Generalized TASE-RK methods for stiff problems with application to the numerical solution of parabolic PDEs.

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The so-called family of Time-Accurate and Stable Explicit (TASE) methods for the numerical integration of Initial Value Problems in stiff Ordinary Differential Equations (ODEs) was recently introduced in [1]. Such methods consider a base explicit Runge-Kutta (RK) method whose stability properties are improved by multiplying the vector field of the underlying ODE by a certain operator which approximates the identity mapping up to a given order p. This family of methods was further extended to a wider class of TASE operators in [2], where some classical linear stability properties were studied, improving the stabilization of some classical explicit Runge-Kutta up to order four. The TASE operators considered for a given explicit method of order p and p stages ($1 \leq p \leq 4$) require the solution of p linear systems for each internal stage.
In this talk, generalized TASE-RK methods are considered in order to improve the efficiency of the TASE approach while retaining the order of consistency and good linear stability properties. Since these methods are linearly implicit, connections to the class of W-methods [3] are established. Furthermore, an extension of the TASE approach with the Approximate Matrix Factorization technique is proposed in order to deal with the numerical solution of large ODEs coming from the spatial discretization of parabolic Partial Differential Equations with time-dependent boundary conditions in several spatial dimensions.

References

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