On a Black-Box Preconditioner Update for Solving Sequences of Nonsymmetric Linear Systems in Matrix-free Environment

Jurjen Duintjer Tebbens

Institute of Computer Science, Czech Academy of Sciences, Pod vod. věží 2,
18207 Praha 8, Czech Republic.

In numerous industrial and scientific simulation processes every time-step asks for the solution of a nonlinear system. The nonlinear problem is frequently solved with a Newton-type method and every Newton iteration, in turn, leads to a linear system. These linear systems can be solved efficiently with Krylov subspace methods. An appealing property of such methods is that they allow matrix-free implementations where the Jacobians are approximated using a difference scheme.

To share part of the computational effort throughout the sequence of linear systems that arises, one option is approximate updating of preconditioners for the Krylov subspace methods. Computing a factorized preconditioner from scratch in matrix-free environment is rather costly because the system matrix is not available and must be estimated before. In this talk we describe a cheap preconditioner updating technique for nonsymmetric systems that was proposed recently and discuss its modification in order to be applicable in matrix-free environment. We present, among others, a new implementation strategy which is based on mixed matrix-free/explicit triangular solves. This is joint work with Miroslav Tůma.