A Study on the Steering Angle Optimization Considering Thruster Interaction in a Semi-submersible

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ABSTRACT

Mobile offshore drilling units (MODU), such as semi-submersibles, usually employ multiple azimuth thrusters to maintain their position during drilling or exploration. However, it has been reported that there is a considerable degradation compared with its open water performance. This reduction results from thruster interactions with the hull, current and other thrusters. Because it is essential for an accurate evaluation of the dynamic positioning capabilities (DP), researches have been performed to understand and quantify the thruster interaction itself. However, these thrusters are often used as a self-propulsion device. In that case, thruster interaction affects the overall power, so the transit speed would be decreased. In the present study, method to improve an effective thrust during the transit operation by steering individual thruster considering the interaction was studied.

KEY WORDS: Thruster interaction, Semi-submersible, Steering angle, Transit speed, thrust degradation, Azimuth thruster

INTRODUCTION

Mobile offshore drilling units (MODU), such as semi-submersibles, are vessels designed to engage in drilling and exploration activity. To maintain their position during the process, these facilities require either dynamic positioning (DP) or mooring system. The DP capability can be obtained by using the multiple thrusters under the vessel. However, it has been reported that there is a considerable disparity between the effective powers generated from thrusters and expected value based on its open water performance. This degradation results from thruster interactions with the hull, current and neighboring thrusters. Because it is essential for an accurate evaluation of the DP capabilities, previous researches have been focused on understanding and quantifying the thruster interaction itself.

However these thrusters are often used as a self-propulsion device. Normally, during the transit operation all thrusters are steered in the same direction to maintain the route over an environmental load. Because of the thruster interaction, power from aft thrusters has significantly degraded and consequently the speed of the vessel is decreased. One of the solutions to avoid the low effective operation is reducing the power of fore thrusters. Although this procedure could be used to increase overall efficiency, a faster transit speed is hard to be achieved.

In the present paper, considering a semi-submersible with 8 thrusters, a method to improve an effective thrust by steering individual thruster was studied. Empirical formula, experiments and computational simulation are compared with each other. In the developing stage where no experimental data is available, the data from a similar shaped vessel is a good starting point to estimate a performance. However, it is difficult to determine a correlation factor. While model test is the common procedure to estimate the performance, its expensive to perform in the design step where changes could be made consequently. Moreover, the model test takes time to be prepared and to analyze the results. Because of this reason, it sometime conducted at the later time in the development. Nowadays, as the computing power increased, numerical simulations to evaluate the performance of the vessels are widely used in the industry.

To investigate the effect of a steering, optimum angle had been determined based on the empirical formula. Then a model test was conducted at MARIN in 2014. At the same time, estimation of a thruster performance and thruster-thruster interaction in tandem condition was simulated using commercial software, STAR-CCM+. The simulation results were compared with the experiments to validate the suggested procedure. After that, sets of steering angle around the examined optimum angle were calculated and results were compared to find the trend of efficiency variation. Although the angle was slightly different from it solely from the empirical formula, the results