The Application of Multi-phase Flow Models in Simulations of Fluid-Structure Interaction

J. Knap and D.E. Stevens
Lawrence Livemore National Laboratory
Livemore, CA 94550
U.S.A.

In recent years, the issue of accurate prediction of thermo-mechanical response of structures subjected to dynamical loading induced by fluids has gained renewed attention. Such loading scenarios, commonly referred to as fluid-structure interaction (FSI) phenomenon, have been investigated in a wide range of applications, including: the effects of blast waves on buildings, personnel protection, impulse failure of marine structures, and also, biomechanics of cells or arterial blood flow. Often, simulations of FSI require development of large scale computer models that incorporate, however, only severely simplified constitutive models for the thermo-mechanical response of solids. Moreover, frequently some of the most essential aspects of FSI, such as structural failure due to fracture and fragmentation, are left out of the model entirely.

We apply the DEM multi-phase flow methodology to simulate FSI. The focus of this work is on the various aspects of failure in solids. In particular, we investigate the fracture and fragmentation of structures in response to blast waves. Verification and validation results of our numerical predictions are also provided.