



KARLSTAD APPLIED ANALYSIS SEMINAR (KAAS)

A day in Functional Analysis and Applications

Organizers: Sorina Barza, Adrian Muntean, Nicklas Jävergård

Date: 10 March, 2026

Place: Karlstad University, Room 21A345

Schedule

Time	Event
09:15–09:30	Opening
09:30–10:00	Anca-Nicoleta Marcoci, <i>New Pointwise Inequalities for Rough Singular Integral Operators and Applications to (Weighted) Sobolev-Type Estimates, part I</i>
10:00–10:30	Grigor Nika, <i>An Altman-Shinbrot approach of a multi-physics problem in magnetorheology</i>
10:35–11:05	Arghya Kundu <i>An optimal control problem for Stokes - Cahn-Hilliard-Oono equations</i>
11:05–12:15	Lunch!
12:15–12:45	Martin Lind, <i>On classical differentiability of functions of several variables</i>
12:45–13:15	Quoc Khanh Nguyen and Eddie Wadbro, <i>A priori error estimates of a fictitious domain formulation of the Newtonian cooling problem</i>
13:35–14:05	Mario Setta, <i>Simulation of effective scale-size dependent heat conduction in rigid microgeometries</i>
14:05–14:35	Liviu Marcoci <i>New Pointwise Inequalities for Rough Singular Integral Operators and Applications to (Weighted) Sobolev-Type Estimates, part II</i>

Anca-Nicoleta Marcoci:

New Pointwise Inequalities for Rough Singular Integral Operators and Applications to (Weighted) Sobolev-Type Estimates, part I

This joint lecture is divided into two parts and concerns new pointwise inequalities for the rough singular integral. In the first part, we present a generalization of the classical subrepresentation formula by replacing the function with a rough singular integral operator with a kernel satisfying a cancellation condition. The pointwise estimate involves the Hardy–Littlewood maximal function and homogeneous Morrey spaces. This framework leads to refined Sobolev-type inequalities and provides sharper control than previous results obtained under other assumptions on the kernel.

Grigor Nika:

An Altman-Shinbrot approach of a multi-physics problem in magnetorheology

Using Altman-Shinbrot fixed point theory, we prove the existence of a solution for a three-dimensional, time-stationary nonlinear problem describing a magneto-rheological suspension. The proof is based on an augmented variational formulation of Maxwell’s equations under the assumption of a small magnetic Reynolds number together with a Poincaré-type inequality for the relevant function space.

Arghya Kundu:

An optimal control problem for Stokes - Cahn-Hilliard-Oono equations

This abstract discusses an optimal control problem for a phase field model of two immiscible incompressible fluid flow, incorporating surface tension effects. The optimal control problem is defined with a 2-cost functional and subject to the constraints governed by a system of coupled Stokes-Cahn-Hilliard-Oono equations. In this model, fluids are separated by a dynamic diffuse interface of finite width. We investigate the optimality condition of a given control. Initially, we establish the existence and the uniqueness of the solution for the coupled system. Subsequently, we derive the optimality condition with respect to the corresponding adjoint system.

Quoc Khanh Nguyen and Eddie Wadbro:

A priori error estimates of a fictitious domain formulation of the Newtonian cooling problem

We present a theoretical analysis of a fictitious domain formulation of the Newtonian cooling problem, motivated by applications in topology optimization. The method reformulates the classical heat conduction model with Robin-type boundary conditions on a fixed computational domain using a so-called weak material approximation. In this setting, the conductivity equals one in the solid subdomain Ω_s and a small positive parameter ϵ in the surrounding fictitious region. We derive a priori error estimates that quantify the consistency error between the extended and original formulations and prove that the solution restricted to Ω_s converges to the true solution with an $\mathcal{O}(\epsilon)$ error in the $H^1(\Omega_s)$ norm. Thus, this work provides a theoretical foundation for utilizing weak material approximations for boundary-effect-dominated problems, thereby extending existing analyses to cases with Robin-type boundary conditions.

Mario Setta:

Simulation of effective scale-size dependent heat conduction in rigid microgeometries

We present homogenization and simulation results for an enhanced heat equation model that captures thermal scale-size effects through higher-gradient corrections involving characteristic internal lengths. The resulting equation is a fourth-order parabolic equation that incorporates thermal scale effects inherent to microstructure materials. We derive effective thermal coefficients for the time-stationary problem using asymptotic homogenization. This enables accurate simulation via a quadratic B-spline-based finite element approach. Our results quantify the influence of microstructure shape and volume fraction on the effective thermal behavior, demonstrating how scale-size-induced phenomena critically affect heat transport in micro- and nanoscale devices.

Liviu Marcoci:

New Pointwise Inequalities for Rough Singular Integral Operators and Applications to (Weighted) Sobolev-Type Estimates, part II

In this second part, we extend the presented in part I to a weighted setting. We prove a pointwise inequality for the maximal rough singular integral operator, involving weighted maximal functions and weighted Morrey spaces. Under suitable assumptions on Muckenhoupt weights satisfying a lower Ahlfors condition, we obtain a new class of weighted Sobolev-type inequalities and interpolation-type estimates.

Martin Lind:

On classical differentiability of functions of several variables

I will discuss some relations between the notions of classical and weak differentiability of functions of several variables.