Improved Convergence Rates of an Iterative Scheme with Extra Sub-steps for Gauss Method

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Abstract

Several authors proposed variety of linear iteration schemes to solve non-linear equations arising in the implementation of implicit Runge-Kutta methods. A linear scheme of this type with some additional computation in each iteration step was proposed. The rate of convergence of this scheme was examined when it is applied to the scalar test problem $x' = qx$ and the convergence rate depends on the spectral radius $\rho[M(z)]$ of the iteration matrix *M(z)*, a function of $z = hq$, where h is a step size. The spectral radius $\rho[M(z)]$ was minimized over left-half of the complex plane for the case $r = s + 1$. Improved convergence rates are obtained for the case $r = 2s$ for two, three and four stage Gauss methods and numerical results are given.

Keywords - Gauss method, Implementation, Rate of convergence, Spectral radius, Stiff system