Computer Aided Modeling of Boeing 737-800 Aircraft for Aerodynamic Study using SolidWorks Software

Abstract

This research article aims to study the aerodynamics of a Boeing 737-800 aircraft using low and high-fidelity computer models to rigorously verify the accuracy and reliability of those tools against field data. The low-fidelity computer application is based on the Lifting Line Theory and Vortex Lattice Method, which provides a comprehensive framework for quickly understanding and predicting the aerodynamic characteristics of the aircraft. The ANSYS Fluent Computational Fluid Dynamics (CFD) model is also used in the present study to perform a comprehensive aerodynamic study of the same aircraft. We need accurate Computer-Aided Design (CAD) of the aircraft to execute and make this research work thriving. Here we have used SOLIDWORKS software to accomplish the aircraft modeling properly so that every parameter and dimension can be done exactly and compatible to run in CFD software. Different modifications will be done in the CAD design to get an optimized aerodynamic performance.

The methodology involves modeling the aircraft to get accurate dimensions like Fuselage length, width and height, dihedral angle, ¼ sweep angle, etc., and the images of the aircraft from reliable sources to use to design the aircraft model in SOLIDWORKS. Correct Airfoils also have been used in modeling the wings, and horizontal and vertical stabilizers of the aircraft to get proper lift. For modeling the aircraft engine, we simplified and optimized it to avoid any complications for meshing and to get the result in ANSYS easily. Then through systematic analysis and statistical methods, the research seeks to establish the fidelity and precision of the computational model in replicating real-world aerodynamic behaviors. Field data collected from pilots of Boeing 737 is used for benchmarking both the low-fidelity and high-fidelity models.

The significance of this project lies in the establishment of a verified computational model capable of accurately predicting aircraft characteristics. The validated model outputs serve as a benchmark for the CarbonLess Electric AviatioN (CLEAN) aircraft design within the broader research initiative. By ensuring the fidelity of the computational tool in replicating verified aerodynamic behaviors, this research contributes to the estimation of reliability for the simulations. Ultimately, the project outcomes play a foundational role in advancing the field of aerospace engineering, particularly in the pursuit of cleaner fuels in aircraft designs.

Keywords: Aircraft Intuitive Design, Athena Vortex Lattice-VLM, Tornado-VLM, Aircraft Parameter Modeling, Fuselage, Dihedral Angle, ¼ sweep angle, Airfoil, Boeing 737-800, Aerodynamics, Validation, Computational Fluid Dynamics, Aerospace Engineering, CLEAN Aircraft Design