A high-order Lagrange–Galerkin method for compressible flows

Authors:

- Manuel Colera, Universidad Politécnica de Madrid (m.colera@upm.es)
- Jaime Carpio, Universidad Politécnica de Madrid (jaime.carpio@upm.es)
- Rodolfo Bermejo, Universidad Politécnica de Madrid (rodolfo.bermejo@upm.es)

Abstract:

We present a novel Lagrangian–Eulerian scheme for the solution of two-dimensional compressible and inviscid flows [2]. The scheme considers arbitrary-order continuous space discretizations on unstructured triangular meshes, as well as arbitrary-order implicit–explicit Runge–Kutta time marching schemes. The method preserves mass, momentum and total energy as long as the integrals in the formulation are computed exactly. The recent model proposed by Brenner [1] for viscous flows is employed to define the operators needed to stabilize the continuous Galerkin formulation. The method has been tested on several benchmark problems using a fourth-order time-marching formula and up to fifth-degree elements, showing good accuracy both for smooth and discontinuous solutions.

References:

[1] Howard Brenner. Fluid mechanics revisited. *Physica A: Statistical Mechanics and its Applications*, 370(2):190–224, 2006.

[2] Manuel Colera, Jaime Carpio, Rodolfo Bermejo. A nearly-conservative, high-order, forward Lagrange–Galerkin method for the resolution of compressible flows on unstructured triangular meshes. *Journal of Computational Physics*, 467:111471, 2022.