Implicit-Explicit Runge-Kutta schemes for hyperbolic systems and kinetic equations in the diffusion limit

S. Boscarino(⋆), L. Pareschi, G. Russo

(⋆) Dipartimento di Matematica e Informatica, Università di Catania
email: boscarino@dmi.unict.it

Sommario

We consider the development of Implicit-Explicit (IMEX) Runge-Kutta schemes for hyperbolic and kinetic equations in the diffusion limit. In such regime the system relaxes towards a parabolic diffusion equation and it is desirable to have a method that is able to capture the asymptotic behavior with an implicit treatment of limiting diffusive terms. To this goal we reformulate the problem by properly combining the limiting diffusion flux with the convective flux. This, however, introduces new difficulties due to the dependence of the stiff source term on the gradient. Thus, at variance with standard IMEX schemes, the methods here proposed work uniformly with respect to the small scaling parameter and in the zero relaxation limit originates a fully implicit method for the diffusion equation. Several numerical examples including neutron transport confirm the theoretical analysis.

Riferimenti bibliografici
