Implicit Peer-methods using AMF and Krylov-techniques for large stiff ODE systems

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We discuss the application of implicit two-step Peer methods [1] of the form

$$Y_{m,i} = \sum_{j=1}^{s} b_{ij} Y_{m-1,j} + h_m \sum_{j=1}^{i} g_{ij} F_{m,j}, \quad i = 1, 2, \dots, s$$

for large stiff systems of ordinary differential equations. Peer methods are characterized by a high stage order and therefore they do not suffer from order reduction for very stiff systems. This makes them well suited for semi-discretized partial differential equations. The linear systems in the Newton iteration are solved with the Krylov method FOM or by using approximate matrix factorization(AMF).
We develop, by using Matlab, a code based on some optimized two-step Peer methods of order three which implements linear systems solvers of two types, Krylov's and AMF, to be selected by the user. The performance of our code is compared with other solvers in the current literature, such as the AMF-version of the two-stage Radau IIA [3], ROWMAP [4] and EXP4 [2], on three interesting problems of parabolic type having large dimensions in their ODE systems resulting of the semidiscretized spatial versions of the PDE problems.

References

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