Robust implicit preconditioning and applications

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Preconditioning is the most common approach for accelerating an iterative method and consists in solving an auxiliary problem structurally close to the original one. In most situations, the art of preconditioning consists in building in a efficient way a matrix or a sequence of matrices. This explicit approach is not however always possible and there are situations in which preconditioned versions are not available, or the explicit matrix approach is too expensive. We present here a derivative-free preconditioned residual method [4]. The new scheme is based on a variable implicit preconditioning technique associated with the globalized spectral residual method. It consists in combining continuous Newton-like approach [1, 5], the spectral direction and globalization techniques [6]. We present the derivation of the scheme, its properties and we consider, as applications, the numerical solution of nonlinear problems, such as the steady state of Navier-Stokes equations at high Reynolds [3] but also of linear problems such as Generalized Sylvester equations for which a preconditioning matrix is difficult to build [2]. We also discuss some recent developments of the method.

References


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