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DYNAMIC STALL CHARACTERISTICS OF LOW REYNOLDS NUMBER AIRFOIL IN MARTIAN AND TITAN'S ATMOSPHERE

Abstract

Exploratory missions to Mars and Titan have increased recently with various endeavors to find an alternate home to humankind. The use of surface rovers has its limitations due rugged and uneven surfaces of these planetary bodies. The use of Aerial Robots requires the complete aerodynamic characterization of these vehicles in the atmospheric conditions of these planetary bodies. The dynamic stall phenomena is an extremely important for rotary wings performance under low Reynolds number that can be encountered in Martian and Titan's atmosphere. The current research focuses on the aerodynamic characterization and exploration of the dynamic stall phenomenon of three low Reynolds number airfoils viz. E387, SD7003 and NACA 2412, in Martian and Titan's atmosphere at Reynolds numbers of 10000, 50000, and 100000. The two- dimensional numerical simulations are conducted using commercially available finite volume solver with multi-species non-reacting mixture of gases as the working fluid. The -Re transition SST turbulence model is used to capture the unsteady flow separation and the effect of turbulence. The dynamic characteristics is studied at three different constant rotational speeds with -30 and 30 and extremes of angles of attack. The results presented are extremely beneficial for future exploratory missions with flying robots