On the use of parallel processors for implicit Runge-Kutta methods

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Abstract

An iteration scheme, for solving the non-linear equations arising in the implementation of implicit Runge-Kutta methods, is proposed. This scheme is particularly suitable for parallel computation and can be applied to any method which has a coefficient matrix A with all eigenvalues real (and positive). For such methods, the efficiency of a modified Newton scheme may often be improved by the use of a similarity transformation of A but, even when this is the case, the proposed scheme can have advantages for parallel computation. Numerical results illustrate this. The new scheme converges in a finite number of iterations when applied to linear systems of differential equations, achieving this by using the nilpotency of a strictly lower triangular matrix $S^{-1}AS - \Lambda$, with Λ a diagonal matrix. The scheme reduces to the modified Newton scheme when $S^{-1}AS$ is diagonal. A convergence result is obtained which is applicable to nonlinear stiff systems.

Author keywords

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