

Miroslav Rozložník

Analysis and implementation of iterative methods for solving saddle-point systems in applications.

Short abstract: This topic focuses on the analysis of the convergence and numerical behavior of iterative methods for solving large-scale saddle-point systems that arise in various applications such as discretizations of partial differential equations via mixed formulations of the finite element method or nonlinear programming with equality constraints. A large amount of work has been devoted to a wide selection of solution techniques for saddle-point systems varying from the fully direct approach through the use of iterative stationary methods up to the combination of direct and iterative techniques including preconditioned iterative schemes. For an excellent survey on applications, solution methods and results on algebraic solution of saddle-point systems, we refer to the paper by M. Benzi, G. H. Golub and J. Liesen, and numerous reference therein. Significantly less attention has been, however, paid to the numerical behavior of such schemes. In this work we would like to concentrate not only on the effects of rounding errors but also on the analysis of inexact Krylov subspace methods, where some computations in the solution schemes are due to savings intentionally approximated and performed with some degree of inexactness. This may have a substantial effect on the behavior of such solution techniques. We believe that careful analysis of these effects can contribute to better understanding of relaxation strategies that are successfully used in various applications.

References:

- M. Benzi, G. H. Golub, J. Liesen. Numerical solution of saddle point problems. *Acta Numerica*, 2005, pp. 1– 137.
- P. Jiránek, M. Rozložník, Maximum Attainable Accuracy of Inexact Saddle Point Solvers, *SIAM Journal on Matrix Analysis and Applications* 29 (4), 2008, 1297-1321.
- M. Rozložník: [Saddle point problems, iterative solution and preconditioning: a short overview](#), Proceedings of the XV-th Summer School Software and Algorithms of Numerical Mathematics, I. Marek ed., University of West Bohemia, Pilsen, 97-108 (2003).
- M. Rozložník, V. Simoncini, Krylov Subspace Methods for Saddle Point Problems with Indefinite Preconditioning, *SIAM Journal on Matrix Analysis and Applications* 24 (2), 2002, 368-391.