Int. Workshop on Numerical Analysis with Applications in Medium Imaging and Computer Visions

December 10-14, 2018

Nanjing, P.R.China

Shing-Tung Yau Center of Southeast University

School of Mathematics, Southeast University

Program and Abstracts

Int. Workshop on Numerical Analysis with Applications in Medium Imaging and Computer Visions 2018

Nanjing, P.R.China
December 10-14, 2018

Scientific Committee：

Raymond Chan, *The Chinese University of Hong Kong*
Xianfeng Gu, *The State University of New York at Stony Brook*
Shi-Min Hu, *Tsinghua University*
Ren-Cang Li, *University of Texas at Arlington*
Wen-Wei Lin, *National Chiao Tung University*
Jijun Liu, *Southeast University*
Zuoqiang Shi, *Tsinghua University*
Shing-Tung Yau, *Harvard University*

Local Organizing Committee：

Jinde Cao, *Southeast University*
Tiexiang Li, *Southeast University*
Jijun Liu, *Southeast University*
Yue Lu, *Southeast University*
Qiao Wang, *Southeast University*
Yinghong Wu, *Southeast University*

Organized by：

Shing-Tung Yau Center of Southeast University
School of Mathematics, Southeast University

Address: No.2, Sipailou, Nanjing, China, 210096
Conference Website: http://sign.digitcampus.cn/index.htm

Sponsored by：

东南大学丘成桐中心
Shing-Tung Yau Center of Southeast University

東南大學 数学学院
School of mathematics, SEU

General Information

Registration

There will be a registration desk on Monday (December 10) from 09:00-20:30 in the ground floor of the Lakeview Xuanwu Hotel.

Sessions location

The conference will be held on
Ball Room (third floor) for opening ceremony and plenary talks,
Jinxiu Room (second floor) for M1(Medium Imaging and Image Processing),
Jinjiang Room (ground floor) for M2(Matrix Computations and Optimization),
Juxing Room (second floor) for M3(Computer Vision with Applications).

Wireless network

The hotel has a free wireless network, the account password is as follows:
Wifi: XuanWu Hotel
User: 83358888
Password: 147258

Tea breaks and lunches

Tea breaks will be served outside each conference room, and lunches will be served at the Le Papillion. Please take your meal tickets for lunches.

Buffet dinners

Buffet dinners will be served at Lake-view Revolving Restaurant from 10-13, December. Please take your daily buffet dinner ticket with you.

Conference banquet

The conference banquet will be on Tuesday, December 11 at 18:30 at Ball Room. Please take your conference banquet ticket.

Int. Workshop on Numerical Analysis with Applications in Medium Imaging and Computer Visions 2018

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1 Venue information, map and general schedule

Venue information

With the promotions of efficient computations for novel mathematical models from engineering areas, the interactions between applied math and computational math develop very quickly. This international workshop aims to provide a forum for Chinese mathematicians over the world working on numerical algebra, medium imaging and computer vision with applications. This workshop is the 7th meeting of the ICCM (International Congress of Chinese Mathematician) Consortium on CAM (Computational and Applied Mathematics). The consortium has the mission of enhancing collaboration among Chinese mathematicians working on CAM and enhancing their collaboration with international experts.

Registration: 09:00-20:30, December 10, 2018, Lakeview Xuanwu Hotel
Accommodation: Lakeview Xuanwu Hotel, No.193, Central Road,
Gulou District, Nanjing
Conference Venue: Ball Room, Lakeview Xuanwu Hotel
Organizers: Tiexiang Li, Wen-Wei Lin, Jijun Liu, Shing-Tung Yau
Sponsors: Shing-Tung Yau Center of Southeast University
School of Mathematics, Southeast University

Map to Lakeview Xuanwu Hotel

Taxi：

1. **Nanjing Lukou Airport to Lakeview Xuanwu Hotel:** the taxi fare is about 110 yuan.
2. **Nanjing Railway Station to Lakeview Xuanwu Hotel:** the taxi fare is about 10 yuan.
3. **Nanjing South Railway Station to Lakeview Xuanwu Hotel:** the taxi fare is about 35 yuan.

Public transportation:

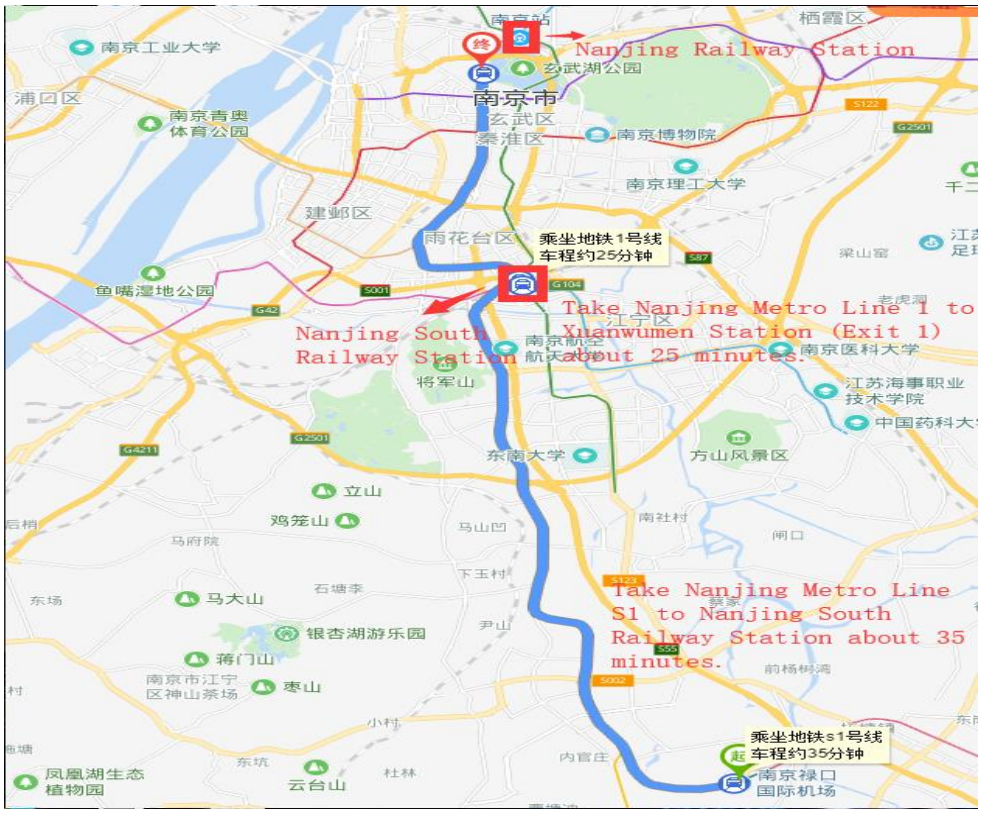
1. **Nanjing Lukou Airport → Lakeview Xuanwu Hotel**

Take Nanjing Metro Line S1 and transfer at Nanjing South Railway Station to Metro Line 1. Then take Metro Line 1 to Xuanwumen Station (Exit 1).

2. **Nanjing Railway Station → Lakeview Xuanwu Hotel**

Take Nanjing Metro Line 1 to Xuanwumen Station (Exit 1).

Then you can see the hotel when you come out the Xuanwumen Station.



