Time Evolving Volume Fractions in Mixed Zones in During a Lagrange Step

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Many hydrodynamics codes use a "Lagrange plus remap" approach, in which first a pure Lagrangian step is taken then a mesh relaxation step is performed. This is one way to obtain an "ALE" code (Arbitrary Lagrange-Eulerian), in which the mesh motion can be purely Lagrangian, purely Eulerian, or anywhere in between. The quality of the Lagrange step is crucial to getting a good solution. However, a good solution can be ruined if mixed zones (zones which contain two or more materials) are not treated carefully. During the Lagrange step, a zone which has materials with different bulk moduli (air and solid metal, for example) can develop unphysical densities and pressures in one or both materials if the volume fractions remain constant. This problem can be avoided by evolving the volume fractions of the materials during the Lagrange step in a physically reasonable way that takes the differences in bulk modulus into account. We discuss four different methods and show test calculations that demonstrate their virtues and weaknesses.

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