Frequency evaluation for adapted peer methods

Leila Moradi @ (University of Salerno), Dajana Conte, Beatrice Paternoster

R 1.23 Wed Z3 11:00-11:10

In this talk, we consider systems of Ordinary Differential Equations (ODEs) of the form

$$y'(t) = f(t, y(t)), \quad y(t_0) = y_0 \in \mathbb{R}^d, \quad t \in [t_0, T], \tag{1}$$

where $f : \mathbb{R} \times \mathbb{R}^d \to \mathbb{R}^d$ is sufficiently smooth to ensure that the solution exists and it is unique. We consider a general class of Exponentially Fitted (EF) two-step peer methods [5, 6] for numerical integration of ODEs (1) with oscillatory solution. EF algorithms for the numerical integration of problems with oscillating or periodic solutions are able to exploit the information about the frequency of oscillation in order to reduce the computational cost [1].
An important question is how to choose frequencies in order to maximize the benefits of EF methods. In this work, we will show that the key to the answer is the analysis of the error's behavior. By following the approach of [2, 3, 4], we develop an algorithm for the estimation of the frequency, by analyzing the behavior of the leading term of the error. Numerical experiments illustrate the obtained results.

References

[1] L.Gr. Ixaru, G. Vanden Berghe, Exponential Fitting Kluwer, Boston-Dordrecht-London 2004

[2] G. Vanden Berghe, L.Gr. Ixaru, H. De Meyer, Frequency determination and step-length control for exponentially fitted Runge–Kutta methods J. Comput. Appl. Math. 132 95–105, 2001

[3] L.Gr. Ixaru, G. Vanden Berghe, H. De Meyer, Frequency evaluation in exponential fitting multistep algorithms for ODEs J. Comput. Appl. Math. 140 423–434, 2002

[4] H. Van de Vyver Frequency evaluation for exponentially fitted Runge–Kutta methods, J. Comput. Appl. Math. 184 442–463, 2005

[5] D. Conte, R. D'Ambrosio, M. Moccaldi, B. Paternoster Adapted explicit two-step peer methods, J. Num. Math. 255 725–736, 2018

[6] D. Conte, F. Mohammadi, L. Moradi, B. Paternoster, Exponentially fitted two-step peer methods for oscillatory problems, Comput. Appl. Math. 39 2020