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Effects of X and + Tail-Body Configurations on Hydrodynamic Performance and Stability of an Underwater Vehicle

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Abstract : This paper proposes a comparison of hydrodynamic performance and stability characteristic for an underwater vehicle which has two type of tail design, namely X and +tail-body configurations. The effects of these configurations on the underwater vehicle's hydrodynamic performance and maneuvering characteristic will be investigated comprehensively. Hydrodynamic damping coefficients for modeling the motion of the underwater vehicles will be predicted. Additionally, forces and moments due to control surfaces will be compared using computational fluid dynamics methods. In the aviation, the X tail-body configuration is widely used for high maneuverability requirements. However, in the underwater, the + tail-body configuration is more commonly used than the X tail-body configuration for its stability characteristics. Thus it is important to see the effect and differences of the tail designs in the underwater world. For CFD analysis, the incompressible, three-dimensional, and steady Navier-Stokes equations will be used to simulate the flows. Also, k-ε Realizable turbulence model with enhanced wall treatment will be taken. Numerical results is verified with experimental results for verification. The overall goal of this study is to present the advantages and disadvantages of hydrodynamic performance and stability characteristic for X and + tail-body configurations of the underwater vehicle.

Keywords : maneuverability, stability, CFD, tail configuration, hydrodynamic design
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