General schedule

<table>
<tr><td></td><td>10,Dec.</td><td colspan="2">11,Dec.</td><td>12,Dec.</td><td>13,Dec.</td><td>14,Dec.</td></tr>
<tr><td rowspan="3">09:00-12:00</td><td rowspan="20">Registration（Lobby of the hotel)</td><td colspan="2">Opening Ceremony
09:00-09:30</td><td rowspan="3">Chair: Xianfeng Gu
PS3: Jin Cheng
09:00-09:50
PS4: Wenping Wang
10:00-10:50</td><td rowspan="3">Chair: Ren-Cang Li
PS6: Jianlin Xia
09:00-09:50
PS7: Zhaojun Bai
10:00-10:50</td><td rowspan="3">Chair: Jijun Liu
PS8: Qiang Du
09:00-09:50
PS9: Xiaolin Li
10:00-10:50</td></tr>
<tr><td colspan="2">Taking Photograph
09:30-09:50</td></tr>
<tr><td colspan="2" rowspan="2">Chair: Wen-Wei Lin
PS1: Shing-Tung Yau
10:00-10:50
PS2: Michael Kwok-Po Ng
11:00-11:50</td></tr>
<tr><td>Tea Break
10:50-11:10</td><td>Tea Break
10:50-11:10</td><td rowspan="2">Closing Ceremony
10:50-11:00</td></tr>
<tr><td>12:00-14:00</td><td colspan="5">Lunch</td></tr>
<tr><td rowspan="5">14:00-15:45</td><td rowspan="5">MS1</td><td>Chair: Zhiyuan Li</td><td>Chair: Xiaoping Yang</td><td>Chair: Xiaoqun Zhang</td><td rowspan="20"></td></tr>
<tr><td>Zhihui Wei</td><td>Haixia Liang</td><td>Shuai Lu</td></tr>
<tr><td>Youwei Wen</td><td>Youjun Deng</td><td>Shixiang Chen</td></tr>
<tr><td>Ganghua Yuan</td><td>Min Tao</td><td>Daijun Jiang</td></tr>
<tr><td rowspan="5">MS2</td><td>Chair: Weiguo Gao</td><td>Chair: Leihong Zhang</td><td>Chair: Yimin Wei</td></tr>
<tr><td>Ninoslav Truhar</td><td>Eric King-wah Chu</td><td>Wen Li</td></tr>
<tr><td>Musheng Wei</td><td>Xin Liang</td><td>Jungong Xue</td></tr>
<tr><td>Yangfeng Su</td><td>Yuji Nakatsukasa</td><td>Yifei Lou</td></tr>
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<tr><td>Na Lei</td><td>Ying He</td><td>Shihong Xia</td></tr>
<tr><td>Lin Gao</td><td>Jianmin Zheng</td><td>Yong-Jin Liu</td></tr>
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<tr><td>Zhiyuan Li</td><td>Xiaoping Yang</td><td>Jingzhi Li</td></tr>
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<tr><td>Deyu Meng</td><td></td><td>Haizhao Yang</td></tr>
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<tr><td>21:00-22:00</td><td></td><td colspan="2">Chinese Applied Mathematicians Board Meeting</td><td></td><td></td></tr>
</table>

2 Invited talks

Plenary talks

Plenary talks are arranged at Ball Room, Lakeview Xuanwu Hotel.

Tuesday, December 11

Chair: Wen-Wei Lin
Tuesday, December 11, 10:00-11:50

Computational quasi-conformal geometry with applications
Shing-Tung Yau, *Harvard University*
Tuesday, December 11, 10:00-10:50

Robust tensor completion and its applications
Michael Kwok-Po Ng, *The Hong Kong Baptist University*
Tuesday, December 11, 11:00-11:50

Wednesday, December 12

Chair: Xianfeng Gu
Wednesday, December 12, 09:00-10:50

Quantitative estimate for the solutions of Helmholtz equations on the analytic surface
Jin Cheng, *Fudan University*
Wednesday, December 12, 09:00-09:50

AI-enabled digital orthodontics
Wenping Wang, *Hong Kong University*
Wednesday, December 12, 10:00-10:50

Chair: Zuoqiang Shi
Wednesday, December 12, 11:10-12:00

Computing and regularizing medial axes in 3D
Tao Ju, *Washington Univ. St. Louis*
Wednesday, December 12, 11:10-12:00

Plenary talks are arranged at Ball Room, Lakeview Xuanwu Hotel.

Thursday, December 13

Chair: Ren-Cang Li
Thursday, December 13, 09:00-10:50

Fast Hermitian eigenvalue decompositions and applications
Jianlin Xia, *Purdue University*
Thursday, December 13, 09:00-09:50

Nonlinear eigenvalue problems: recent advances and challenges
Zhaojun Bai, *University of California, Davis*
Thursday, December 13, 10:00-10:50

Friday, December 14

Chair: Jijun Liu
Friday, December 14, 09:00-10:50

Nonlocal models and their applications
Qiang Du, *Columbia University*
Friday, December 14, 09:00-09:50

Front tracking method at its best--applications in fluid structure interactions
Xiaolin Li, *Stony Brook University*
Friday, December 14, 10:00-10:50

Minisymposium talks

Minisymposium 1（Medium Imaging and Image Processing）

Talks are arranged at Jinxiu Room, Lakeview Xuanwu Hotel.

Tuesday, December 11

Chair: Zhiyuan Li
Tuesday, December 11, 14:00-15:45

Tensor based hyperspectral image fusion and compressed sensing
Zhihui Wei, *Nanjing University of Science and Technology*
Tuesday, December 11, 14:00-14:35

Using generalized cross validation to select regularization parameter for total variation regularization problems
Youwei Wen, *Hunan Normal University*
Tuesday, December 11, 14:35-15:10

Inverse problems for some stochastic PDEs
Ganghua Yuan, *Northeast Normal University*
Tuesday, December 11, 15:10-15:45

Chair: Zhihui Wei
Tuesday, December 11, 16:15-18:00

Inversion for orders of fractional derivatives of diffusion equation
Zhiyuan Li, *Shandong University of Technology*
Tuesday, December 11, 16:15-16:50

Scattering transform and sparse Linear classifiers for art authentication
Haixia Liu, *Huazhong University of Science and Technology*
Tuesday, December 11, 16:50-17:25

Bioluminescence tomography: models and reconstruction
Rongfang Gong, *Nanjing University of Aeronautics and Astronautics*
Tuesday, December 11, 17:25-18:00

Minisymposium 1（Medium Imaging and Image Processing）

Talks are arranged at Jinxiu Room, Lakeview Xuanwu Hotel.

Wednesday, December 12

Chair: Xiaoping Yang
Wednesday, December 12, 14:00-15:45

Truncated fractional-order total variation model for image restoration
Haixia Liang, *Xian Jiaotung Liverpool University*
Wednesday, December 12, 14:00-14:35

Generalized polarization tensors for inhomogeneous medium and cloaking
Youjun Deng, *Central South University*
Wednesday, December 12, 14:35-15:10

On Glowinski's open question on the alternating direction method of multipliers
Min Tao, *Nanjing University*
Wednesday, December 12, 15:10-15:45

Chair: Min Tao
Wednesday, December 12, 16:15-18:00

Region inhomogeneity active contours
Xiaoping Yang, *Nanjing University*
Wednesday, December 12, 16:15-16:50

Image recovery: from classical approach to deep learning
Tieyong Zeng, *Chinese University of Hong Kong*
Wednesday, December 12, 16:50-17:25

On nonconvex regularized models for image restoration problems
Chunlin Wu, *Nankai University*
Wednesday, December 12, 17:25-18:00

Minisymposium 1（Medium Imaging and Image Processing）

Talks are arranged at Jinxiu Room, Lakeview Xuanwu Hotel.

