Contact algorithms for cell-centered lagrangian schemes

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We describe fundamental numerical features of multidimensional Riemann solvers for interface problems. In our sense, an interface can be viewed as a specific mathematical constraint. We illustrate this point of view in the framework of compressible fluid dynamics, specifically using advanced lagrangian cell-centered schemes based on a nodal velocity solver. We propose a new formulation of traditional nodal velocity solvers in order to solve constrained problems which are evidenced near an interface.

An example is the 2D impact of a lagrangian compressible fluid on a wall. At the time of impact, the normal component to the wall of the fluid velocity must cancel at the interface fluid-wall, constraining the fluid to slide on the interface. In this example, two different contact constraints (impact + sliding) apply on nodes belonging to the face that impinges on the wall.

In their actual formulation, traditional nodal velocity solvers are not capable to solve such problem. Most of them are based on the solving of a linear system to compute nodal velocities, which is inadequate to take into account constraints. The new multidimensional formulation of the nodal solver is based on a global constrained minimization procedure. Such procedure enables to incorporate many kind of constraints in the calculation of the nodal velocities, particularly impact and sliding. 1D and 2D numerical tests illustrate the potentialities of this new formulation.

References

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