Fudan – Vienna Strategic Partners Week 2021

Joint Workshop on Applied and Computational Mathematics

November 5, 2021 08.30-11.00 CET (Vienna) / 3.30pm-6.00pm CST (Shanghai)

Zoom Meeting Link: https://univienna.zoom.us/j/96913671307

Meeting ID: 969 1367 1307 | Passcode: 289203

Programme

08:30-09:05 (Vienna)/15:30-16:05 (Shanghai)

Peter Elbau (University of Vienna): Regularising with higher order dynamical systems

09:05-09:40 (Vienna)/16:05-16:40 (Shanghai)

Yingzhou Li (Fudan University): On the global convergence of coordinate gradient descent for non-convex optimization

09:40-09:50 (Vienna)/16:40-16:50 (Shanghai)

Coffee Break

09:50-10:25 (Vienna)/16:50-17:25 (Shanghai)

Axel Böhm (University of Vienna): The role of min-max problems in modern optimization

10:25-11:00 (Vienna)/17:25-18:00 (Shanghai)

Jian Zhai (Fudan University): Generic uniqueness of the mixed ray transform

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Abstracts and Short Bios

Talk 1:

Speaker: Peter Elbau (University of Vienna)

Title: Regularising with higher order dynamical systems

Abstract: When solving ill-posed problems (that is, equations where the solution does not depend continuously on the data), a classical way to deal with the error occurring by reconstructing the solution from inexact data is to replace the exact inversion operator by an appropriately chosen approximating continuous inverse.

One example of such a regularisation method is to consider a dynamical system whose stationary limit corresponds to the exact inverse (the gradient flow for the squared norm of the residuum, for example) and to pick a point reached after a certain finite time as the regularised solution.

Despite their oscillating behaviour, second order dynamical systems have been recently used for this construction. And in this talk, we want to study the convergence rates with which the regularised solutions of these methods converge to the exact solution when the error in the data tends to zero.

We will restrict the discussion to dynamical systems in which only the gradient of the squared norm of the residuum enters so that we can apply spectral theory to solve them, which will then allow us to characterise the convergence rates of the regularisation method uniquely by, for example, variational source conditions.

Short Bio: Peter Elbau is a senior scientist at the University of Vienna, where he got his habilitation in 2017 for his work on mathematical modelling of coupled physics imaging methods and analysing the corresponding inverse problems to extract the relevant physical imaging parameters, and his main research interests are still in the field of inverse problems for tomographic imaging methods.

Talk 2:

Speaker: Yingzhou Li (Fudan University)

Title: On the global convergence of coordinate gradient descent for non-convex optimization

Abstract: Coordinate descent methods are considered for eigenvalue problems based on a reformulation of the leading eigenvalue problem as a nonconvex optimization problem. The convergence of several deterministic coordinate methods is analysed and compared. We also analyse the global convergence property of coordinate gradient descent with random choice of coordinates and step sizes. Under generic assumptions, we prove that the algorithm iterate will almost surely escape strict saddle points of the objective function. As a result, the algorithm is guaranteed to converge to local minima if all saddle points are strict. Numerical examples of applications to quantum many-body problems demonstrate the efficiency and provide benchmarks of the proposed coordinate descent methods.

Short Bio: Dr. Yingzhou Li is an Assistant Professor at Fudan University. Li obtained his Ph.D. from Stanford University in 2017 and was a Phillip Griffiths Research Assistant Professor at Duke University

from 2017 to 2020. His research focuses on designing and analysing efficient algorithms to address problems from various fields, including differential and integral equations, computational chemistry, machine learning, and quantum computing.

Talk 3:

Speaker: Axel Böhm (University of Vienna)

Title: The role of min-max problems in modern optimization

Abstract: Min-max optimization, a.k.a. saddle point problem, have seen a recent surge in interest. While more classical application such as robust statistics have been around for decades, we will shine light on some of the more modern applications inspired by machine learning such as adversarial training and generative adversarial networks (GANs). Characterized by the presence of a second agent with conflicting objective, min-max problems can be interpreted as zero-sum games in the sense of game theory. Their dynamics can be quite different from the "pure minimization" counterpart and provide many interesting areas of research.

Short Bio: Axel Böhm is a Post-Doc at the University of Vienna in the group of Radu Bot, where he also obtained his PhD last year after spending extended research visits at the Universidad the Chile with Aris Daniilidis and the University of Wisconsin-Madison with Steve Wright. His research focuses on the analysis of numerical algorithms for optimization and min-max with applications in inverse problems and machine learning.

Talk 4:

Speaker: Jian Zhai (Fudan University)

Title: Generic uniqueness of the mixed ray transform

Abstract: We consider the mixed ray transform of tensor fields on a three-dimensional compact simple Riemannian manifold with boundary. We prove the injectivity of the transform, up to natural obstructions, on generic three dimensional simple manifolds. The problem arises naturally from elastic inverse problems.

Short Bio: Dr. Jian Zhai is an Assistant Professor at Fudan University. Zhai received his PhD in Computational and Applied Mathematics from Rice University in 2018 under the supervision of Maarten V. de Hoop. Before joining Fudan, he was a Postdoc Fellow at the Hong Kong University of Science and Technology working with Gunther Uhlmann. He also was a Visiting Lecturer at the University of Washington. His research focuses on the inverse problems for partial differential equations, especially related with wave phenomenon.