TITLE: High-order semi-implicit schemes for evolutionary partial differential equations with higher order derivatives

Abstract:
The aim of this work is to apply a semi-implicit (SI) strategy in an implicit-explicit (IMEX) Runge-Kutta (RK) setting introduced in [37] to a sequence of 1D time-dependent partial differential equations (PDEs) with high order spatial derivatives. This strategy gives a great flexibility to treat these equations, and allows the construction of simple linearly implicit schemes without any Newton's iteration. Furthermore, the SI IMEX- RK schemes so designed does not need any severe time step restriction that usually one has using explicit methods for the stability, i.e. $\Delta t = O(\Delta tk)$ for the k-th ($k \geq 2$) order PDEs. For the space discretization, this strategy is combined with finite difference schemes. We illustrate the effectiveness of the schemes with many applications to dissipative, dispersive and biharmonic-type equations. Numerical experiments show that the proposed schemes are stable and can achieve optimal orders of accuracy.

[37]: S. Boscarino, F. Filbet, G. Russo, High Order Semi-implicit Schemes for time dependent Partial Differential Equations, J. Sci. Comput., 68, pages 975-1001 (2016).