Thursday, December 13

Chair: Xiaoqun Zhang
Thursday, December 13, 14:00-15:45

Increasing stability in the inverse source problem with attenuation and many frequencies
Shuai Lu, *Fudan University*
Thursday, December 13, 14:00-14:35

Proximal gradient method for manifold optimization
Shixiang Chen, *The Chinese University of Hong Kong*
Thursday, December 13, 14:35-15:10

Convergence analysis of LMM and DDMs for a parabolic inverse Robin problem
Daijun Jiang, *Central China Normal University*
Thursday, December 13, 15:10-15:45

Chair: Shixiang Chen
Thursday, December 13, 16:15-18:00

Shape derivatives -new perspective and applications to scattering
Jingzhi Li, *Southern University of Science and Technology*
Thursday, December 13, 16:15-16:50

Bi-modality joint reconstruction via variational models
Xiaoqun Zhang, *Shanghai Jiao Tong University*
Thursday, December 13, 16:50-17:25

The Inverse problem approach for X-ray radiograph tomography
Suhua Wei, *Institute of Applied Physics and Computational Mathematics, CAS*
Thursday, December 13, 17:25-18:00

Minisymposium talks

Minisymposium 2（Matrix Computations and Optimization）

Talks are arranged at Jinjiang Room, Lakeview Xuanwu Hotel.

Tuesday, December 11

Chair: Weiguo Gao
Tuesday, December 11, 14:00-15:45

Qn eigenvector-dependent nonlinear eigenvalue problem from perspective of relative perturbation theory
Ninoslav Truhar, *University of Osijek*
Tuesday, December 11, 14:00-14:35

Quaternion matrix computations
Musheng Wei, *Shanghai Normal University*
Tuesday, December 11, 14:35-15:10

Number of 2D eigenvalues
Yangfeng Su, *Fudan University*
Tuesday, December 11, 15:10-15:45

Chair: Musheng Wei
Tuesday, December 11, 16:15-18:00

Jacobi-like algorithm for Bethe-Salpeter eigenvalue problem
Weiguo Gao, *Fudan University*
Tuesday, December 11, 16:15-16:50

The ascend algorithm for solving generalized symmetric eigenvalue complementarity problem
Yuan Lei, *Hunan University*
Tuesday, December 11, 16:50-17:25

Nonlinear eigenvalue problem in domain adaptation
Limin Li, *Xi'an Jiaotong University*
Tuesday, December 11, 17:25-18:00

Minisymposium 2（Matrix Computations and Optimization）

Talks are arranged at Jinjiang Room, Lakeview Xuanwu Hotel.

Wednesday, December 12

Chair: Leihong Zhang

Wednesday, December 12, 14:00-15:45

Inheritance properties of Krylov subspace methods for algebraic Riccati equations

Eric King-Wah Chu, *Monash University*

Wednesday, December 12, 14:00-14:35

Nearly optimal stochastic approximation for online principal subspace estimation

Xin Liang, *Tsinghua University*

Wednesday, December 12, 14:35-15:10

Inertia laws and localization of real eigenvalues for generalized indefinite eigenvalue problems

Yuji Nakatsukasa, *University of Oxford*

Wednesday, December 12, 15:10-15:45

Chair: Eric King-Wah Chu

Wednesday, December 12, 16:15-18:00

Probabilistic dimensionality reduction via structure learning

Li Wang, *University of Texas at Arlington*

Wednesday, December 12, 16:15-16:50

The generalized Lanczos trust-region method

Leihong Zhang, *Shanghai University of Finance and Economics*

Wednesday, December 12, 16:50-17:25

PSBCM-ALH algorithm for large-scale SVM

Bo Yu, *Dalian University of Technology*

Wednesday, December 12, 17:25-18:00

Minisymposium 2（Matrix Computations and Optimization）

Talks are arranged at Jinjiang Room, Lakeview Xuanwu Hotel.

Thursday, December 13

Chair: Yimin Wei

Thursday, December 13, 14:00-15:45

The uniqueness of multilinear PageRank vectors

Wen Li, *South China Normal University*

Thursday, December 13, 14:00-14:35

Computing exponentials of essentially nonnegative matrices entrywise to high relative accuracy

Jungong Xue, *Fudan University*

Thursday, December 13, 14:35-15:10

Nonconvex approaches in data science

Yifei Lou, *University of Texas Dallas*

Thursday, December 13, 15:10-15:45

Chair: Yifei Lou

Thursday, December 13, 16:15-18:00

Randomized algorithms for large-scale total least squares problems

Yimin Wei, *Fudan University*

Thursday, December 13, 16:15-16:50

Structured condition numbers for the Tikhonov regularization of discrete ill-posed problems

Bing Zheng, *Lanzhou University*

Thursday, December 13, 16:50-17:25

Doubling algorithm for the discretized Bethe-Salpeter eigenvalue problem

Zhenchen Guo, *Nanjing University*

Thursday, December 13, 17:25-18:00

Minisymposium talks

Minisymposium 3（Computer Vision with Applications）

Talks are arranged at Juxing Room, Lakeview Xuanwu Hotel.

Tuesday, December 11

Chair: Ke Chen
Tuesday, December 11, 14:00-15:45

Image Illumination editing and processing
Chun-Xia Xiao, *Wuhan University*
Tuesday, December 11, 14:00-14:35

Feature preserving hexahedral meshing
Na Lei, *Dalian University of Technology*
Tuesday, December 11, 14:35-15:10

Automatic unpaired shape deformation transfer
Lin Gao, *Institute of Computing Technology, Chinese Academy of Sciences*
Tuesday, December 11, 15:10-15:45

Chair: Na Lei
Tuesday, December 11, 16:15-18:00

Learning on hypergraph: method and applications
Yue Gao, *Tsinghua University*
Tuesday, December 11, 16:15-16:50

On some more robust image selective segmentation models
Ke Chen, *University of Liverpool, United Kingdom*
Tuesday, December 11, 16:50-17:25

Signal recovery through noise/loss modeling
Deyu Meng, *Xi'an Jiaotong University*
Tuesday, December 11, 17:25-18:00

Minisymposium 3（Computer Vision with Applications）

Talks are arranged at Juxing Room, Lakeview Xuanwu Hotel.

Wednesday, December 12

Chair: Yue Gao
Wednesday, December 12, 14:00-15:45

Intelligent processing and display of future 3D video
Shaoping Lu, *Nankai University*
Wednesday, December 12, 14:00-14:35

Fast construction of discrete geodesic graph
Ying He, *Nanyang Technological University*
Wednesday, December 12, 14:35-15:10

Estimating geometry and illumination from multi-view images
Jianmin Zheng, *Nanyang Technological University*
Wednesday, December 12, 15:10-15:45

Chair: Ming Yan
Wednesday, December 12, 16:15-18:00

TBA
Laurent Younes, *The Johns Hopkins University*
Wednesday, December 12, 16:15-16:50

TBA
Giuseppe Patane, *The Johns Hopkins University*
Wednesday, December 12, 16:50-17:25

Signal and image recovery from saturated measurements
Ming Yan, *Michigan State University*
Wednesday, December 12, 17:25-18:00

Minisymposium 3（Computer Vision with Applications）

Talks are arranged at Juxing Room, Lakeview Xuanwu Hotel.

Thursday, December 13

Chair: Hang Si

Thursday, December 13, 14:00-15:45

Data-driven sketch interpretation

Hongbo Fu, *City University of Hong Kong*

Thursday, December 13, 14:00-14:35

Reconstruction of 3D human body pose

Shihong Xia, *Institute of Computing Technology, Chinese Academy of Sciences*

Thursday, December 13, 14:35-15:10

Geodesic voronoi diagrams and intrinsic delaunay triangulation

Yong-Jin Liu, *Tsinghua University*

Thursday, December 13, 15:10-15:45

Chair: Shihong Xia

Thursday, December 13, 16:15-18:00

Data-driven indoor scene 3D modeling and simulation

Yanwen Guo, *Nanjing University*

Thursday, December 13, 16:15-16:50

Advances in unstructured mesh generation and adaptation

Hang Si, *Weierstrass Institute for Applied Analysis and Stochastics*

Thursday, December 13, 16:50-17:25

Atomic scale crystal analysis: methodology and discovery

Haizhao Yang, *National University of Singapore*

Thursday, December 13, 17:25-18:00

3 Abstract of talks

Plenary talks

Tuesday, December 11

Computational quasi-conformal geometry with applications

SPEAKER:	Shing-Tung Yau, *Harvard University*
SCHEDULED:	Tuesday, December 11, 10:00-10:50
DETAILS:	Plenary talk
ABSTRACT:	

Robust tensor completion and its applications

SPEAKER:	Michael Kwok-Po Ng, *The Hong Kong Baptist University*
SCHEDULED:	Tuesday, December 11, 11:00-11:50
DETAILS:	Plenary talk
ABSTRACT:	In this talk, we report the results of robust tensor completion using tubal singular value decomposition, and its applications. Several applications and theoretical results are discussed. Numerical examples are also presented for demonstration.

