# Multimaterial ALE Remap with Interface Sharpening using High-Order Finite Elements

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## ABSTRACT

We are interested in multiphysics simulations using high-order finite elements in the context of multimaterial arbitrary Lagrangian-Eulerian (ALE) hydrodynamics. For the ALE remap phase, we have relied on a method in which material volume fractions are advected in pseudo-time without any form of interface reconstruction [1]. In practice, this can lead to excessive diffusion of material interfaces. In this work, we introduce a new approach for multi-material ALE remap using techniques which incorporate a flux modification to sharpen material interfaces in a conservative manner. This approach draws inspiration from interface aware volume of fluid (VOF) methods such as [2] and [3]. In our approach, we augment our semi-discrete advection equations with a conservative flux modification which acts to sharpen material volume fraction fields based on their gradients and the transport direction. This approach requires an adaptive pseudo-time stepping technique to maintain the bounds of the remapped solution variables.

In addition, we formulate this new interface aware ALE remap method using matrix-free partial assembly techniques where globally assembled matrix operators used in the semi-discrete advection equation are no longer needed. Instead, we combine an element based, bounds preserving low order solution with a high-order DG scheme and consider both clip/scale and flux corrected transport (FCT) projection strategies for doing element wise blending of the high and low order solutions, resulting in a matrix-free FCT method for multi-material, multi-field ALE remap. We present results of our new interface aware method on standard benchmarks and complicated practical simulations.

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## References

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