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Numerical investigation on the pressure drag of some low-speed airfoils for UAV application (Article) [\(Open Access\)](#)

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Abstract

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Progressive advancements in small to medium-sized fixed-wing UAVs call for prototype designing to be fast, accurate, and economical. This requires the numerical assessment of airfoil performance to be based on high fidelity replication of wind tunnel data. Furthermore, integration of drag reduction techniques is attractive as improvements in endurance, payload capacity and reduction in carbon footprints can be attained. Since a variety of suitable airfoil geometries are currently available for this application, selecting a fitting candidate can be difficult therefore risking potential gain in efficiency. The aim of this paper is to assist in resolving this issue by investigating the variation in pressure drag and its distribution with respect to the type of airfoil geometry, angle of attack, and the contribution of pressure towards the total drag at low Reynolds numbers. The airfoils selected in this study comprises of the NACA 4415, FX 61-184, E420 and S1223 which are preferred for subsonic UAV applications in addition to having the NACA 0012 serving as a standard profile. Performance of the S1223 airfoil was examined at a chord-based Reynolds number of 0.3×10^6 with the remaining airfoils at 1.0×10^6 for a range of angle of attack of around $0-10^\circ$. The unsteady 3-equation Intermittency SST model from ANSYS FLUENT 2020 was utilized with gradual reduction of timestep from 0.001s, 0.0005s, 0.00025s and 0.0001s. Experimental lift and drag validation across the airfoils generally suggest that the transitional model regularly outperforms XFOIL. Among the selection, concave airfoils such as the E420 and S1223 excel in delivering high lift at the expense of an increase in drag. Evaluation of the l/d ratio alone may underestimate their potential. Hence, further studies should focus on the implementation of drag reduction techniques on concave airfoils to enhance their performance. At the maximum tested angle of attack, the E420 reaches a c_l value of 2.09 and S1223 at 1.98 while the FX 61-184 only at 1.57 and NACA 4415 at 1.36. © 2021, Penerbit Akademia Baru. All rights reserved.

SciVal Topic Prominence ⓘ

Topic: Boundary Layer Transition | Transition Model | Cascade Wind Tunnels

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