Quantitative estimate for the solutions of Helmholtz equations on the analytic surface

SPEAKER:	Jin Cheng, *Fudan University*
SCHEDULED:	Wednesday, December 12, 09:00-09:50
DETAILS:	Plenary talk
ABSTRACT:	Unique continuation means that the solution of the partial differential equations on the small domain can determine the solution on the large connected domain. It is one of the fundamental properties in the theory of partial differential equations. In study of the inverse problems for partial differential equations, unique continuation plays a key role. In this talk, we will present our recent results on the quality estimation for the solution of Helmholtz equation on the analytic surface. The conditional stability estimates are proved based on the analyticity of the Green functions. These kind conditional stability estimates indicate the convergence rate of the regularized solutions in the numerical algorithms. This is the joint work with Yu CHEN(Fudan), Faouzi Triki(Grenoble, Frnace)

AI-enabled digital orthodontics

SPEAKER:	Wenping Wang, *Hong Kong University*
SCHEDULED:	Wednesday, December 12, 10:00-10:50
DETAILS:	Plenary talk
ABSTRACT:	With the elevated awareness of dental health and improved standard of living, there is an increasing need for orthodontic treatment. Indeed, misaligned teeth (e.g. overjet and crowding) are a prevalent health issue, since they compromise masticatory function (i.e. chewing) and cause aesthetic concerns. However, traditional orthodontic treatment is costly, inefficient and of varied quality because the treatment process entails tedious manual operation and the treatment outcome heavily depends on the skills of individual orthodontists. All this calls for advances in digital orthodontics to make orthodontic treatment more efficient, more affordable and more accessible. Several imaging and computational technologies are already applied in digital orthodontics, ranging from image acquisition, tooth segmentation, visualization, CAD/CAM and 3D fabrication of customized appliances. In this talk I will focus on how AI can be applied to facilitate various tasks in orthodontics. Specifically, several novel machine learning methods will be presented for solving the following key problems: (1) detection of cephalometric landmark for diagnosis; (2) segmentation of teeth in 2D intra-oral scans and 3D cone-beam CT images; 3) determination of the optimal tooth setup to define the treatment goal for a patient; and (4) generation of tooth motion from the initial pre-treatment arrangement to the target setup for treatment simulation.

Computing and regularizing medial axes in 3D

SPEAKER:	Tao Ju, *Washington Univ. St. Louis*
SCHEDULED:	Wednesday, December 12, 11:10-12:00
DETAILS:	Plenary talk
ABSTRACT:	Medial axis is a classical concept in computational geometry and has been the basis of most of today's skeletal shape descriptors. In this talk, I will present our recent work in tackling two roadblocks in using medial axes for 3D shape analysis: the difficulty in approximating the medial axes of general 3D shapes, and the sensitivity of the medial axes to noise. First, I will describe a novel sampling-based approximation algorithm for 3D medial axes that is theoretically sound, numerically robust, and simple to implement. Second, I will present a novel significance measure over the 3D medial axes that can effectively highlight parts of the medial axis that lie in prominent plate-like and tube-like shape parts. This measure is then used to guide the production of a family of skeletons that are descriptive and robust to noise. Finally, I will briefly discuss some applications of skeletons in biomedicine.

Thursday, December 13

Fast Hermitian eigenvalue decompositions and applications

SPEAKER:	Jianlin Xia, *Purdue University*
SCHEDULED:	Thursday, December 13, 09:00-09:50
DETAILS:	Plenary talk
ABSTRACT:	We show how to quickly and accurately compute the eigenvalue decompositions for a class of Hermitian matrices which include banded matrices, Toeplitz matrices, discretized matrices, many sparse matrices, etc. The eigendecomposition is computed in a divide-and-conquer procedure accelerated by a sequence of fast structured algorithms. The intermediate computations are assembled into dense structured matrix-vector multiplications that can be performed quickly. For some cases, it only takes nearly $O(n)$ complexity to compute all the eigenvalues and all the eigenvectors, where n is the matrix size. We prove the existence of eigenvector matrices that have various types of structures. We also show how to control the accuracy. The fast eigenvalue decomposition method can be used to accelerate many other important computations, especially the solution of some challenging PDEs. This is joint work with James Vogel.

Nonlinear eigenvalue problems: recent advances and challenges

SPEAKER:	Zhaojun Bai, *University of California, Davis*
SCHEDULED:	Thursday, December 13, 10:00-10:50
DETAILS:	Plenary talk
ABSTRACT:	Nonlinear eigenvalue problems (NEPs) arise in electronic structure calculations and robust data clustering among many others. The NEPs pose intriguing challenges in analysis and computation and are a much less explored topic compared to linear eigenvalue problems. From a linear algebra point of view, I will start this talk with some recent advances in analysis and computation of NEPs and applications. Then I will discuss a number of challenges and open problems.

Friday, December 14

Nonlocal models and their applications

SPEAKER:	Qiang Du, *Columbia University*
SCHEDULED:	Friday, December 14, 09:00-09:50
DETAILS:	Plenary talk
ABSTRACT:	As the world gets increasingly connected, nonlocal interactions and nonlocal modeling start to receive more attention. This lecture presents first an overview of nonlocal models, their mathematics, computation, and application. We sample our recent attempts in the development of a systematic mathematical framework for nonlocal models. Various applications are considered including mechanics, diffusion and deep learning. We also draw connections with traditional local continuum models, discrete and fractional models and other relevant mathematical subjects.

Front tracking method at its best--applications in fluid structure interactions

SPEAKER:	Xiaolin Li, *Stony Brook University*
SCHEDULED:	Friday, December 14, 10:00-10:50
DETAILS:	Plenary talk
ABSTRACT:	Front tracking is a Lagrangian interface tracking method, it is more challenging than the Eulerian level set method. But there are problems that this method is uniquely superior to the Eulerian method. In this talk, we will introduce a mesoscale dual-stress spring-mass model based on the Rayleigh-Ritz analysis to mimic the fabric surface as an elastic membrane in numerical computation. This model is coupled with the incompressible or compressible fluid solver through the impulse method. We will discuss how to build such system on the front tracking computational platform using its data structure and functionalities, and apply this platform to the simulations of parachute deceleration devices and the airbag system. In addition, we discuss the renovation of the front tracking method to enhance its robustness, conservativeness, and the order of accuracy in computing geometric variables and handling of topological bifurcations. We will discuss these new algorithms in other applications including fluid interface instabilities and phase transition problems.

Minisymposium talks

Minisymposium 1（Medium Imaging and Image Processing）

Talks are arranged at Jinxiu Room, Lakeview Xuanwu Hotel.

