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COMBINATION OF INTERSECTION- AND SWEPT-BASED METHODS FOR SINGLE-MATERIAL REMAP

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Remapping is a key component of most Arbitrary Lagrangian-Eulerian (ALE) Methods [4]. It conservatively transfers the discrete solution from the (old) Lagrangian computational mesh produced by the Lagrangian solver to the (new) Eulerian mesh produced by a particular mesh rezoning algorithm.

In general, two approaches for function remapping exist. The first natural method is based on the construction of the intersections between each new cell with the cells belonging to the neighborhood of the same cell in the old mesh [3, 8]. The mass fluxes are then computed by integrating the reconstructed density function over these intersections. This method is very intuitive but has one big disadvantage – constructing the intersections can be computationally very expensive, especially when robustness is required. People often employ an alternative cheaper approach based on the swept regions, which are defined by the motion of the mesh edges during the rezoning step [2, 3, 8, 7]. The mass fluxes are then approximated by integrals over these regions. This method does not require any intersections and in practice, it shows similar properties as the intersection-based method – conservation, consistency, and second order of accuracy.

In a series of papers [5, 1, 6], we have developed the concept of hybrid remapping, combining both methods in the multi-material case in such a way that the intersections are only used in the vicinity of material interfaces while the cheaper swept-based approach is used in the rest of the computational domain. In this presentation, we apply the same idea for single material discrete functions. We analyze both approaches and show that the swept-based approach can potentially produce higher numerical error and violation of solution symmetry. To fix this, we designed several switches picking one or the other method, depending on the function features and mesh motion. In a series of numerical simulations we demonstrate properties of both original methods and their combination.

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