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An asymptotic preserving scheme for the full Euler equations in the low Mach limit

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This work is in collaboration with Marie-Hélène Vignal, Institut de Mathématiques de Toulouse, UT3-Paul Sabatier.

In this work, we develop and study an asymptotic preserving (AP) scheme for the compressible Euler system in the low Mach number regime. For subsonic flows, the acoustic waves are very fast compared to the velocity of the fluid, we are in an incompressible regime. From a numerical point of view, when the Mach number tends to zero, classical explicit schemes present two major drawbacks : they loose consistency and impose a very restrictive constraint on the time step to guaranty the stability of the scheme since they have to follow the fast acoustic waves.

We propose a new linear asymptotic stable scheme, with a CFL condition independent of the Mach number, and asymptotically consistent, that is it degenerates into a consistent discretization of the incompressible model when the Mach

number is sufficiently small.
This type of scheme has been widely studied in the literature, in particular for the isentropic case [5, 4, 3, 6] but also for the full Euler system [2, 1] with various methods. In this work we propose an AP scheme based on an IMEX (Implict-Explicit) discretization in time and cell-centered finite volume in space. I will present our AP scheme, its extension to order 2 and the MOOD procedure used to reduce the oscillations (classical problem of high order schemes). Finally, I will finish my presentation with some results on the Navier-Stokes equations.

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