Simulation of Blast Loads on Arbitrary Geometry Structures

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Abstract

This paper describes two approaches to the problem of the calculation of blast loads on arbitrary geometry structures. The first is a traditional CFD approach in which the Navier-Stokes or Euler equations are solved. The simulation uses a high-order accurate spatial and temporal discretization of the equations of motion. Calculations are presented for the interaction of a shock wave, represented by a nonlinear Gaussian pulse with a rectangular solid body. Comparisons are made between the solutions obtained on coarse and fine grids. In addition, solutions obtained using the Navier-Stokes and Euler equations are compared. These traditional CFD solutions are used as benchmark solutions for the second numerical approach. In this method, the solid body is treated as a fluid region with different mean density and pressure. A unified numerical scheme is then sufficient to perform the simulation: even for complex body shapes. However, regions of high density tend to diffuse with time and the body shape becomes blurred. To overcome this shortcoming the Nonlinear Disturbance Equations (NLDE) are used. This approach preserves the mean flow variables during time integration and prevents the mean density from diffusing. Even in this form, significant oscillations may be generated at the body surface due to the rapid rate of change of the mean properties. A simple transformation of the equations of motion can overcome this difficulty. The effectiveness of this new method is demonstrated with a simple one-dimensional reflection problem.