

BIOMIMETIC STUDY OF SAILFISH FINS ON THE HULL PERFORMANCE OF THE DARPA SUBOFF SUBMARINE

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ABSTRACT

The hydrodynamic performance of a submarine plays a crucial role in determining operational efficiency, propulsion power requirements, and underwater maneuverability. This study aims to analyze the effect of applying sailfish-inspired biomimetic fins using NACA 0012 and NACA 2412 airfoil profiles at angles of attack of 0°, positive 5°, and negative 5° on the hydrodynamic characteristics of the DARPA SUBOFF submarine hull. The analysis was conducted using the Computational Fluid Dynamics (CFD) method with ANSYS Fluent based on the Reynolds-Averaged Navier–Stokes (RANS) approach. A grid independence test yielded a deviation of 2.14%, indicating that the computational mesh was independent and suitable for the simulation. The hydrodynamic characteristics were evaluated based on Drag Force and lift force, while pressure distribution and flow patterns were used to support the analysis. The simulation results indicate that each airfoil profile and angle of attack produces different hydrodynamic characteristics. The optimum configuration was achieved using the NACA 2412 airfoil at a negative 5° angle of attack, resulting in a Drag Force of 102.778 N, representing a 3.40% reduction compared with the conventional model, and a lift force of 66.918 N. These results demonstrate that this configuration provides the best balance between drag reduction and lift enhancement, thereby improving the hydrodynamic characteristics of the DARPA SUBOFF submarine hull.

Keywords: (CFD), DARPA SUBOFF, Drag Force, lift force, biomimetic.