JOURNAL OF SPACECRAFT AND ROCKETS
Vol. 50, No. 6, November–December 2013

Lee-Side Flow Structures of Very Low Aspect Ratio Cruciform Wing–Body Configurations

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DOI: 10.2514/1.A32522

Abstract

A numerical and experimental investigation was performed to study the dominant flow structures in the lee side of a cruciform wing–body configuration at supersonic speeds in the + orientation. The wings or strakes are of very low aspect ratio of order 0.025 with taper ratio ≈1 with a length of 11.25*D* mounted on a 19*D* tangent ogive body. The numerical simulations were performed using Fluent with the Spalart–Allmaras turbulence model. The Mach numbers simulated were 2.0, 2.5, and 3.0 up to angles of attack of 25 deg. The simulations revealed that the flow at low angles resembles that of a body and a strake, with the dominant separated flow feature being the rolled up side-edge vortex sheet. For angles of attack ≥10 deg, the flow resembles that of a body only configuration with two symmetric vortices at the moderate angles instead of two body and two strake vortices because the body vortex coalesces with the strake vortex. Vortex shedding is initiated at crossflow Mach numbers greater than 0.55 where the coalesced body and strake vortex separates into two symmetric pairs of vortices.