Tuesday, December 11

Tensor based hyperspectral image fusion and compressed sensing

SPEAKER:	Zhihui Wei, *Nanjing University of Science and Technology*
SCHEDULED:	Tuesday, December 11, 14:00-14:35
DETAILS:	Minisymposium talk 1
ABSTRACT:	

Using generalized cross validation to select regularization parameter for total variation regularization problems

SPEAKER:	Youwei Wen, *Hunan Normal University*
SCHEDULED:	Tuesday, December 11, 14:35-15:10
DETAILS:	Minisymposium talk 1
ABSTRACT:	The regularization approach is used widely in image restoration problems. The visual quality of the restored image depends highly on the regularization parameter. In this paper, we develop an automatic way to choose a good regularization parameter for total variation (TV) image restoration problems. It is based on the generalized cross validation (GCV) approach and hence no knowledge of noise variance is required. Due to the lack of the closed-form solution of the TV regularization problem, difficulty arises in finding the minimizer of the GCV function directly. We reformulate the TV regularization problem as a minimax problem and then apply a first-order primal-dual method to solve it. The primal subproblem is rearranged so that it becomes a special Tikhonov regularization problem for which the minimizer of the GCV function is readily computable. Hence we can determine the best regularization parameter in each iteration of the primal-dual method. The regularization parameter for the original TV regularization problem is then obtained by an averaging scheme. In essence, our method needs only to solve the TV regulation problem twice: {one to determine the regularization parameter and one to restore the image with that parameter.} Numerical results show that our method gives near optimal parameter, and excellent performance when compared with other state-of-the-art adaptive image restoration algorithms.

Inverse problems for some stochastic PDEs

SPEAKER:	Ganghua Yuan, *Northeast Normal University*
SCHEDULED:	Tuesday, December 11, 15:10-15:45
DETAILS:	Minisymposium talk 1
ABSTRACT:	In this talk, I would like to present some results on uniqueness and stability for inverse problems for some stochastic or random partial differential equations such as parabolic equations, Euler-Bernoulli equations and wave equations.

Inversion for orders of fractional derivatives of diffusion equation

SPEAKER:	Zhiyuan Li, *Shandong University of Technology*
SCHEDULED	Tuesday, December 11, 16:15-16:50
DETAILS:	Minisymposium talk 1
ABSTRACT:	In this talk, we investigate the following initial boundary value problem

$$\begin{cases} \mathrm{D}_t^{(\mu)} u - \Delta u = f & in\ \Omega \times (0,T) \\ u = u_0 & in\ \Omega \times \{0\} \\ u = g & on\ \partial\Omega \times (0,T) \end{cases}$$

where Ω is an open bounded domain in R^d with a smooth boundary $\partial\Omega$, and $\mathrm{D}_t^{(\mu)}$ denotes a distributed order fractional derivative defined by

$$\mathrm{D}_t^{(\mu)} \varphi(t) = \int_0^1 \partial_t^\alpha \varphi(t) \mu(\alpha) d\alpha,$$

where the weight function μ is non-negative and continuous, and $\partial\alpha$ is the Caputo derivative. Compared with the classical diffusion model, the Caputo derivative is inherently nonlocal in time with a history dependence, which makes the fractional diffusion equation as an efficient model for describing the non-Markovian diffusion processes in various fields, such as porous media, polymer materials, laser cooling, and environmental engineering. However, when considering fractional diffusion equation as model equation in a range of problems in analyzing anomalous diffusion in complex systems, some important para.

Scattering transform and sparse Linear classifiers for art authentication

SPEAKER:	Haixia Liu, *Huazhong University of Science and Technology*
SCHEDULED:	Tuesday, December 11, 16:50-17:25
DETAILS:	Minisymposium talk 1
ABSTRACT:	Art authentication is an important problem both in art history and art collection. Recently, the scattering transform was proposed as a signal-processing tool aimed at providing a theoretical understanding of deep neural networks and state-of-the-art performance in image classification. In this talk, we use a cascade of wavelet filters and nonlinear (modulus) operations to build translation-invariant and deformation-stable representations. Here we explore the performance of this tool for art authentication purposes. We analyze two databases of art > objects (postimpressionist paintings and Renaissance drawings) with the goal of determining which of them where created by van Gogh and Raphael, respectively. Our results show that these tools provide excellent performance, superior to state-of-the-art results. Further, we suggest the benefits of using sparse classifiers in combination with deep networks.

Bioluminescence tomography: models and reconstruction

SPEAKER:	Rongfang Gong, *Nanjing University of Aeronautics and Astronautics*
SCHEDULED:	Tuesday, December 11, 17:25-18:00
DETAILS:	Minisymposium talk 1
ABSTRACT:	In this talk, we consider inverse source problems arising in bioluminescence tomography (BLT). A brief introduction of the background of the BLT is given. Then some mathematical models and the related reconstruction frameworks are addressed. A new time-dependent model is proposed motivated by the solution uniqueness, based on which some regularization frameworks are given.

Minisymposium 1（Medium Imaging and Image Processing）

Talks are arranged at Jinxiu Room, Lakeview Xuanwu Hotel.

Wednesday, December 12

Truncated fractional-order total variation model for image restoration

SPEAKER:	Haixia Liang, *Xian Jiaotung Liverpool University*
SCHEDULED:	Wednesday, December 12, 14:00-14:35
DETAILS:	Minisymposium talk 1
ABSTRACT:	In this talk, I will report the works that we have done on the truncated fractional-order variation models for image restoration.

Generalized polarization tensors for inhomogeneous medium and cloaking

SPEAKER:	Youjun Deng, *Central South University*
SCHEDULED:	Wednesday, December 12, 14:35-15:10
DETAILS:	Minisymposium talk 1
ABSTRACT:	In this talk, we shall introduce the notion of Generalized Polarization Tensors(GPTs) for inhomogeneous medium, which was previously defined for homogeneous medium. We shall also present some properties of the GPTs and then show its applications in super resolution imaging and cloaking.

On Glowinski's open question on the alternating direction method of multipliers

SPEAKER:	Min Tao, *Nanjing University*
SCHEDULED:	Wednesday, December 12, 15:10-15:45
DETAILS:	Minisymposium talk 1
ABSTRACT:	The alternating direction method of multipliers was proposed by Glowinski and Marrocco in 1974; and it has been widely used in a broad spectrum of areas, especially in some sparsity-driven application domains. In 1982, Fortin and Glowinski suggested to enlarge the range of the dual step size for updating the multiplier from 1 to the open interval of zero to the golden ratio; and this strategy immediately accelerates the convergence of alternating direction method of multipliers for most of its applications. Meanwhile, Glowinski raised the question of whether or not the range can be further enlarged to the open interval of zero to 2; this question remains open with nearly no progress in the past decades. In this paper, we answer this question affirmatively for the case where both the functions in the objective function are quadratic. Thus, Glowinski's open question is partially answered. We further establish the global linear convergence of the alternating direction method of multipliers with this enlarged step size range for the quadratic programming under a tight condition.

Region inhomogeneity active contours

SPEAKER:	Xiaoping Yang, *Nanjing University*
SCHEDULED:	Wednesday, December 12, 16:15-16:50
DETAILS:	Minisymposium talk 1
ABSTRACT:	In In this talk, unlike some of the existing algorithms that use local region descriptors to reduce or correct the intensity inhomogeneity, we present a framework which can make use of it to help to accomplish segmentation tasks. Our main argument is to quantify intensity inhomogeneity and convert it to be a useful feature to improve the segmentation results. We formulate a level set segmentation framework based on the quantification of intensity inhomogeneity.

Image recovery: from classical approach to deep learning

SPEAKER:	Tieyong Zeng, *Chinese University of Hong Kong*
SCHEDULED:	Wednesday, December 12, 16:50-17:25
DETAILS:	Minisymposium talk 1
ABSTRACT:	We will present some recent progress on image recovery including the classical approach and deep learning method.

On nonconvex regularized models for image restoration problems

SPEAKER:	Chunlin Wu, *Nankai University*
SCHEDULED:	Wednesday, December 12, 17:25-18:00
DETAILS:	Minisymposium talk 1
ABSTRACT:	Variational methods with regularization techniques have become an important kind of methods image restoration. The convex total variation (TV) regularization, although achieved great successes,suffers from a contrast reduction effect. Recently nonconvex regularization techniques become popular. In this talk, I will mainly present two parts. The first one is a motivation of using nonconvex regularizations and a general truncated regularization framework. The second is a lower bound theory for nonconvex regularized models, which shows the good edge recovery property.

