ALE formulation with mixed elements

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Arbitrary Lagrangian Eulerian (ALE) formulation with multi-material elements has been implemented in a Lagrangian hydrocode to improve the robustness of the Lagrangian simulation, especially on thin meshes.

In a same simulation, we mix Lagrangian blocks (single material) and Ale blocks (multi-material). Disjoint blocks can interact at the boundaries through sliding surfaces.

In an Ale Block, the basic computational cycle consists in a Lagrangian step followed by a rezone one.

The Lagrangian step uses the classical Wilkins second order scheme. The assumption of equal material volumetric strain rate which governs the average values computation in mixed elements is improved by an iterative pressure relaxation algorithm.

The rezone step is splitted in two phases : the mesh smoothing phase in which a new grid is defined and a remapping phase in which the material quantities are interpolated on the new grid.

The mesh smoothing phase uses specific mesh smoothing schemes for boundary nodes and classical equipotential methods for interior nodes.

The remapping is based on the reconstruction of unstructured lagrangian mesh with variable connectivities for each material in the Ale block. The position of the interface between materials in mixed elements is computed by Young's method. The material quantities are mapped by an intersection mesh method on the new regular grid.