FAU Erlangen-Nürnberg
Department Mathematik
Lehrstuhl Angewandte Mathematik
- Modellierung und Numerik

Seminar *Selected topics of applied analysis* and Masterseminar MApA/NASi
Summer Semester 2025

Mathematical Modelling and Analysis of Multiscale Problems

Prof. Dr. Maria Neuss-Radu

Link to StudOn page: https://www.studon.fau.de/studon/go/crs/6309924

Preliminary discussion (Vorbesprechung): 24.04.2025, at 8:15 in Cauerstr. 11, Seminar room 04.363

Language: English

Prerequisites: Basic knowledge in Partial Differential Equations and Functional Analysis.

Target group: Students from M.Sc. Mathematics as well as students from M.Sc. Computational and Applied Mathematics (CAM) from the 2rd semester on.

Contents: In the seminar we discuss problems involving thin porous layers with a complex microstructure, also denoted as membranes, which separate bulk domains. These occur in many applications from engineering, material sciences, biology and medicine. Our aim is to start from models at the level of the microscopic scale (given by the pores inside the porous layer) and to derive so called *effective* models, at the level of the macroscopic scale (given by the dimension of the bulk domains). In the effective models the layer is replaced by an interface and *effective* interface laws have to be derived. We will use methods of multiscale analysis (e.g., two-scale convergence, unfolding method) in combination with dimension reduction techniques to derive such interface laws.

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Literature:

[1] G. Allaire: Homogenization and two-scale convergence, SIAM J. Math. Anal. 23:1482-1518, 1992.
[2] M. Gahn, M. Neuss-Radu: Effective interface laws for fluid flow and solute transport through thin reactive porous layers, Journal of Evolution Equations, 25:1–65, 2025.
[3] M. Neuss-Radu, W. Jäger: Effective transmission conditions for reaction-diffusion processes in domains separated by an interface, SIAM J. Math. Anal. 39:687–720, 2007.