Paper ID: 14710
student

MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Vehicles – Mechanical/Thermal/Fluidic Systems (7)

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AN ALL-SPEED UNSTRUCTUREDFLOW SOLVER FOR SEPARATION PROCESS

Abstract

Multi-bodies separation is a common problem in aerospace. The surrounding flow would affect other bodies while separating in the air, thus to simulate the separation process correctly plays an important role while designing. The unstructured flow solver is based on unstructured Cartesian grid, which could generate meshes for various complex configurations easily. This feature is important for the engineering applications. The spring analogy method is used for the mesh transformation. The 3D Cartesian grid has hexahedron cells, which should be particularly treated while grid points moving. To solve the ALE(Arbitrary Lagrangian-Eulerian) governing equations, coupled the 6DOFs trajectory equation, the AUSM+-up scheme and the Roe's Riemann solver are supplied for spatial discretization, both of which considered the cell-face velocity. There are usually low-speed domains in the flowfield regardless of the large mach number of the far field. An improper simulation of the low-speed area may lead to false result. The preconditioning method could extend the spatial schemes to low-speed flows, which turn the solver into all-speed, makes simulating large range mach flow simple and feasible. The dual-time stepping method is used for time advancing, with the fourth-order Rung-Kutta method applied for the pseudo time domains. Flow problems with different mach numbers are used for all-speed test, the forced oscillation NACA0012 airfoil and separation examples with experimental data are used for code verification.