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INTERFERENCE OF SIDE STRUT WITH THE NATURAL CAVITATING FLOWS AROUND A SUBMERGED VEHICLE IN WATER TUNNEL EXPERIMENTS*

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Abstract: To apply the measurements of model experiment in water tunnel to the actual sailing condition, it is necessary to know accurately the strut effect and its rule. In the present work, the corresponding interferences of one-side strut and two-side strut on the natural cavitating flows around a submerged vehicle in water tunnel were investigated numerically, using the homogeneous equilibrium two-phase model coupled with a natural cavitation model. The numerical simulation results show that the strut types have distinct effects on the hydrodynamic properties. For the same given upstream velocity and downstream pressure, the existence of the strut leads to an increment of natural cavitation number, reduces the low-pressure region and depresses the pressure on the vehicle surface near the sides of strut. In the case of given cavitaiton number, the influences of the two-side strut on the drag and lift coefficients are both enhanced along with the increment of attack angle, however the influence of the one-side strut gradually gets stronger on the drag coefficient but weaker on the lift coefficient contrarily. In addition, based on the present numerical results, a correction method by introducing the sigmoidal logistic function is proposed to eliminate the interference from the foil-shaped strut.

Key words: strut effect, natural cavitating flow, submerged vehicle, water tunnel experiment

Introduction

Hydrofoils are usually adopted as side-support strut to fix a vehicle model in water tunnel experiments. Even if a carefully designed foil will have rather low incipient cavitation number, it can not avoid the problem of disturbing the surrounding flow. In some specific situations, its interference on the flow field and hydrodynamic properties is even stronger than that of the tunnel-wall effect. To apply the measurements of model experiment in water tunnel to the actual sailing condition, it is necessary to know accurately the strut effect and its rule, and to find a suitable method to modify the strut interferences, so as to guarantee accurate and reliable experimental results in water tunnel tests.

The researches on strut interference are mainly focused on the methods of reducing and eliminating such interferences. The primary methods have been usually divided into two types. The first one is entirely based on pure experimental approach. For example, Jiang et al.[1] carried out the model experiments of three types of strut, namely tail-support, belly-support and head-support, and analyzed the results by contrast. The results indicated that the head-support strut is most applicable to research the hydrodynamic properties around the tail of supercavitating vehicle. All the works of the first type have the shortcomings of great cost and capability restriction in experiments. Further-

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