World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:10, No:02, 2016

Analysis of Stall Angle Delay in Airfoil Coupled with Spinning Cylinder

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Abstract : Several Centuries ago, the aerodynamic studies on rotating cylinders and spheres have started. From the observation, the rotation of a cylinder has a remarkable effect on the aerodynamic characteristics is noticed. In case of airfoils as the angle of attack increases, the drag increases with reduction in lift i.e at the critical angle of attack. If at this point a strong impulse is imparted to the boundary layer by means of a spinning cylinder, the re-energisation of boundary layer is achieved and hence delaying the boundary layer separation and stalling characteristics. Analysis of aerodynamic effects spinning cylinder either at leading edge or at trailing edge of the airfoil is carried in the past, the positioning of cylinder close to trailing edge and its effects in delaying the stall are yet to be analyzed in depth. This paper aim is to understand the combined aerodynamic effects of coupling the spinning cylinder with the airfoil closer to the Trailing edge, by considering different spin ratio of the cylinder, its location and geometrical parameters in relation to the chord of the airfoil. From the analysis, it was observed that the spinning cylinder speed of rotation and location had a impact on stalling characteristics for a prescribed free stream condition. The results predicted through CFD analysis and experimental analysis showed a raise in aerodynamic efficiency and as the spin ratio increases, increase in stalling angle of attack is noticed when compared to the airfoil without spinning cylinder.

Keywords : aerodynamics, airfoil, spinning cylinder, stalling
Conference Title : ICMAAE 2016 : International Conference on Mechanical, Automotive and Aerospace Engineering
Conference Location : Melbourne, Australia
Conference Dates : February 04-05, 2016