SEMINÁRIO

17 de Outubro de 2008
(Departamento de Matemática, sala Sousa Pinto, 11:00-12:00)

Título: On the linear convergence of Newton-Krylov methods.

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Resumo: Variational principles of elasticity theory consisting in minimization of the stored energy functional under some constraints give rise to the finite element formulation of the deformation model. In this way the elasticity theory problem is reduced to numerical solution of a large system of nonlinear equations. The dimension of the system, N, is so high that the Newton method cannot be applied in its classical form. The inverse matrix has to be calculated approximately, for example using a Krylov subspace method. If the Petrov-Galerkin method is used, the matrix is not necessarily symmetric. How many iterations of the Krylov subspace method we need in order to guarantee a linear convergence of a corresponding Newton-Krylov method? From the mathematical point of view the answer to this question can be reduced to the study of the existence of a polynomial $P(z)$ with a minimal possible degree, $M < N$, satisfying $P(0) = 1$ and $|P(z)| < 1$ whenever z is an eigenvalue of the matrix, A, to be inverted. If the matrix A is symmetric positive definite, M equals to 1, and for general symmetric matrices $M = 2$. However, if the matrix A is not symmetric, M depends on N and goes to infinity as N tends to infinity. We find explicit expressions for L and U satisfying $L < M < U$.

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