Closure Models for Multimaterial Cells in Arbitrary Lagrangian-Eulerian Hydrocodes

Mikhail Shashkov[1]

[1] *Los Alamos National Laboratory, T-7, MS B284, Los Alamos, NM 87545, U.S.A.*

High-speed multimaterial flows with strong shear deformations occur in many problems of interest. Due to the nature of shock wave propagation in complex materials, the Arbitrary Lagrangian-Eulerian (ALE) Methods are currently the only proven technology to solve such problems. In ALE methods, the mesh does not move with the fluid, and so it is unavoidable that mixed cells containing two or more materials will appear.

Multimaterial cells are introduced in ALE methods to represent material interfaces that undergo high deformation. The main difficulties in this case are how to accurately determine the thermodynamic states of the individual material components and the nodal forces that such a zone generates, despite the lack of information about the velocity distribution within multimaterial cells.

A separate set of material properties is normally maintained for all the materials in each multimaterial cell along with the volume fractions that define the fraction of the cell's volume occupied by each material. The volume fractions also can be used to reconstruct material interfaces inside mixed cell.

A subcell model is then required to define how the volume fractions and states of the individual materials evolve during the Lagrangian step. This subcell model is required to close the governing equations, which otherwise are underdetermined.

In my presentation I will describe different closure models and present numerical comparison of different models in Lagrangian calculations with mixed cells.

This work was carried out under the auspices of the National Nuclear Security Administration of the U.S. Department of Energy at Los Alamos National Laboratory under Contract No. DE-AC52-06NA25396 and the DOE Office of Science Advanced Scientific Computing Research (ASCR) Program in Applied Mathematics Research.