Minisymposium 1（Medium Imaging and Image Processing）

Talks are arranged at Jinxiu Room, Lakeview Xuanwu Hotel.

Thursday, December 13

Increasing stability in the inverse source problem with attenuation and many frequencies

SPEAKER:	Shuai Lu, *Fudan University*
SCHEDULED:	Thursday, December 13, 14:00-14:35
DETAILS:	Minisymposium talk 1
ABSTRACT:	We study the interior inverse source problem for the Helmholtz equation from boundary Cauchy data of multiple wave numbers. The main goal of this paper is to understand the dependence of increasing stability on the attenuation, both analytically and numerically. To implement it we use the Fourier transform with respect to the wave numbers, explicit bounds for analytic continuation, and observability bounds for the wave equation. In particular, by using Carleman estimates for the wave equation we trace the dependence of exact observability bounds on the constant damping. Numerical examples in 3 spatial dimension support the theoretical results. It is a joint work with Prof. Victor Isakov (Wichita State University).

Proximal gradient method for manifold optimization

SPEAKER:	Shixiang Chen, *The Chinese University of Hong Kong*
SCHEDULED:	Thursday, December 13, 14:35-15:10
DETAILS:	Minisymposium talk 1
ABSTRACT:	This paper considers manifold optimization problems with nonsmooth and nonconvex objective function. Existing methods for solving this kind of problems can be classified into two classes. Algorithms in the first class rely on information of the subgradients of the objective function, which leads to slow convergence rate. Algorithms in the second class are based on operator-splitting techniques, but they usually lack rigorous convergence guarantees. In this paper, we propose a retraction-based proximal gradient method for solving this class of problems. We prove that the proposed method globally converges to a stationary point. Iteration complexity for obtaining an ϵ-stationary solution is also analyzed. Numerical results on solving sparse PCA and compressed modes problems are reported to demonstrate the advantages of the proposed method.

Convergence analysis of LMM and DDMs for a parabolic inverse Robin problem

SPEAKER:	Daijun Jiang, *Central China Normal University*
SCHEDULED:	Thursday, December 13, 15:10-15:45
DETAILS:	Minisymposium talk 1
ABSTRACT:	We study the Levenberg-Marquardt method (LMM) and domain decomposition methods (DDMs) for solving the highly nonlinear and ill-posed inverse problem of identifying the Robin coefficients in a parabolic system. The LMM transforms the Tikhonov regularized nonlinear non-convex minimizations into convex minimizations. And the quadratic convergence of the L-M method is rigorously established for the nonlinear parabolic inverse problems for the first time, under a simple novel adaptive strategy for selecting regularization parameters during the L-M iteration. Then the DDMs are used to solve the convex minimizations. The methods are completely local and the local minimizers have explicit expressions within the subdomains. Numerical experiments are presented to show the accuracy and efficiency of the methods, in particular, the convergence seems nearly optimal in the sense that the iteration number of the methods is independent on the mesh size. (This is a joint work with Profs. Jun Zou and Hui Feng.)

Shape derivatives -new perspective and applications to scattering

SPEAKER:	Jingzhi Li, *Southern University of Science and Technology*
SCHEDULED:	Thursday, December 13, 16:15-16:50
DETAILS:	Minisymposium talk 1
ABSTRACT:	This talk studies the “derivative” of solutions of second-order boundary value problems and of output functionals based on them with respect to the shape of the domain. A rigorous approach relies on encoding shape variation by means of deformation vector fields, which will supply the directions for taking shape derivatives. These derivatives and methods to compute them numerically are key tools for studying shape sensitivity, performing gradient based shape optimization, and small-variation shape uncertainty quantification. A unifying view of second-order elliptic boundary value problems recasts them in the language of differential forms (exterior calculus). Fittingly, the shape deformation through vector fields matches the concept of Lie derivative in exterior calculus. This paves the way for a unified treatment of shape differentiation in the framework of exterior calculus. Applications in scattering problems reveals the extraordinary power of the machinery.

Bi-modality joint reconstruction via variational models

SPEAKER:	Xiaoqun Zhang, *Shanghai Jiao Tong University*
SCHEDULED:	Thursday, December 13, 16:50-17:25
DETAILS:	Minisymposium talk 1
ABSTRACT:	Recent technical advances lead to the coupling of multi-modality for joint image reconstruction, information fusion and analysis. For instance, PET-MRI scanners enable to acquire functional and anatomical data simultaneously. For the joint reconstruction problem, the goal is to improve the reconstruction quality of one modality by utilizing complementary information from the other modality. We considered two variational approaches for PET-MRI joint reconstruction. The first model relies on a joint regularization term based on an adaptively estimated common edge and weighted total variation. The common edge is designed to be flexible for taking into account of small misalignment of edge sets of two modal image. The second model is based on the joint sparsity of tight frame coefficients. A non-convex balanced approach is adopted to take the different sparsity patterns of PET-MRI images into account. A proximal alternating minimization algorithm is applied to solve both nonconvex and nonsmooth model and the global convergence can be stablished. The numerical experiments show that the our proposed models achieve better performance over the existing PET-MRI joint reconstruction models.

The Inverse problem approach for X-ray radiograph tomography

SPEAKER:	Suhua Wei, *Institute of Applied Physics and Computational Mathematics, CAS*
SCHEDULED:	Thursday, December 13, 17:25-18:00
DETAILS:	Minisymposium talk 1
ABSTRACT:	X-ray is an excellent tool to pear into the interior of an object. Image reconstruction means to inverse the object physical parameters from x-ray radiographs. This is an inverse problem. In this talk, the illposedness of the inverse problem will be analyzed and the mathematical model will be given based on variational method. The mathematical model deals with Abel transform inversion and the determination of the indirectly measuring data. Two terms of regularizers are introduced in our model. Numerical tests show the efficiency of the proposed model.

Minisymposium talks

Minisymposium 2（Matrix Computations and Optimization）

Talks are arranged at Jinjiang Room, Lakeview Xuanwu Hotel.

Tuesday, December 11

Qn eigenvector-dependent nonlinear eigenvalue problem from perspective of relative perturbation theory

SPEAKER:	Ninoslav Truhar, *University of Osijek*
SCHEDULED:	Tuesday, December 11, 14:00-14:35
DETAILS:	Minisymposium talk 2
ABSTRACT:	We consider the eigenvector-dependent nonlinear eigenvalue problem (NEPv) $H(V)V = V\Lambda$, where $H(V) \in C^{n\times n}$ is an Hermitian matrix-valued function of $V \in C^{n\times k}$ with or- thonormal columns, i.e., $V^HV = I_k$, $k \leq n$ (usually $k<<n$). We present the conditions on existence and uniqueness for the solvability of NEPv using the well-known results of the relative perturbation theory. Our results are motiveted by the results on NEPv presented in Y. Cai, L.-H. Zhang, Z. Bai, and R.-C. Li, on an eigenvector-dependent nonlinear eigenval- ue problem, accepted for publication in SIAM Journal on Matrix Analysis and Applications (SIMAX) (2018), where among the other results one can find conditions for existence and uniqueness for the solvability of an NEPv. These results are based on well-known standard perturbation theory for Hermitian matrices. The differences between so called standard perturbation theory approach, and our new (relative perturbation theory) approach have been illustrated in several numerical examples.

