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Aerodynamic Modelling of Unmanned Aerial System through Computational Fluid Dynamics: Application to the UAS-S45 Balaam

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Abstract : As the Unmanned Aerial Systems have found diverse utilities in both military and civil aviation, the necessity to obtain an accurate aerodynamic model has shown an enormous growth of interest. Recent modeling techniques are procedures using optimization algorithms and statistics that require many flight tests and are therefore extremely demanding in terms of costs. This paper presents a procedure to estimate the aerodynamic behavior of an unmanned aerial system from a numerical approach using computational fluid dynamic analysis. The study was performed using an unstructured mesh obtained from a grid convergence analysis at a Mach number of 0.14, and at an angle of attack of 0°. The flow around the aircraft was described using a standard k-ω turbulence model. Thus, the Reynold Averaged Navier-Stokes (RANS) equations were solved using ANSYS FLUENT software. The method was applied on the UAS-S45 designed and manufactured by Hydra Technologies in Mexico. The lift, the drag, and the pitching moment coefficients were obtained at different angles of attack for several flight conditions defined in terms of altitudes and Mach numbers. The results obtained from the Computational Fluid Dynamics analysis were compared with the results obtained by using the DATCOM semi-empirical procedure. This comparison has indicated that our approach is highly accurate and that the aerodynamic model obtained could be useful to estimate the flight dynamics of the UAS-S45.

Keywords : aerodynamic modelling, CFD Analysis, ANSYS FLUENT, UAS-S45
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