عنوان مقاله:

Influence of Full and Symmetrical Domains on the Numerical Flow around a SUBOFF Submarine Model using OpenFOAM

محل انتشار:

دوماهنامه مکانیک سیالات کاربردی, دوره 16, شماره 5 (سال: 1402)

تعداد صفحات اصل مقاله: 13

نویسندگان:

N. V. A. Permadi - *Department of Systems & Naval Mechatronic Engineering, National Cheng Kung University, Tainan, Taiwan*

J. H. Chen - *Department of Systems & Naval Mechatronic Engineering, National Cheng Kung University, Tainan, Taiwan*

E. Sugianto - *Department of Marine Engineering, Hang Tuah University, Surabaya, Indonesia*

خلاصه مقاله:

In this research, we consider the influence of two kinds of domain on the numerical flow around a submarine model. A fully appended SUBOFF submarine model was used, and the structure and characteristics of the flow were investigated under a full domain and a symmetrical domain arrangement. The numerical simulation was carried out using the OpenFOAM software, and the flow was numerically modelled as single-phase and incompressible. The SST k-ω turbulence model was used in both domains, together with an insensitive Spalding wall function to represent the boundary layer near the wall. The results showed that simulations in both the full and symmetrical domains could accurately predict the total resistance. Compared to the symmetrical domain, the resistance value obtained with the full domain was more precise; the symmetrical domain under coarse grid conditions had an error value of ۱.۳۴%, whereas the full domain using the same grid size had an error value of ۰.۶%. Hence, the full domain was superior in terms of predicting the resistance with a coarse grid. Next, the pressure coefficient comparison at the leading edge of the rudder was calculated, where = ۰.۹۲, and the symmetric domain was found to have a value of ۰.۰۷۴۷ whereas the full domain had a value of ۰.۲۳۶. Compared with the results from experiment (=۰.۳۰۲), the symmetric domain appears to give an underestimate for the pressure distribution at this position. In addition, the flow structures and properties in both domains differ, particularly in terms of the vortical structures generated by the sail and rudders. The simulation results for the full domain reveal that the flow around the SUBOFF model is asymmetric. The full domain was able to capture the flow structures in more detail than the symmetrical domain, and represented the velocity distribution at the propeller plane better. As a result, the full domain must be considered when carrying out propeller analysis and self-propulsion simulations.

کلمات کلیدی:

Turbulent flow, Wall function, velocity distribution, Stern wake, Flow structures, Numerical accuracy, OpenFOAM