Temple University Mathematics Colloquium

Michael Eiermann

Technische Universität Bergakademie Freiberg, Germany

will speak on

Convergence results and a-posteriori error estimators for Krylov subspace approximates of matrix functions

ABSTRACT: The evaluation of

$$f(A)\mathbf{b}, \qquad \text{where } A \in \mathbb{C}^{n\times n},\ \mathbf{b} \in \mathbb{C}^n \tag{$*$}$$

and $f : \mathbb{C} \supset D \to \mathbb{C}$ is a function for which $f(A)$ is defined, is a common computational task. Besides the solution of linear systems of equations, which involves the reciprocal function $f(\zeta) = 1/\zeta$, by far the most important application is the time evolution of a system under a linear operator, in which case $f(\zeta) = f_t(\zeta) = e^{t\zeta}$ and time acts as a parameter t. Other applications arising in the context of solving differential equations require the evaluation of $(*)$ for the square root and trigonometric functions. Further applications include identification problems for semigroups involving the logarithm and lattice quantum chromodynamics simulations requiring the evaluation of the matrix sign function. In many of the applications mentioned above the matrix A is large and sparse or structured, typically resulting from discretization of an infinite-dimensional operator. In this case evaluating $(*)$ by first computing $f(A)$ is usually unfeasible, so that most of the algorithms for the latter task cannot be used. The standard approach for approximating $(*)$ directly is a projection method onto a nested sequence of Krylov subspaces generated by A and $\mathbf{b}$.

We give an overview of recent developments in this area with special emphasis on the convergence behavior of Krylov subspace approximations and on the question of how reliable a-posteriori error estimators may be constructed for such methods.

Monday, 20 October 2008
Lecture at 4:00 pm
Coffee, tea, and refreshments from 3-5 pm
Room 617, Wachman Building
Department of Mathematics