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Numerical Investigation of Shock and Blast Loads on Composite Marine Structures

A strongly coupled 2D/axisymmetric Eulerian–Lagrangian numerical solver is presented for the modeling of shock and blast loads on composite marine structures. An overview of the numerical formulation is given for the compressible multiphase fluid, the generalized continuum solid, and the fluid-fluid and fluid-solid interface coupling methodology using modified versions of the ghost fluid method. The resulting strongly coupled Eulerian–Lagrangian solver is able to efficiently capture nonlinear fluid-structure and shock-bubble interactions involving strong shocks, gas bubble dynamics, cavitation inception and collapse, and complex stress and deformation fields of anisotropic, composite marine structures. Analytical, numerical, and experimental validation studies are shown. The objective of this work is to use the newly developed coupled Eulerian–Lagrangian method to study the transient response of composite marine structures subject to shock and blast loads. Special attention is given to quantify the influence of surface and core material elasticity/plasticity, boundary conditions, surface curvature, and strain-rate dependency on the fluid-structure interaction response caused by planar shocks and underwater explosions.

The goal is to develop parametric curves that can assist the design of general composite structures subject to shock and blast loads, and to explore potential shock mitigation strategies.