Thirteenth International Conference Zaragoza-Pau on Mathematics and its Applications
Jaca, September 15–18th 2014

On the performance of low storage Additive Runge-Kutta methods

I. Higueras, **T. Roldán**[1].

SUMMARY

Space discretization of some time-dependent PDEs gives rise to systems of ordinary differential equations in additive form. Some of these systems have a special structure that allows us to rewrite them as

$$\begin{aligned} u' &= f_1(u,v)\,, \\ v' &= f_2(u,v) + \frac{1}{\varepsilon} g_2(u,v)\,, \end{aligned} \tag{1}$$

where ε is the stiffness parameter. These systems, often with a large number of equations, arise from the semidiscretization of convection-diffusion problems and hyperbolic systems with relaxation. They have been analyzed in, e. g. [1, 4], where robust implicit-explicit Runge-Kutta methods have been considered.

In this talk we consider implicit-explicit Runge-Kutta methods for additive differential equations of the form (1). In the construction of Runge-Kutta methods, properties like stability and accuracy are important items that must be taken into account. However, in some contexts, storage requirements of the schemes also play an important role. Low storage explicit Runge Kutta methods have been studied in different contexts by some authors, e. g. [2, 3]. In this talk we analyze different implicit-explicit Runge-Kutta methods with good stability properties and low storage requirements from [3], and we compare them with other additive low storage methods.

Keywords: Additive Runge-Kutta methods, IMEX methods, low storage methods.

AMS Classification: 65L06, 65L05, 34-04, 65Y20, 65H10

References

[1] Boscarino, S. Error analysis of IMEX runge-kutta methods derived from differential-algebraic systems. *SIAM Journal on Numerical Analysis 45*, 4 (2007), 1600–1621.

[2] Calvo, M., Franco, J., and Rández, L. Minimum storage runge-kutta schemes for computational acoustics. *Computers & Mathematics with Applications 45*, 1 (2003), 535–545.

[3] Higueras, I., Roldán, T. Construction of robust and efficient additive Runge-Kutta methods. *In preparation* (2014).

[4] Pareschi, L., and Russo, G. Implicit-Explicit Runge-Kutta schemes for stiff systems of differential equations. *Recent Trends in Numerical Analysis 3* (2000), 269–289.

[1]Departamento de Ingeniería Matemática e Informática
Universidad Pública de Navarra
Campus de Arrosadía
higueras@unavarra.es, teo@unavarra.es