Accelerating convergence of Generalized Picard Iterations

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Generalized Picard Iterations (GPI) is a family of iterated Runge–Kutta methods aimed to matrix-free solution of stiff systems [1]. Originally based on artificial time integration these methods can be regarded as a special iterative processes for solving nonlinear systems during the implementation of implicit RK methods. The convergence rate of GPI in case of linear ODE system $y' = Jy$, where J is a square matrix with spectrum from left complex half-plane, is determined by the magnitude of $\rho(J)\rho(J^{-1})$.
In the talk we are going to discuss some properties of GPI as a representatives of explicit RK family and suggest a way of accelerating the convergence of GPI by means of damping the components of residual vector corresponding to small eigenvalues of J. Some numerical experiments justifying the efficiency of suggested approach will be presented.

[1] B. Faleichik, I. Bondar, V. Byl: Generalized Picard iterations: A class of iterated Runge–Kutta methods for stiff problems. Journal of Computational and Applied Mathematics, Volume 262, 15 May 2014, Pages 37-50, ISSN 0377-0427, http://dx.doi.org/10.1016/j.cam.2013.10.036.