On the low Mach number limit of the Active Flux scheme

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In multiple spatial dimensions, the Euler equations exhibit a number of phenomena not present in one-dimensional flow, e.g. vortex structures and the incompressible (low Mach number) limit, which only is nontrivial in multiple dimensions. Numerical methods need to be able to resolve these efficiently.

Obtaining the intercell flux of a finite volume method from the solution of a Riemann Problem is prohibitively complicated in multiple spatial dimensions. Additionally, it is found that for simpler equations that allow such an approach it still does not lead to e.g. a vorticity preserving or a low Mach number compliant scheme.

The *Active Flux scheme* is a finite volume scheme that considers continuous reconstructions instead. The intercell flux is obtained using additional degrees of freedom distributed along the boundary. For their time evolution an exact evolution operator is employed, which naturally ensures the correct direction of information propagation and provides stability. The additional degrees of freedom allow the Active Flux scheme to be accurate to third order.

In this talk the Active Flux scheme is applied to linear acoustics obtained as linearized Euler equations in two spatial dimensions. These equations possess a low Mach number limit analogous to that of the Euler equations. An implementation of Active Flux on Cartesian grids is presented. It is demonstrated that continuous reconstruction is not standing in the way of simulating discontinuous solutions with explicit time stepping in a stable manner.

Furthermore, it is shown that the Active Flux scheme for linear acoustics is low Mach number compliant without the need for any fix. This result is obtained by showing that the scheme is stationarity preserving.