Quaternion matrix computations

SPEAKER:	Musheng Wei, *Shanghai Normal University*
SCHEDULED:	Tuesday, December 11, 14:35-15:10
DETAILS:	Minisymposium talk 2
ABSTRACT:	In this talk we describe state-of-the-art real structure-preserving algorithms for quaternion matrix computations, especially the LU, the Cholesky, the QR and the singular value decomposition of quaternion matrices, direct and iterative methods for solving quaternion linear system, generalized least squares problems, and quaternion right eigenvalue problems. Formulas of the methods are derived, and numerical codes are provided which utilize advantages of real structure-preserving of quaternion matrices and high-level performance of vector pipelining arithmetic operations, using Matlab software. These algorithms are very efficient and stable.

Number of 2D eigenvalues

SPEAKER:	Yangfeng Su, *Fudan University*
SCHEDULED:	Tuesday, December 11, 15:10-15:45
DETAILS:	Minisymposium talk 2
ABSTRACT:	In this talk, we talk about how many 2D eigenvalues a 2D EVP has. We will first prove the existance of 2D eigenvalues. Generally there exist complex 2D eigenvalues which are not interested. Then we will prove that there are only finite number of non-trivial 2D eigenvalues. In this sense, 2D eigenvalue problems are well defined.

Jacobi-like algorithm for Bethe-Salpeter eigenvalue problem

SPEAKER:	Weiguo Gao, *Fudan University*
SCHEDULED:	Tuesday, December 11, 16:15-16:50
DETAILS:	Minisymposium talk 2
ABSTRACT:	In this talk, we investigate the Bethe-Salpeter eigenvalue problems and propose a Jacobi-like algorithm. The eigen-structure is preserved during the iterations. Global convergence of the new algorithm is given and numerical examples demonstrate the fast convergence. This is a joint-work with Meiyue Shao and Chenming Yang.

The ascend algorithm for solving generalized symmetric eigenvalue complementarity problem

SPEAKER:	Yuan Lei, *Hunan University*
SCHEDULED:	Tuesday, December 11, 16:50-17:25
DETAILS:	Minisymposium talk 2
ABSTRACT:	The Generalized Eigenvalue Complementarity Problem (GEiCP) appears in the study of static equilibrium states of finite dimensional mechanical systems with unilateral frictional contact. The GEiCP with real symmetric matrices is equivalent to finding an equilibrium solution of a differentiable optimization problem in a compact set, and an ascend algorithm for finding the equilibrium solution is presented in this talk. In this algorithm, the optimal step size can be determined in each step by choosing suitable ascend direction, and some numerical examples show the effectiveness of this algorithm.

Nonlinear eigenvalue problem in domain adaptation

SPEAKER:	Limin Li, *Xi'an Jiaotong University*
SCHEDULED:	Tuesday, December 11, 17:25-18:00
DETAILS:	Minisymposium talk 2
ABSTRACT:	Transferring knowledge from a source domain to a target domain by domain adaptation has been an interesting and challenging problem in many machine learning applications. The key problem is how to match the data distributions of the two heterogeneous domains in a proper way such that they can be treated indifferently for learning. We propose a covariance matching approach DACoM for semi-supervised domain adaptation. The DACoM embeds the original samples into a common latent space linearly such that the covariance mismatch of the two mapped distributions is minimized. The KKT conditions of DACoM optimization model are given as a nonlinear eigenvalue equation. We show that the KKT conditions could at least ensure local optimality. An efficient eigen-updating algorithm is then given for solving the nonlinear eigenvalue problem, whose convergence is guaranteed conditionally. Numerical experiments on simulation datasets and real-world applications are given to comprehensively demonstrate the effectiveness and efficiency of the proposed approach. The experiments show that our method outperforms other existing methods for both homogeneous and heterogeneous domain adaptation.

Minisymposium 2（Matrix computations and optimization）

Talks are arranged at Jinjiang Room, Lakeview Xuanwu Hotel.

Wednesday, December 12

Inheritance properties of Krylov subspace methods for algebraic Riccati equations

SPEAKER:	Eric King-Wah Chu, *Monash University*
SCHEDULED:	Wednesday, December 12, 14:00-14:35
DETAILS:	Minisymposium talk 2
ABSTRACT:	We consider the numerical solution of large-scale algebraic Riccati equations by Krylov subspace methods. We show that the solvability of the projected algebraic Riccati equation need not be assumed but can be inherited. This study of inheritance properties is the first of its kind. We conduct our study via the stabilizability and detectability of the control system, the stability of the associated Hamiltonian matrix and perturbation in terms of residuals. Special attention is paid to the stabilizing and positive semi-definite properties of approximate solutions. Illustrative numerical examples are presented.

Nearly optimal stochastic approximation for online principal subspace estimation

SPEAKER:	Xin Liang, *Tsinghua University*
SCHEDULED:	Wednesday, December 12, 14:35-15:10
DETAILS:	Minisymposium talk 2
ABSTRACT:	Processing streaming data as they arrive is often necessary for high dimensional data analysis. In this talk, we analyze the convergence of a subspace online PCA iteration. Under the sub-Gaussian assumption, we obtain the finite-sample error bound that closely matches the minimax information lower bound by Vu and Lei [Ann. Statist. 41:6(2013), 2905-2947]. The case for the most significant principal component only, was solved by Li, Wang, Liu, and Zhang [Math. Program., Ser. B, DOI 10.1007/s10107-017-1182-z], but a straightforward extension of their proofs, however, does not seem to work for the subspace case. People may see matrix analysis plays an important role in generalizing results for one-dimensional case to those for multi-dimensional case.

Inertia laws and localization of real eigenvalues for generalized indefinite eigenvalue problems

SPEAKER:	Yuji Nakatsukasa, *University of Oxford*
SCHEDULED:	Wednesday, December 12, 15:10-15:45
DETAILS:	Minisymposium talk 2
ABSTRACT:	Sylvester's law of inertia states that the number of positive, negative and zero eigenvalues of Hermitian matrices is preserved under congruence transformations. The same is true of generalized Hermitian definite eigenvalue problems, in which the two matrices are allowed to undergo different congruence transformations, but not for the indefinite case. In this work we investigate the possible change in inertia under congruence for generalized Hermitian indefinite eigenproblems, and derive sharp bounds that show the inertia of the two individual matrices often still provides useful information about the eigenvalues of the pencil, especially when one of the matrices is almost definite. A prominent application of the original Sylvester's law is in finding the number of eigenvalues in an interval. Our results can be used for estimating the number of real eigenvalues in an interval for generalized indefinite and nonlinear eigenvalue problems.

Probabilistic dimensionality reduction via structure learning

SPEAKER:	Li Wang, *University of Texas at Arlington*
SCHEDULED:	Wednesday, December 12, 16:15-16:50
DETAILS:	Minisymposium talk 2
ABSTRACT:	We propose an alternative probabilistic dimensionality reduction framework that can naturally integrate the generative model and the locality information of data. Based on this framework, we present a new model, which is able to learn a set of embedding points in a low- dimensional space by retaining the inherent structure from high-dimensional data. The objective function of this new model can be equivalently interpreted as two coupled learning problems, i.e., structure learning and the learning of projection matrix. Inspired by this interesting interpretation, we propose another model, which finds a set of embedding points that can directly form an explicit graph structure. We proved that the model by learning explicit graphs generalizes the reversed graph embedding method, but leads to a natural interpretation from Bayesian perspective. This can greatly facilitate data visualization and scientific discovery in downstream analysis.

The generalized Lanczos trust-region method

SPEAKER:	Leihong Zhang, *Shanghai University of Finance and Economics*
SCHEDULED:	Wednesday, December 12, 16:50-17:25
DETAILS:	Minisymposium talk 2
ABSTRACT:	The so-called Trust-Region Subproblem gets its name in the trust-region method in optimization and also plays a vital role in various other applications. In this talk, we will present the convergence of the Generalized Lanczos Trust-Region (GLTR) method proposed by [Gould, Lucidi, Roma and Toint, SIOPT, 9:504-525 (1999)] to reveal its convergence behavior in theory, and then propose new stopping criteria that can be integrated into GLTR for better numerical performance of the trust-region solver TRU in the Fortran routine GLTR in the library GALAHAD.

