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TRIANGULAR METRIC-BASED MESH ADAPTATION FOR COMPRESSIBLE MULTI-MATERIAL FLOWS IN SEMI-LAGRANGIAN COORDINATES

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Lagrangian formulation is a powerful tool to compute compressible multi-material flows. Indeed, contact discontinuities are automatically preserved by construction which avoids usage of mixing models. Also, convection terms being treated through mesh motion, Lagrangian methods are usually more precise than their Eulerian counterparts: lesser terms having to be discretized. However, Lagrangian methods fail to calculate vortexes or shears: the mesh following the flow might become too distorted to pursue calculation after some time.

To overcome this difficulty, one has to maintain the mesh suitable for the calculation. The more classical remedy is ALE method. It consists in adding two steps to the initial Lagrangian method: smoothing the mesh to improve its quality and then remapping the approximated solution on the new grid. New Lagrangian steps can then be performed.

However, ALE formulation has limitations by itself. For instance, since the number of cells and the mesh connectivity remain unchanged, one might need a fine mesh all calculation in order to compute complex phenomenon. Nevertheless, one can adapt meshes by the means of monitor functions to standard smooting methods, but it cannot be an optimal answer for two obvious reasons. First, since one performs a global mesh smoothing, the whole mesh will be changed while trying to capture a local phenomenon. So, the numerical approximation could be deteriorated at some other locations. Second, there is no reason for the cell number to remain the same all along the calculation: mesh might be too fine for some time steps of the calculation and too coarse for some others. As a consequence, it seems relevant to provide more flexibility to the mesh adaptation step than just smoothing it. In the Lagrange/Remap context recent works have re-investigated the field of remeshing with modern tools. For instance, [4] deals with polygonal mesh adaptation and smoothing, [6] is based on a Voronoi approach (reconnection only and smoothing), [2] uses local triangular remeshing and [5] utilises patch-based triangular remeshing and mesh smoothing.

The approach we proposed in [2] can be described as an *as lagrangian as possible* AMR (Adaptive Mesh Refinement) method for compressible gas dynamics. It is very efficient and cheep as well as reproducible in parallel. Also, since it is based on local remeshing techniques [1] and since only few cells are remeshed from one time step to the other, it has very small numerical dissipation due to the remesh/remap step. A conservative remapping step is easy to define since we use finite-volume schemes in the Lagrangian step (such as Glace [3] or Eucclhyd [7] for instance).

Dealing with multi-material flows, it is generally not possible to maintain Lagrangian interfaces so that, any remeshing techniques (including ALE) usually requires to treat multi-material cells that requires mixing models [8]. In [2], we avoided mixing treatment by preserving Lagrangian interfaces between materials. This allowed to perform nice calculations but eventually fails due to time step vanishing (while interfaces enrolling for instance). This is one of the point we address in this presentation.

We shall present multi-material treatment improvements of our method [2] and propose a better remapping strategy (only first-order was described previously). We describe our interface reconstruction procedure in the particular case of local triangular mesh adaptation. We illustrate the efficiency of the method through numerical tests.

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