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EFFECTIVENESS OF A BELLY FLAP IN MARTIAN ATMOSPHERE

Abstract

Mankind has already witnessed a sustained atmospheric flight outside the Earth's atmosphere. The Martian atmosphere however, is very thin and the aerodynamics of aerial robots is dominated by low Reynolds number effects. Such low Reynolds numbers flows are susceptible to separation leading to a deterioration in the aerodynamic performance of the airfoil, wing and the aircraft in general. Some innovative passive flow control mechanisms must thus be deployed, for a significantly attached flow in such low Reynolds numbers flow environment. The current research thus, investigates the effect of a belly flap, a thin flat plate flap attached perpendicularly on the pressure surface of the airfoil, on the aerodynamic characteristics of NACA 0012 airfoil in Martian atmosphere. The transient numerical analysis is carried out using a segregated finite volume Navier-Stokes solver with CO_2 as the working fluid. The analysis is carried out at Reynolds numbers of 5000 and 10000 with angles of attack of the airfoil between = 0 and = 20. The height of the belly flap is varied between 0.05c and 0.02c while its location is fixed at 10