is essential to analyze major factors and internal laws influencing wake field of this type ship to improve the uniformity. In this paper, a special CFD numerical method is developed to predict the nominal wake field of a twin-skeg type ro-ro ship with large breadth and shallow draught, in which results of different mesh partition methods and motion freedoms are compared with experiments. On this basis, with displacement and total resistance as constraint conditions, with maximum and mean values of wake field as well as Wake Object Function (WOF) proposed by the Dutch MARIN tank as measurements, influence of skeg shape thinness represented by exit angle and tail radius of 0.8R (R is the propeller radius) water line above the propeller shaft center line is investigated. As results, those factors of skeg have important influence on maximum, mean and WOF values of nominal wake field, which will be the foundation for skeg shape optimization to improve the wake field uniformity.

KEY WORDS: twin-skeg type ship; large breadth and shallow draught; nominal wake field; affecting factors; numerical study

INTRODUCTION

Twin-skeg type ship is widely used on ro-ro ships with restricted draft and highly loaded propellers due to the obvious advantage of propulsion efficiency (Kim K et al. 2014). However, it is difficult to design the stern shape of the twin-skeg ship with large breadth and shallow draught due to the huge peak and gradient of the wake field behind skegs, which is one of the main reasons for reduce of propulsion efficiency, deteriorate of cavitation and even excessive vibration of the stern structure. In brief, relationships between stern shape, wake field, propulsion efficiency and cavitation performance are too complicate and internal laws are not enough to support engineering design.

In terms of this issue, amounts of studies have been done by researchers. Kim H-T et al (2007) proposed a CFD method to study resistance characteristics of a twin-skeg container ship with skeg vertical angles (0, 10, 20) and skeg distances (16m, 20m, 24m). It is found that both the skeg vertical angle and the skeg distance have obvious effects on resistance and the former gives more effect to the resistance than the latter. Maimun A et al. (2015) investigated the variation of skeg distance and angle on the behavior of stern flow in view point of propulsion performance. Svoren, NØ (2015) investigate the flow characteristics of a twin-Screw trawler using CFD in view