

Lecture (summer semester 2015): Extended Finite Element Methods (XFEM)

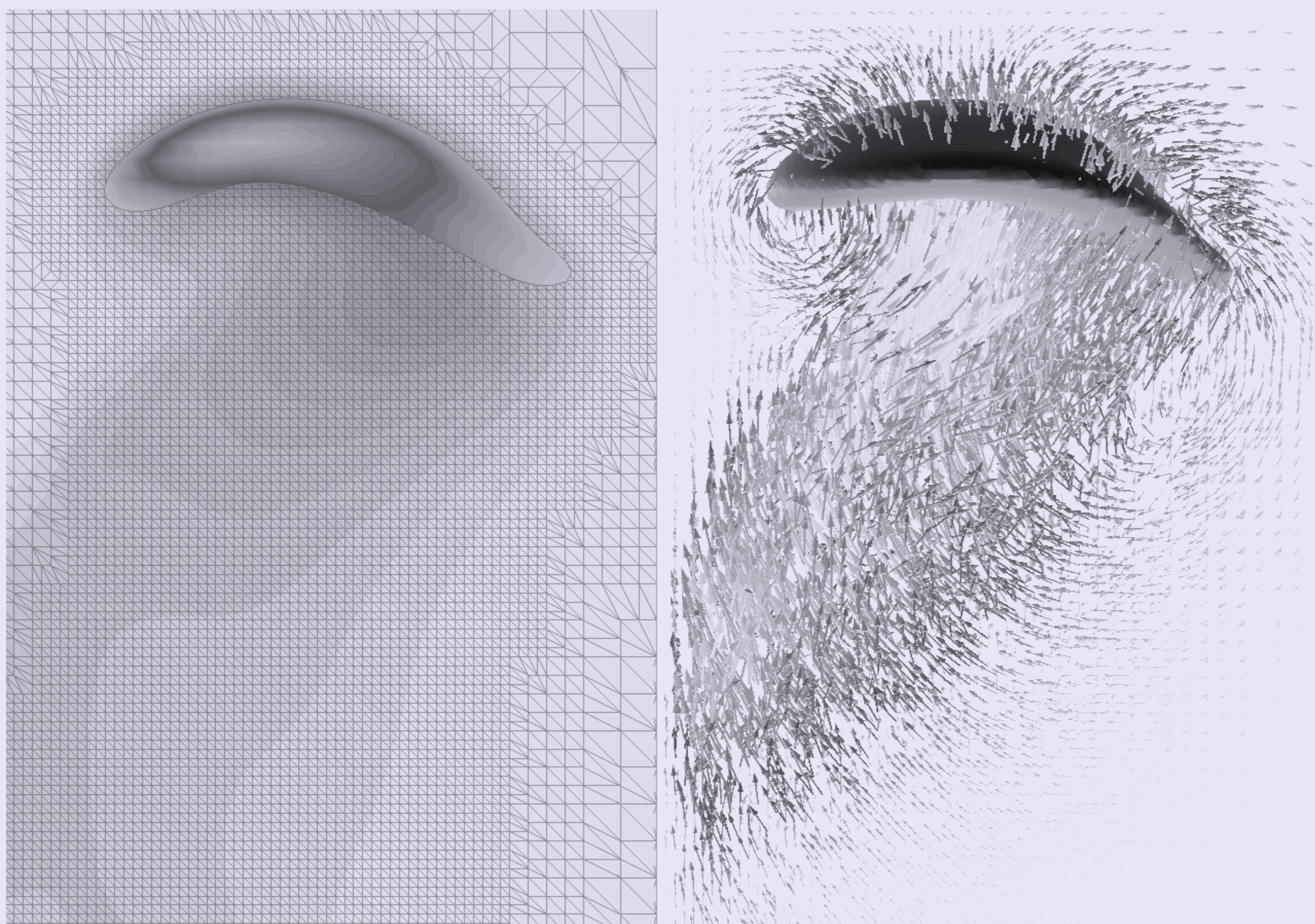
Implementation, Analysis and Application of XFEM

