UAV NACA4415 wing structural performance analysis subjected to external aerodynamic load using Schrenk's approximation

ABSTRACT

Structural analysis is widely used in the analysis of aircraft structures with the common application of the finite element method. The optimum structural design of aircraft wing is the crucial aspect in the performance of the aircraft considering the high stiffness-to-weight ratio and sustain maneuvering condition. In this study, the structural analysis is carried out on the two types of NACA4415 leading edge wing, namely conventional and tubercles. The analysis involves the combination of internal structures that contributed towards the optimization of increase the strength of the wing.Tubercles at the leading edge (TLE) wing commonly known for its superior aerodynamic performancein Computational Fluid Dynamic (CFD) analysis. Whereas, Schrenk's approximation method is usedto estimate aerodynamic load acting on aircraft lifting surfaces by predicting lift distribution along wing span. The structural static analysis is performed with the aid of computational finite element software, ANSYS 16.1 in order to determine stress and displacement distribution on the selected wing. Slight difference of both stress and displacement 0.4% and 0.1% as compared to conventional ones, thus proven that the design of TLE is acceptable for both aerodynamic and structural conditions. Hence, the result which showed that the composition of internal structures influences the strength of the wing in respect to the different pattern of leading edge.

Keyword: Finite element; Schrenk's approximation; NACA4415 airfoil; Tubercles leading edge