Aerodynamic study of a Boeing 737-800 aircraft using high-fidelity turbulence models

ABSTRACT

This research article aims to study the aerodynamics of a Boeing 737-800 aircraft using high-fidelity computer models. The ANSYS Fluent Computational Fluid Dynamics (CFD) model is used in the present study to perform a comprehensive aerodynamic study of the same aircraft using K-Omega, SST model in Ansys Fluent. The overall study focuses on validating the lift and drag outputs of the model, specifically applied to the Boeing 737-800 aircraft. The CFD model will provide much more details of the flow characteristics and turbulence properties around the aircraft.

K-Omega and SST (Shear Stress Transport) are turbulence models used in ANSYS FLUENT, a computational fluid dynamics (CFD) software. These models are used to simulate turbulent flow behavior in various engineering application. The K-Omega model is a two-equation turbulence model that solves for the turbulence kinetic energy (K) and the specific dissipation rate (omega). It provides accurate predictions for a wide range of turbulent flows, including both wall-bounded and free shear force. The SST model on the other hand, is a hybrid turbulence model that combines the benefits of both the K-omega and K-Epsilon models. It is particularly useful for simulating flows with adverse pressure gradients, such as boundary layers and separated flow. Both K-Omega and SST models are widely used in ANSYS FLUENT to accurately predict turbulent flow phenomena in various engineering simulations.

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: Aerodynamics, Aerospace Engineering, Aircraft Parameter Modeling, Ansys Fluent, Boeing 737-800, CLEAN Aircraft Design, Computational Fluid Dynamics, High-fidelity Model.