

Domain-based explicit-exponential methods for flow problems

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In the computation of wall bounded flows, resolving the boundary layer requires a very fine resolution. The CFL condition then makes the use of explicit time integration schemes infeasible. However, these may be used in parts of the domain where the mesh is coarse, and using an implicit method only on the remainder. This gives rise to domain based IMEX methods. In this talk, we consider the combination of explicit Runge-Kutta (ERK) methods and exponential integrators, called EXPEX.

A first result is that such a combination of an ERK method with a standard EPIRK method can not have more than order one. However, methods of higher order can be obtained by making use of the (s)EPIRK methods of Rainwater and Tokman. Care has to be taken to define the splitting in a way such that conservation of the flow quantities is not lost.

These methods are then applied to Discontinuous Galerkin discretizations of the compressible Euler and Navier-Stokes equations. Numerical Results show the competitiveness with existing IMEX methods.

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