The 6th CAS SIAM Student Chapter Annual Meeting

June 24th, 2018, Beijing

The 6th CAS SIAM Student Chapter Annual Meeting will take place on Sunday, 24th June 2018 at Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, China.

The purpose of the meeting is to bring graduate students, young researchers and faculty together to share their works, exchange ideas and promote potential cooperation in computational mathematics, applied mathematics and their application in industry and real problems.

Committee

Faculty Advisor

Ya-xiang Yuan (Chinese Academy of Sciences, China)

Officers

Xiaoyu Wang (Chinese Academy of Sciences, China)
Peng Wei (Chinese Academy of Sciences, China)
Meng Shi(Chinese Academy of Sciences, China)
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Sponsor

Society for Industrial and Applied Mathematics (SIAM)
Institute of Computational Mathematics and
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Schedule

会场: 中国科学院数学与系统科学研究院南楼 N204

Time	Speaker	Title
08:00-08:10	**Registration**	
08:10-08:40	**Opening Ceremony & Conference Photography**	
08:40-09:30	**Plenary Talk:** **张世华**	Matrix Factorization for Data Integration in Bioinformatics
09:30-10:20	**Plenary Talk:** **崔涛**	PHG: A Framework for Parallel Adaptive Finite Element Method and Its Applications
10:20-10:35	Coffee Break	
10:35-11:25	**Plenary Talk:** **陈鸽**	A Novel Method of “Transforming Randomness into Control”
11:25-12:15	**Plenary Talk:** **孙聪**	New Stepsizes for the Gradient Method
12:15-13:30	**Lunch:** 中国科学院基础科学园区餐厅	
13:30-14:20	**Plenary Talk:** **熊世峰**	Function Estimation via Reconstruction
14:20-15:10	**Plenary Talk:** **丁超**	Matrix Optimization: Recent Progress on Algorithm Foundation
15:10-15:45	**李凌霄**	Finite Element Methods for 3D Incompressible Magnetohydrodynamics Using Vector-potential
15:45-15:50	**Closing Ceremony**	
15:50-16:10	Coffee Break	
16:10-17:00	**Election Meeting**	

Abstract

Matrix Factorization for Data Integration in Bioinformatics

张世华
中国科学院数学与系统科学研究院应用数学研究所

Abstract: Matrix factorization is a powerful technique for dimension reduction and pattern recognition. In this talk, I will first describe some joint NMF models and new algorithmic exploration for data integration in bioinformatics. Next, I will present a flexible NMF framework CSMF to combine data dimension reduction and differential analysis into one paradigm to simultaneously reveal common and specific patterns from data generated under interrelated biological scenarios. Moreover, I will introduce a Bayesian Joint Matrix Decomposition (BJMD) framework for data integration with heterogeneous noise, and describe two efficient optimization algorithms for solving it. Applications of these methods and extensive analysis in bioinformatics yield novel insights into hidden combinatorial patterns embedded in interrelated multi-modal data.

PHG: A Framework for Parallel Adaptive Finite Element Method and Its Applications

崔涛
中国科学院数学与系统科学研究院计算数学研究所

Abstract: PHG (Parallel Hierarchical Grid) is a general framework for developing parallel adaptive finite element method applications, which is currently under active development at State Key Laboratory of Scientific and Engineering Computing of Chinese Academy of Sciences. The key feature of PHG includes: bisection based conforming adaptive tetrahedral meshes, various finite element bases support and hp adaptivity, finite element code automatic generation, etc. PHG has an object oriented design which hides parallelization details and provides common operations on meshes and finite element functions in an abstract way, allowing the users to concentrate on their numerical algorithms. In this lecture, the main algorithms in PHG and the simulation of parastic extraction problems and 3D seismic waves using PHG will be introduced. We will propose new algorithm for these two applications and their implementation on today's heterogeneous computer like Tianhe-2A and Sunway Tiahu Light. Numerical experiments show that the algorithms and implementation are efficient and scalable.

A Novel Method of “Transforming Randomness into Control”

陈鸽
中国科学院数学与系统科学研究院系统科学研究所

Abstract: A complex system is composed by many nonlinear equations mutually coupled and has multiple equilibrium points. At present, to mathematically analyze the properties like the convergence of complex systems, the most common method is to construct a Lyapunov function. However, the construction of the Lyapunov function has no general method and is usually very difficult. In order to break through this limitation, we propose a novel method of "transforming randomness into control". Using this method we analyze the original Vicsek model, the heterogeneous opinion dynamics, and a multiplayer repeated game model for the first time.

New Stepsizes for the Gradient Method

孙聪
北京邮电大学理学院

Abstract: It is popular to solve large scale problems by gradient methods. Based on the idea of coordination transformation, we proposed a new stepsize update strategy for the gradient method, which is the extension of Yuan's stepsize from 2-dimension to 3-dimension. For 3-dimensional convex quadratic function minimization problems, it guarantees to find the optimal solution in 5 iterations. We also modified the strategy to improve the performance. We proved that, for 3-dimensional convex quadratic function minimization problems, the new modified gradient method terminates in finite iterations; for general dimensional problems, it converges R-linearly. Numerical tests show the superior performance of the proposed method over the states of the art.

Function Estimation via Reconstruction

熊世峰
中国科学院数学与系统科学研究院系统科学研究所

Abstract: Function estimation is one of core issues in statistics and machine learning, while interpolation is an important technique for function approximation in applied/computational mathematics. This paper introduces an interpolation-based method, called the reconstruction approach, for function estimation with noisy data. Based on the fact that interpolation usually has negligible errors compared to statistical estimation, the reconstruction approach uses an interpolator to parameterize the unknown function with its values at finite knots, and then estimates these values by minimizing a regularized empirical risk function. Some popular methods including

kernel ridge regression and kernel support vector machines can be viewed as its special cases. It is shown that, the reconstruction idea not only provides different angles to look into existing methods, but also produces new effective methods for nonparametric regression and classification.

Matrix Optimization: Recent Progress on Algorithm Foundation

丁超
中国科学院数学与系统科学研究院应用数学研究所

Abstract: Matrix optimization problems (MOPs) have been recognized in recent years to be a powerful tool by researchers beyond the optimization community to model many important applications arising from data science. In this talk, I will present some recent progress on algorithm foundation of solving MOPs.

Finite Element Method for 3D Incompressible Magnetohydrodynamics Using Vector-potential

李凌霄
中国科学院数学与系统科学研究院计算数学研究所

Abstract: The magnetohydrodynamics (MHD) model has important applications in engineering field, such as liquid metal blankets in thermal fusion reactor devices, simulation of natural convection in the earth's core, aluminum electrolysis and MHD generator. This report gives some finite element models for incompressible MHD equations based on magnetic vector-potential in 3D. The main advantage of the vector-potential formulation lies in that the Gauss's law for magnetic induction can be satisfied precisely in the discrete level. Some theoretical analyses and numerical experiments are also presented to illustrate the effectiveness of the methods.