TECHNISCHE UNIVERSITÄT
IN DER KULTURHAUPTSTADT EUROPAS
CHEMNITZ

Fakultät für Mathematik
Chemnitzer Mathematisches Colloquium

E i n l a d u n g

In der Reihe „Chemnitzer Mathematisches Colloquium“ der Fakultät für Mathematik der TU Chemnitz spricht

Herr Prof. Dr. Robert Scheichl (Universität Heidelberg)

über das Thema

Multiscale-Spectral Generalized Finite Elements: Efficient Localized Model Order Reduction.

Der Vortrag findet am

Donnerstag, dem 7. November 2024, um 15:30 Uhr, im Raum 2/B202

statt.

Ich möchte Sie hiermit recht herzlich zu dieser Veranstaltung einladen. Das Kolloquium wird von Herrn Prof. Dr. Martin Stoll geleitet.

Abstract: In this talk, I will present an e fficient generalized finite element method with optimal (multiscale spectral) local approximation spaces (MS-GFEM) for PDEs with heterogeneous coe fficients. In practice, the local approximation spaces are constructed from local eigenproblems solved on some su fficiently fine fi nite element mesh with mesh size h. In this work, we will provide rigorous error estimates for the fully discrete method. The error bound of the discrete MS-GFEM approximation is proved to converge as h tends to 0 towards that of the continuous MS-GFEM approximation, which was shown to decay nearly exponentially in previous works. Moreover, even for fixed mesh size h, a nearly exponential rate of convergence of the local approximation errors with respect to the dimension of the local spaces is established. The method can also be used as an effective preconditioner in an iterative solver with a ’tuneable’ convergence rate. On the practical side, an e fficient and accurate method for solving the discrete eigenvalue problems is proposed by incorporating the discrete-harmonic constraint directly into the eigenproblem via a Lagrange multiplier approach. Numerical experiments that con firm the theoretical results and demonstrate the e ffectiveness of the method are presented for a second-order elliptic problem, for a large-scale problem of linear elasticity in composite aerospace applications and for a high-frequency heterogeneous Helmholtz problem. Even in this last example, a quasi-optimal and nearly exponential (wavenumber-explicit) global convergence of the method can be theoretically proved, provided the size of the subdomains is O(1/k) (where k is the

wavenumber). A two-level restricted additive Schwarz preconditioner with MS-GFEM coarse space can be shown to lead to a tuneable GMRES convergence rate with a very mild dependence of the coarse space size on the wavenumber k.

Prof. Dr. Daniel Potts
Dekan