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COMPARATIVE STUDY OF THE PREDICTION OF HIGH ANGLE OF ATTACK PHENOMENA USING TRANSITIONAL TURBULENCE MODELS

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The widespread use of unmanned aerial vehicle (UAVs) has become clear over recent years with its increasing ability to be deployed for a series of comprehensive tasks. This has led to an enormous research boost in that field. Therefore, a deep understanding and correct modeling of the aerodynamic behavior is fundamental, which in turn may lead to the further extension of the UAV's capabilities.

Recent years has seen the appearance within the CFD community of a large number of transitional turbulence models that allow the modeling of the flow around UAVs, which is characterized by very low values of turbulent intensity and in which transition is predominantly of the separation induced kind. However, the appearance of phenomena related to a high angle of attack (AoA), such as bursting, hysteresis, stall cells and high-amplitude-low-frequency oscillations, has often been neglected in the assessment of these models.

Four different turbulence models for low-Reynolds number flow are compared with the experimental data of a NACA 0018 profile [1] over a range of operating conditions and assessed for their ability to predict phenomena related to a high AoA. The models under consideration are Menter's k-ω SST model with Wilcox's low-Re modification [2], Menter et al.'s γ-Re_θ model [3], its simplified γ model [4] and Walters & Cokljat's k-k_l-ω model [5].

The study shows the discrepancy between 2D and 3D results, between the coherent structures that are predicted depending on the model that is used and the obstacles that still need to be overcome on the road towards the trustworthy modeling of low-Re flow.

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