High-Performance Computing on Clusters

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Module number	Credits	Workload	Semester[s]	Duration	Group size
BI-WP55/SE-O-9	6 CP	180 h	3. Sem.	1 Semester[s]	no limitation

Courses	Contact hours	Self-study	Frequency
a) High-Performance Computing on Clusters	a) 4 WLH (60 h)	a) 120 h	a) each winter

Module coordinator and lecturer(s)

Prof. Dr. Andreas Vogel

a) Prof. Dr. Andreas Vogel

Admission requirements

Learning outcome, core skills

After successfully completing the module the students

- are enabled to design and create programs for parallel computing clusters
- can critically evaluate distributed-memory systems and programming patterns
- can assess the mathematical properties of iterative solvers and their scalability

Contents

a)

The lecture deals with the parallelization on cluster computers. Distributed-memory programming concepts (MPI) are introduced and best-practice implementation is presented based on applications from scientific computing including the finite element method and machine learning.

Special attention is paid to scalable solvers for systems of equations on distributed-memory systems, focusing on iterative schemes such as simple splitting methods (Richardson, Jacobi, Gauß-Seidel, SOR), Krylov-methods (Gradient descent, CG, BiCGStab) and, in particular, the multigrid method. The mathematical foundations for iterative solvers are reviewed, suitable object-oriented interface structures are developed and an implementation of these solvers for modern parallel computer architectures is developed.

Numerical experiments and self-developed software implementations are used to discuss and illustrate the theoretical results.

Educational form / Language

a) Tutorial (2 WLH) / Lecture (2 WLH) / English

Examination methods

• Written exam 'High-Performance Computing on Clusters' (120 min., Part of modul grade 100 %)

Requirements for the award of credit points

Passed written examination

Module applicability

- M.Sc. Computational Engineering
- M.Sc. Bauingenieurwesen
- M.Sc. Angewandte Informatik
- M.Sc. Subsurface Engineering

Weight of the mark for the final score
Percentage of total grade [%] = 6 * 100 * FAK / DIV FAK: The weighting factors can be taken from the table of contents. DIV: The values can be taken from the table of contents.
Further Information
Computerlab Exercises