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A Numerical Study on Performance of NACA 2418 Airfoil

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Abstract: The present research is on the 2-D flow simulation and performance optimization of an aerofoil using CFD software ANSYS-Fluent. The aerofoil model NACA-2418 is chosen for the investigation for its rising popularity in training aircrafts. Our motive is to investigate various fluid-dynamic aspects and to optimize its performance for economic use. Geometry of the aerofoil NACA-2418 is prepared and an asymmetric mesh is created in ANSYS-mesh. Optimum grid size is achieved by a suitable grid-independence study. The standard k-ε model has been used for turbulence modelling. Validation with the experimental results proved the CFD-model to fit accurately for the case. Variation of lift coefficient, drag coefficient and lift-to-drag ratio is explained with fluid dynamic visualization obtained from CFD results. An optimum Lift-to-drag ratio is found for the angle of attack lying near the range of 5° angle of attack for the present geometry.

Keywords*: CFD, NACA 2418, Angle of attack, Airfoil characteristics, lift-to-drag ratio*

1. Introduction

The NACA 2418 stands as proof of legacy of National Advisory Committee for Aeronautics (NACA), Describing the NACA's legacy, The 2418 Aerofoil has emerged as a leading figure in aerodynamic research, affecting wind turbines, aircraft, design, Unmanned aerial vehicles (UAVs), and educational programs. Its practical value is illustrated by its application in general aviation, where its optimum lift and haul characteristics support in the maintaining the stability of light aircraft. In addition, the versatile nature of the aerofoil also applies to unmanned aerial vehicles (UAVs), focusing its important role in current aviation technologies. When it deals with teaching, the NACA 2418 is a useful resource for teaching aerodynamics concepts to future aerospace engineers and hobbyists. The NACA 2418 aerofoil is widely utilized in the aviation and aerospace industries. The chosen aerofoil model NACA 2418 is one of the most suitable aerofoil model for research and investigation purposes, which has also resulted in its increasing popularity among researchers.

Graham et al. [1] selected the aerofoil models NACA 0018 and NACA 2418 based on initial investigations. They observed that these aerofoil models perform better with maximum width of 18% when placed within vertical axis wind turbines because, wider aerofoils performs better at inferior tip speeds. The lift and drag coefficients of the aerofoils were compared for estimating the most enhanced lift-drag ratio (L/D). Based upon the results, which were derived from the experiments and researches, it was found that the aerofoil NACA 0018 is more appropriate than the aerofoil model NACA 2418. Hence, it can be observed that, the capability of the aerofoil model NACA 2418 is better in free airflow as compared to wind turbines. The extended width if the aerofoil model provides it with better airflow over the body, that generates an enhanced lift-drag ratio in free air as compared to wind turbines. Abood and Abdulrazzaq [2] used COMSOL Multiphysics Simulation Program for calculating the lift and drag coefficient for various two-dimensional aerofoil models. Along with that, they also focused on finding the glide ratio of each of these aerofoil models, such as NACA 2412, NACA 2415,