



## Project-oriented Software Lab

### Course Description

The main task of this software lab is to engage deeply with applications related (but not limited) to fluid mechanics. Thus, the modeling, the numerical simulation with Finite Element (FE) software and the presentation and interpretation of the results have to be accomplished. The lab is open to problems, suggested by the students, which are modeled with partial differential equations.

Participants will work in groups of two on two projects. The first introductory project runs from April 16 until May 24, and the second more advanced project from May 28 until July 19.

### Reading

You may find these books helpful. Some of them are also available in German.

- Layton. *“Introduction to the Numerical Analysis of Incompressible Viscous Flows”*. SIAM, 2008.
- Goering, Roos, Tobiska. *“Die Finite Elemente Methode für Anfänger”*. Wiley-VCH, 2012.
- Braess. *“Finite Elements”*. Cambridge University Press, 2007.
- Donea, Huerta. *“Finite Element Methods for Flow Problems”*. Wiley, 2003.
- Quarteroni, Sacco, Saleri. *“Numerical Mathematics”*. Springer, 2007.
- Gropp, Lusk, Skjellum. *“Using MPI”*. The MIT Press, 1999.

### Times and Places

The course will take place every Tuesday and Friday between 09:45–11:15 a.m. First session being on April 16 2013 and last session being on July 19 2013. The lecture hall is the computer lab A.U.10 in the Technologiefabrik.

**-Please turn over!-**

Please try and attend the following *mandatory* sessions punctually:

Tue.	16.04.2013	Organizational issues & Introduction to the FE Method
Fri.	19.04.2013	Introduction to FEM (part 2) and HiFlow <sup>3</sup>
Tue.	23.04.2013	Team Building & Start of project 1
Fri.	24.05.2013	Project 1: presentations
Tue.	18.06.2013	Q&A Session
Tue.	09.07.2013	Project 2: presentations
Fri.	12.07.2013	Project 2: presentations

**Requirements** for obtaining a tutorial certificate (“Praktikumsschein“):

- Mandatory presence at the dates listed above
- Successful completion of the two projects. For each project, you will have to give a short presentation (5–10 min). For the second project you will have to additionally:
  - (a) Hand in a report describing your solutions to the exercises, including:
    - (i) Mathematical problem formulation
    - (ii) Reasoning supported by analytical derivations
    - (iii) Plots and tables of computed solutions and other data
  - (b) Hand in your source code, extensively commented

The report should be written with L<sup>A</sup>T<sub>E</sub>X, using the provided template. The report, code and presentation can be in English or German. Submission deadline is:

**Fri July 19 2013 11:15 a.m.**

### **Materials distribution and communication**

During the semester all needed materials, e.g. report templates, will be published on the course homepage:

**[http://www.emcl.kit.edu/336\\_software\\_lab.php](http://www.emcl.kit.edu/336_software_lab.php)**

You can reach the course advisors or all participants plus course advisors via

**[sl-orga-st2013@lists.kit.edu](mailto:sl-orga-st2013@lists.kit.edu),      [sl-st2013@lists.kit.edu](mailto:sl-st2013@lists.kit.edu),**

respectively.