

\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, $\mathcal{H} * \text{vector}$ 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
Univ. Prof. Dr. Wolfgang Hackbusch



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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