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FURTHER INFORMATION: PROF. DR. JOACHIM SCHÖBERL (JOACHIM.SCHOEBERL@TUWIEN.AC.AT)



Content

Partial differential equations the solution of which has (weak) discontinuities across given interfaces require special care for their numerical treatment. In the lecture we present modern numerical approaches for the discretization of interface problems based on the eXtended finite element method (XFEM). The XFEM introduces finite element spaces which provide ansatz functions which are discontinuous across the given interface. Based on this approach numerical discretizations have been derived and used for different applications. We focus on the discussion of interface problems arising in two-phase flow applications and discuss their numerical solution. The lecture includes the introduction and discussion of these methods with respect to implementational aspects as well as their numerical analysis.



Mode, grading and first meeting:

Grading: participation + team project or oral exam

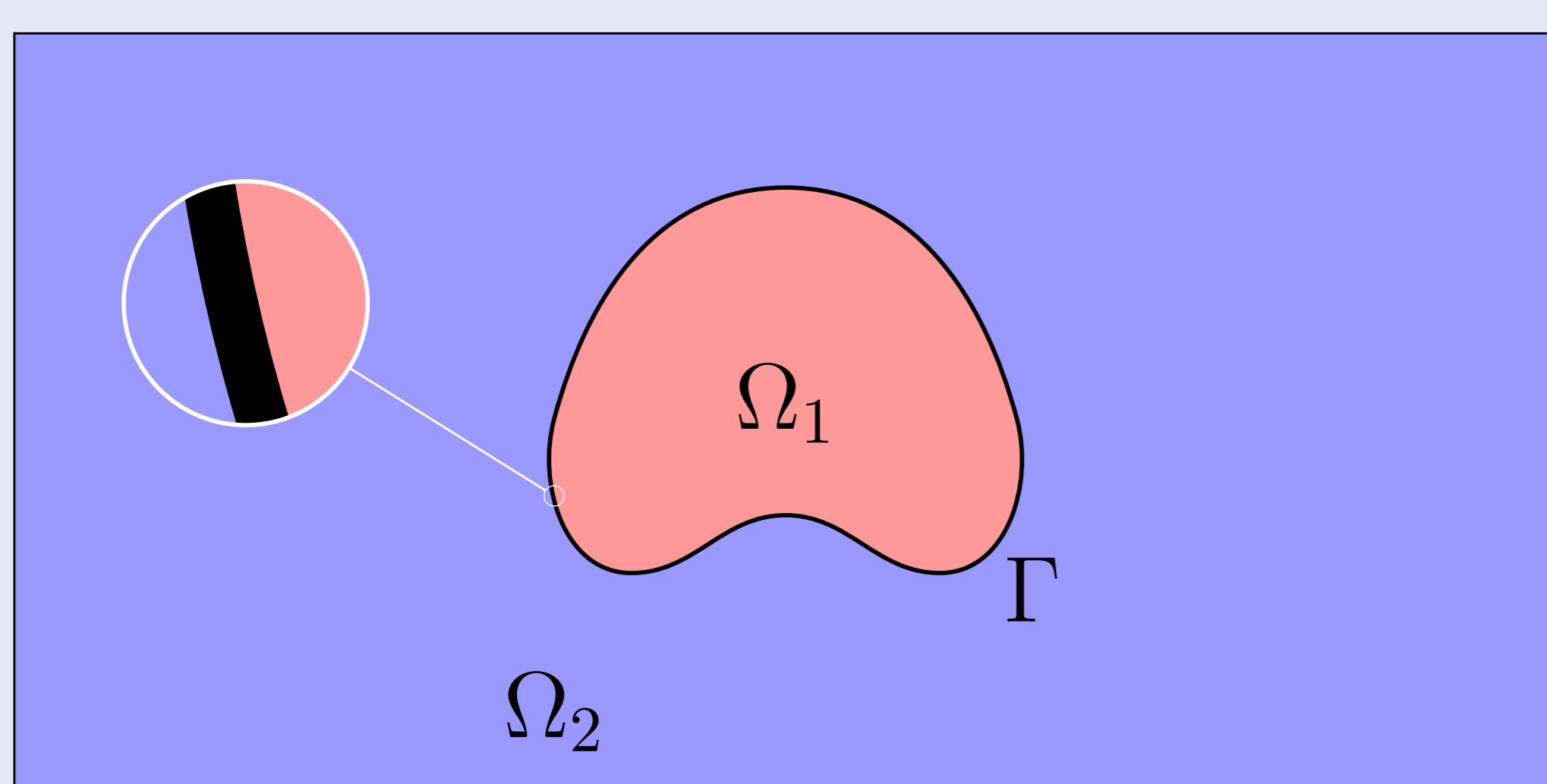
Extent: 4.5 ECTS

Dates: By arrangement at first meeting

First Meeting: Tue, 3. Mar 2015, 13:30,
Besprechungszimmer 3.Stock
(vis a vis SR 101B)

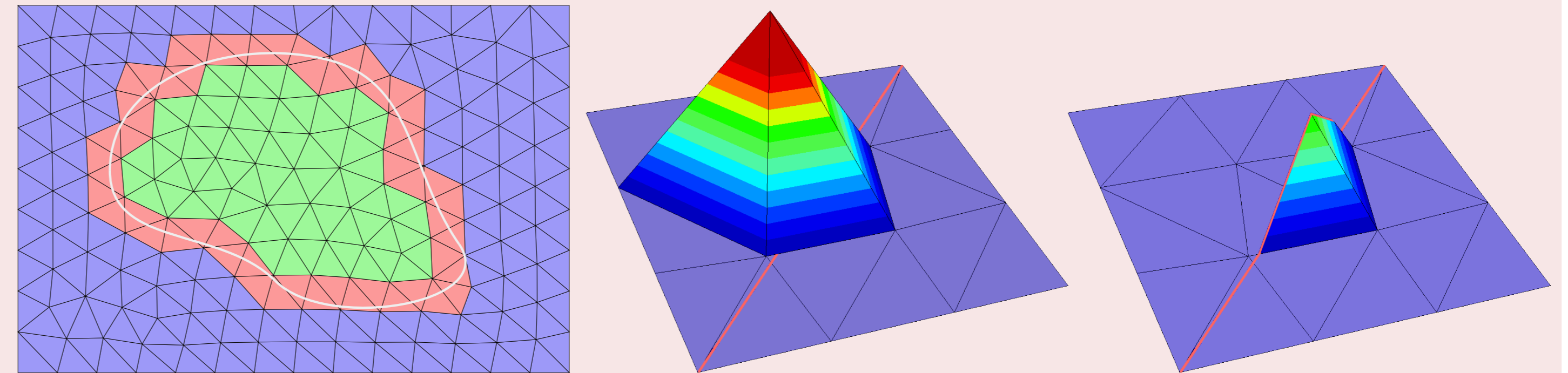
Block 1: Two-phase flow application

- Introduction to two-phase flows
- Introduction of the level set method (interface-capturing)
- Introduction of model problems



