Oberwolfach Seminar 1247a, November 18-24, 2012

"Subspace Correction Methods"

R. Kornhuber (FU Berlin)
J. Xu (PennState)
H. Yserentant (TU Berlin)

Short description

Subspace correction methods are devoted to the efficient and reliable solution of discretized partial differential equations. They can be regarded as a systematic approach to divide and conquer.
The basic idea is to decompose the underlying solution space into smaller subspaces and then compute corrections of a given iterate by solving local problems on these subspaces.
Since the early ninties, subspace correction has been developed into a general framework for the analysis and development of multigrid and domain decomposition methods for large-scale, nonlinear and non-smooth problems arising in practical applications.

In this seminar we plan to first provide a sound theoretical basis of subspace correction methods for self--adjoint linear problems which is then used to construct and analyze advanced algorithms for more challenging linear and nonlinear problems, like, e.g., indefinite problems, problems with jumping coefficients, higher-order problems, contact problems in elasticity or phase transition and separation.
Finally, we will report on recent developments and real--life applications in biomechanics, material science, and industry.

Prerequisites

Applicants should have basic knowledge on the numerical analysis of partial differential equations, variational inequalities, and finite element methods. Preparatory reading could involve the following review papers.

[1] W. Hackbusch. Multi-Grid Methods and Applications.
Springer-Verlag, Berlin – Heidelberg – New York, 1985.

[2] R. Kornhuber. On constrained Newton linearization and multigrid for variational inequalities.
Numer. Math., 91:699–721, 2002.

[3] Jinchao Xu, Iterative methods by space decomposition and subspace correction, SIAM Review, v. 34, 4(1992), 581-613.

[4] H. Yserentant. Old and new convergence proofs for multigrid methods.
Acta Numer., pages 285–326, 1993.