

Parallel Programming

Module no. or code	5
Module name	Elective 1 - Parallel Programming
(If applicable) the module's courses	
Module content	<ol style="list-style-type: none"> 1. Hardware Concepts for Parallel Computing <ul style="list-style-type: none"> - Multicore Processors - Shared Memory Systems - Distributed Memory Systems - GPU Computing - Caches and Memory Hierarchy 2. Thread-Based Parallelization <ul style="list-style-type: none"> - Fundamental Principles - OpenMP - CUDA 3. Message-Passing Parallelization <ul style="list-style-type: none"> - Communication - MPI 4. Performance Analysis and Optimization <ul style="list-style-type: none"> - Bottlenecks and other Typical Performance Challenges - Profiling - Event Tracing - Performance Analysis Tools
Module's learning outcomes	<ul style="list-style-type: none"> - Students understand under which conditions parallelization can be used to improve the performance of software. - Students understand the differences between the current hardware architectures and the implications of these differences on the associated software. - Students know how to write parallel programs on SMP and DMP systems and on GPUs. - Students are aware of potential performance problems that arise in parallel computing. They know how to analyse their software in this respect and how to identify and eliminate such issues.
Semester	1 st semester
Duration of module	4 hours per week
Frequency	
ECTS-Credits	5

Workload	Workload (Total)	Attendance time	Self-Study time (incl. exam preparation)
	150	60	90
Type of module			
Applicability of module			
Conditions for participation			
Responsible for module	Prof. Dr. Kai Diethelm		
Lecturer	Prof. Dr. Kai Diethelm		
Language of instruction, L. of examination	english		
Type of examination; Conditions for the award of CPs	soP (= other examined assignment)		
Teaching and learning formats of the module	SU/Pr		
Literature	<ol style="list-style-type: none"> 1. Thomas Rauber and Gudula Rünger: Parallel Programming for Multicore and Cluster Systems, 2nd ed. Springer, Heidelberg, 2013 2. Timothy G. Mattson, Yun (Helen) He and Alice E. Koniges: The OpenMP Common Core. MIT Press, Cambridge, 2019 3. David Kirk and Wen-mei W. Hwu: Programming Massively Parallel Processors – A Hands-on Approach, 3rd ed. Morgan Kaufmann, Waltham, 2016 4. William Gropp, Ewing Lusk and Anthony Skjellum: Using MPI, 3rd ed. MIT Press, Cambridge, 2014 		