Block 2: XFEM

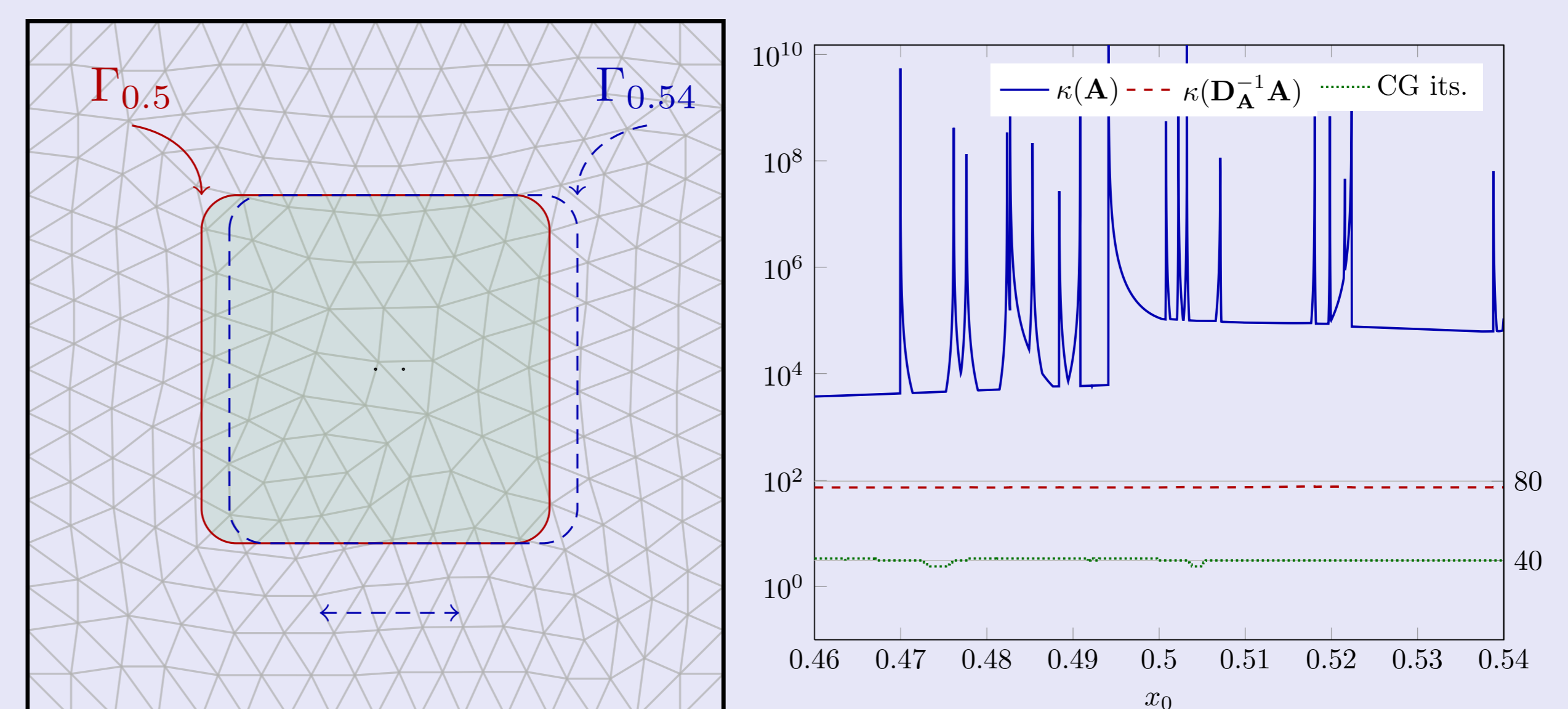
- Introduction of the eXtended Finite Element Method (XFEM)



- Enforcement of interface conditions for XFE spaces
- Implementational aspects of the XFEM
- Analysis of XFEM discretizations

