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Effect of Atmospheric Pressure on the Flow at the Outlet of a Propellant Nozzle

Authors : R. Haoui

Abstract : The purpose of this work is to simulate the flow at the exit of Vulcan 1 engine of European launcher Ariane 5. The geometry of the propellant nozzle is already determined using the characteristics method. The pressure in the outlet section of the nozzle is less than atmospheric pressure on the ground, causing the existence of oblique and normal shock waves at the exit. During the rise of the launcher, the atmospheric pressure decreases and the shock wave disappears. The code allows the capture of shock wave at exit of nozzle. The numerical technique uses the Flux Vector Splitting method of Van Leer to ensure convergence and avoid the calculation instabilities. The Courant, Friedrichs and Lewy coefficient (CFL) and mesh size level are selected to ensure the numerical convergence. The nonlinear partial derivative equations system which governs this flow is solved by an explicit unsteady numerical scheme by the finite volume method. The accuracy of the solution depends on the size of the mesh and also the step of time used in the discretized equations. We have chosen in this study the mesh that gives us a stationary solution with good accuracy.

Keywords : finite volume, lunchers, nozzles, shock wave
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