$\mathcal{H}$-Matrix Techniques

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Outline

- Lecture in $\mathcal{H}$-matrix techniques
- Tutorial in $\mathcal{H}$-matrix techniques
- Research Seminar
- Cooperation and Future plans

Lecture

14 x lecture sessions held by

Univ. Prof. Dr. Wolfgang Hackbusch

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Lecture-notes available:

Hierarchische Matrizen - Algorithmen und Analysis (German) (new)

`http://www.mis.mpg.de/scicomp/Fulltext/hmvorlesung.ps`

Hierarchical Matrices (English)

`http://www.mis.mpg.de/preprints/ln/lecturenote-2103-abstr.html`

Lecture - Contents

- Complexity (CPU, Memory)
- Matrices (rank-k, full, sparse, $\mathcal{H}$-matrix)
- Operations: $\mathcal{H}$-matrix addition, $\mathcal{H}$ * vector multiplication, $\mathcal{H}$ * $\mathcal{H}$ multiplication, truncated variants
- Properties of $\mathcal{H}$-matrices

Lecture - Contents

- Matrix-partitioning
- Properties and Construction of Cluster, Clustertrees
- BEM-matrices, construction, approximation
- FEM-matrices, approximation of K_h^{-1}
- Special Functions: Matrix-Exp-function, SINC-function, ...

Tutorial

8 x tutorial sessions held by

Dr. Steffen Börm and Dr. Lars Grasedyck

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Objective:

practice in the software package HLib

`http://www.hlib.org`

or

`http://www.hmatrix.org`

Tutorial - Contents

- Datastructures: Matrices, Clusters, ...
- Construction of Clusters and Clustertrees
- Construction of $\mathcal{H}$-matrices: Interpolation, Adaptive-Cross-Approximation
- Basic Operations: Addition, Multiplication (with truncation)
- Applications: BEM, data-sparse LU decomposition
- $\mathcal{H}^2$-matrices

Research Seminar

5 x research seminars held by

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- Fast solution of large FEM systems based on Domain Decomposition ideas
- Black-box clustering for $\mathcal{H}$-matrices
- Special Equations: Sylvester, Lyapunov, Riccati

Research Seminar

- $\mathcal{H}^2$-matrices: Less storage and computational costs
- usage of $\mathcal{H}$-matrices for the computation of the Exp-function
- construction of $\mathcal{H}$-matrix hierarchies within a multigrid algorithm
- several discussions

Cooperations and Future plans

- $\mathcal{H}$-matrix techniques for p-FEM discretizations (Schöberl, Beuchler)
- Solution of Lyapunov, Sylvester and Riccati equations, Workshop on Optimal Control (Leibfritz, Group of Prof. Sachs)
- Discussion Multipole/$\mathcal{H}$-matrix (Of)
- Implementation and usage of HLib (Liebmann, Pusch)
- Revision of lecture notes and new features within HLib
- RICAM Reports