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A Computational Fluid Dynamics Study of Turbulence Flow and Parameterization of an Aerofoil

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Abstract : The main objective of this project was to introduce and test a new scheme for parameterization of subsonic aerofoil, using a function called Shape Function. Python programming was used to create a user interactive environment for geometry generation of aerofoil using NACA and Shape Function methodologies. Two aerofoils, NACA 0012 and NACA 1412, were generated using this function. Testing the accuracy of the Shape Function scheme was done by Linear Square Fitting using Python and CFD modelling the aerofoil in Fluent. NACA 0012 (symmetrical aerofoil) was better approximated using Shape Function than NACA 1412 (cambered aerofoil). The second part of the project involved comparing two turbulent models, k-ε and Spalart-Allmaras (SA), in Fluent by modelling the aerofoils NACA 0012 and NACA 1412 in conditions of Reynolds number of 3 × 106. It was shown that SA modelling is better for aerodynamic purpose. The experimental coefficient of lift (Cl) and coefficient of drag (Cd) were compared with empirical wind tunnel data for a range of angle of attack (AOA). As a further step, this project involved drawing and meshing 3D wings in Gambit. The 3D wing flow was solved and compared with 2D aerofoil section experimental results and wind tunnel data.

Keywords : CFD simulation, shape function, turbulent modelling, aerofoil
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