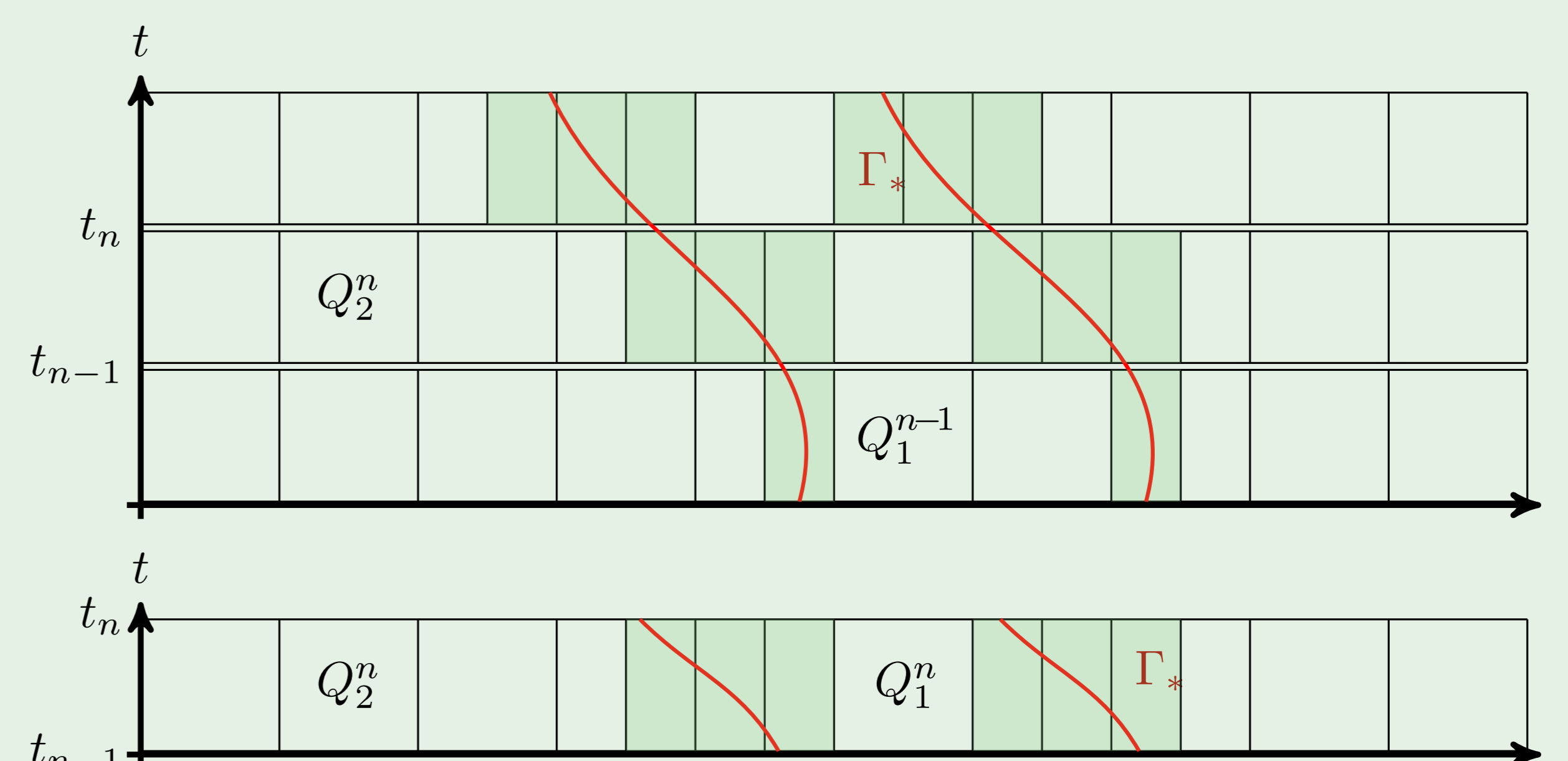
Block 3: Linear systems

- Dependency of condition of system matrix on interface
- Preconditioning strategies for robustness
- Advanced preconditioning strategies



Block 4: Space-Time XFEM

- Space-Time Finite Elements for problems without and with moving discontinuities
- Implementational aspects of space-time (extended) FEM
- Analysis of space-time (extended) FEM discretizations



Literature:

- *Numerical Methods for Two-phase Incompressible Flows*, Sven Gross, Arnold Reusken, Springer 2011
- *On a Space-Time Extended Finite Element Method for the Solution of a Class of Two-Phase Mass Transport Problems*, Christoph Lehrenfeld, PhD thesis, RWTH Aachen, 2015

Lecture notes will be created during the semester.