






## 5-Day-Course — LRZ — 1<sup>st</sup> day

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### Content

#### MPI on beginners' level

1. MPI Overview
2. Process model and language bindings
3. Messages and point-to-point communication
4. Nonblocking communication     

### Schedule

- 08:30 Local registration  
(and Corona status check if needed)
- 09:00 Welcome
- 09:15 Lectures and exercises on MPI  
(including some breaks)
- 13:00 Lunch break
- 14:00 Lectures and exercises on MPI  
(including some breaks)
- 18:00 Final end
- Social Event in Garching (self-paying)

### Other options:

#### Parallel Architectures and Programming Models

#### Other MPI chapters, e.g.,

12. Derived datatypes  
(1) transfer any combination of typed data
15. Probe, Persistent Requests, Cancel

## 5-Day-Course — LRZ — 2<sup>nd</sup> day









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### Content


#### MPI on beginners' level – continued

- 6.(1) Collective communication

#### Shared memory parallelization with OpenMP

- Overview 
- Execution model 
- Worksharing directives 
- Worksharing – continued (Tasks ...) 
- Data environment 
- Heat example (homework) 
- Summary 
- Pitfalls 

#### Shared memory parallelization with OpenMP

- Verifying an OpenMP Parallelization with the Intel Inspector XE 

### Schedule

- 08:30 Lectures and exercises on MPI  
(including some breaks)
- 10:30 Lectures and exercises on OpenMP  
(including some breaks)
- 13:00 Lunch break
- 14:00 Lectures and exercises on OpenMP  
(including some breaks)
- 17:30 Verifying an OpenMP Parallelization with the Intel Inspector XE
- 18:00 **Optional:**  
Exercises with the Intel Inspector XE
- 18:00/18:30 Final end without/with the exercise

### Other options:

#### Other MPI chapters, e.g.,

7. Error handling
8. Groups & Communicators, Environment Management  
(1) MPI\_Comm\_split, intra- & inter-communicators
9. Virtual topologies  
(1) A multi-dimensional process naming scheme

## 5-Day-Course — LRZ — 3<sup>rd</sup> day

### Content

#### Iterative Solvers for Large Linear Systems [Andreas Meister]

- 8:30 Introduction and Basics (I) (talk)
- 10:00 Coffee
- 10:15 Classical Splitting Schemes (II) (talk)
- 11:30 Coffee
- 11:45 Practical (Jacobi-scheme, Exercise 1+2) (practical)
- 13:00 Lunch
- 14:00 Conjugate Gradient Method (CG) (III) (talk)
- 15:15 Coffee
- 15:30 Practical (CG, Exercise 3+4) (practical)
- 17:00 Other options on MPI
- 18:00 End

#### Other options:



#### Other MPI chapters, e.g.,

- 5. The New Fortran Module mpi\_f08
- 10-17. Short tour through other chapters

### Schedule

- 08:30 Lectures & exercises on iterative solvers (including some breaks)
- 13:00 Lunch break
- 14:00 Lectures & exercises on iterative solvers (including some breaks)
- 17:00 Other options on MPI
- 18:00 Final end
- Walking tour trough Munich with both trainers (self-paying, details depend on the weather conditions, e.g. through English garden and the city, ending on the 2<sup>nd</sup> floor of the Hofbräuhaus, transit with U-Bahn, 9€-month-ticket is still valid)

## 5-Day-Course — LRZ — 4<sup>th</sup> day

### Content

#### Iterative Solvers for Large Linear Systems [Andreas Meister]

- 8:30 Multigrid Methods (IV) (talk)
- 9:45 Coffee
- 10:00 GMRES, BiCG and Variants (V) (talk)
- 11:30 Coffee
- 11:45 Practical (Multigrid and Krylov subspace methods, Exercises 5+6) (prac.)
- 13:00 Lunch
- 13:45 Preconditioning, Teil 1 (V) (talk)
- 14:45 Coffee
- 15:00 Preconditioning, Teil 2 (V) (talk)
- 15:45 Q & A [Andreas Meister]
- 16:00 Coffee
- 16:15 MPI Chap. 10-14 More details [3, Rolf Rabenseifner] (talk)  
2<sup>nd</sup> skip-points [31 slides] Ch.10 [5], 11[12], 12[3], 13[5], 14[6]
- 17:30 OpenMP-4.0 and 4.5 Extensions [7A] (talk)
- 18:00 End

### Schedule

- 08:30 Lectures & exercises on iterative solvers (including some breaks)
- 13:00 Lunch break
- 13:45 Lectures & exercises on iterative solvers (including some breaks)
- 16:15 For MPI & OpenMP:  
More details  
OpenMP-4.0 / 4.5 / 5.0 Extensions
- 18:00 Final end














## 5-Day-Course — LRZ — 5<sup>th</sup> day

### Content

#### Parallelization Examples

[Rolf Rabenseifner]

- 8:30 Parallelization of Explicit and Implicit Solvers [38a] (talk)     
- 9:45 Coffee 
- 10:00 Laplace-Example with MPI and PETSc
  - Introduction [42a] (talk) 
  - Writing a parallel MPI program with a CG solver [42b] (talk+practical) 
- 12:00 Coffee
- 12:15 PETSc Tutorial [41] (talk) 
- 13:15 Lunch
- 14:15 Laplace-Example with PETSc [42c] (talk) 
- 15:15 Summary and Q&A (talk+discussion) 
- 15:30 End

### Schedule

- 08:45 Local registration (and Corona status check)
- 09:00 Lectures & exercises on parallelization (including some breaks)
- 13:15 Lunch break
- 14:15 Lectures & exercises on parallelization (including some breaks)
- 15:30 Final end