PSBCM-ALH algorithm for large-scale SVM

SPEAKER:	Bo Yu, *Dalian University of Technology*
SCHEDULED:	Wednesday, December 12, 17:25-18:00
DETAILS:	Minisymposium talk 2
ABSTRACT:	

Minisymposium 2（Matrix Computations and Optimization）

Talks are arranged at Jinjiang Room, Lakeview Xuanwu Hotel.

Thursday, December 13

The uniqueness of multilinear PageRank vectors

SPEAKER:	Wen Li, *South China Normal University*
SCHEDULED:	Thursday, December 13, 14:00-14:35
DETAILS:	Minisymposium talk 2
ABSTRACT:	The uniqueness of multilinear PageRank vectors is discussed, and the new uniqueness condition is given. The new results are better than the existing one. Numerical examples are given to demonstrate the new theoretical results.

Computing exponentials of essentially nonnegative matrices entrywise to high relative accuracy

SPEAKER:	Jungong Xue, *Fudan University*
SCHEDULED:	Thursday, December 13, 14:35-15:10
DETAILS:	Minisymposium talk 2
ABSTRACT:	A real square matrix is said to be essentially non-negative if all of its off-diagonal entries are non-negative. It has recently been shown that the exponential of an essentially non-negative matrix is determined entrywise to high relative accuracy by its entries up to a condition number intrinsic to the exponential function (Numer. Math. 110 (2008), 393–403). Thus the smaller entries of the exponential may be computed to the same relative accuracy as the bigger entries. This talk presents algorithms to compute exponentials of essentially non-negative matrices entrywise to high relative accuracy.

Nonconvex approaches in data science

SPEAKER:	Yifei Lou, *University of Texas Dallas*
SCHEDULED:	Thursday, December 13, 15:10-15:45
DETAILS:	Minisymposium talk 2
ABSTRACT:	Although "big data" is ubiquitous in data science, one often faces challenges of "small data" , as the amount of data that can be taken or transmitted is limited by technical or economic constraints. To retrieve useful information from the insufficient amount of data, additional assumptions on the signal of interest are required, e.g. sparsity (having only a few non-zero elements). Conventional methods favor incoherent systems, in which any two measurements are as little correlated as possible. In reality, however, many problems are coherent. I will present a nonconvex approach that works particularly well in the coherent regime. I will also address computational aspects in the nonconvex optimization. Various numerical experiments have demonstrated advantages of the proposed method over the state-of-the-art. Applications, ranging from super-resolution to low-rank approximation, will be discussed.

Randomized algorithms for large-scale total least squares problems

SPEAKER:	Yimin Wei, *Fudan University*
SCHEDULED:	Thursday, December 13, 16:15-16:50
DETAILS:	Minisymposium talk 2
ABSTRACT:	Motivated by the recently popular probabilistic methods for low-rank approximations and randomized algorithms for the least squares problems, we develop randomized algorithms for the total least squares problem with a single right-hand side. We present the Nyström method for the medium-sized problems. For the large-scale and ill-conditioned cases,we introduce the randomized truncated total least squares with the known or estimated rank as the regularization parameter.We analyze the accuracy of the algorithm randomized truncated total least squares and perform numerical experiments to demonstrate the efficiency of our randomized algorithms. The randomized algorithms can greatly reduce the computational time and still maintain good accuracy with very high probability.

Structured condition numbers for the Tikhonov regularization of discrete ill-posed problems

SPEAKER:	Bing Zheng, *Lanzhou University*
SCHEDULED:	Thursday, December 13, 16:50-17:25
DETAILS:	Minisymposium talk 2
ABSTRACT:	In this talk, we first recall the accurate solution of the structured consistent and inconsistent linear system and then describe a method for the acurrate solution to the structured total least squares problem.

Doubling algorithm for the discretized Bethe-Salpeter eigenvalue problem

SPEAKER:	Zhenchen Guo, *Nanjing University*
SCHEDULED:	Thursday, December 13, 17:25-18:00
DETAILS:	Minisymposium talk 2
ABSTRACT:	The discretized Bethe-Salpeter eigenvalue problem arises in the Green's function evaluation in many body physics and quantum chemistry. Discretization leads to a matrix eigenvalue problem for $H \in \mathbb{C}^{2n \times 2n}$ with a Hamiltonian-like structure. After an appropriate transformation of H to a standard symplectic form, the structure-preserving doubling algorithm, originally for algebraic Riccati equations, is extended for the discretized Bethe-Salpeter eigenvalue problem. Potential breakdowns of the algorithm, due to the ill condition or singularity of certain matrices, can be avoided with a double-Cayley transform or a three-recursion remedy. A detailed convergence analysis is conducted for the proposed algorithm, especially on the benign effects of the double-Cayley transform. Numerical results are presented to demonstrate the efficiency and the structure-preserving nature of the algorithm.

Minisymposium talks

Minisymposium 3（Computer Vision with Applications）

Talks are arranged at Juxing Room, Lakeview Xuanwu Hotel.

Tuesday, December 11

Image Illumination editing and processing

SPEAKER:	Chun-Xia Xiao, *Wuhan University*
SCHEDULED:	Tuesday, December 11, 14:00-14:35
DETAILS:	Minisymposium talk 3
ABSTRACT:	Image is generated by the interaction between the object materials and illumination, illumination understanding and editing is the fundamental of image editing and processing, and is also a popular research areas in computer vision, computer graphics, and image processing. This talk first presents the theory, methodology, key techniques, and application areas of illumination editing and processing, then will give four works, including underexposed video enhancement, illumination decomposition, shadow removal and editing, and image relighting. Finally, this talk will discuss the potential research problems in this field.

Feature preserving hexahedral meshing

SPEAKER:	Na Lei, *Dalian University of Technology*
SCHEDULED:	Tuesday, December 11, 14:35-15:10
DETAILS:	Minisymposium talk 3
ABSTRACT:	Regular hexahedral meshing is crucial for high performance computation purposes. This work introduces a novel method for global regular hexahedral meshing, which preserves major sharp feature curves. The method is based on surface and volume foliations, which can be obtained by the metric graph valued harmonic maps. The feature curve preservation can be achieved by adding various types of constraints for the harmonic maps. The experimental results show the efficiency and efficacy of the proposed method.

Automatic unpaired shape deformation transfer

SPEAKER:	Lin Gao, *Institute of Computing Technology, Chinese Academy of Sciences*
SCHEDULED:	Tuesday, December 11, 15:10-15:45
DETAILS:	Minisymposium talk 3
ABSTRACT:	Transferring deformation from a source shape to a target shape is a very useful technique in computer graphics. State-of-the-art deformation transfer methods require either point-wise correspondences between source and target shapes, or pairs of deformed source and target shapes with corresponding deformations. However, in most cases, such correspondences are not available and cannot be reliably established using an automatic algorithm. Therefore, substantial user effort is needed to label the correspondences or to obtain and specify such shape sets. In this work, we propose a novel approach to automatic deformation transfer between two unpaired shape sets without correspondences. 3D deformation is represented in a high dimensional space. To obtain a more compact and effective representation, two convolutional variational autoencoders are learned to encode source and target shapes to their latent spaces. We exploit a Generative Adversarial Network (GAN) to map deformed source shapes to deformed target shapes, both in the latent spaces, which ensures the obtained shapes from the mapping are indistinguishable from the target shapes. This is still an under-constrained problem, so we further utilize a reverse mapping from target shapes to source shapes and incorporate cycle consistency loss, i.e. applying both mappings should reverse to the input shape. This VAE-Cycle GAN (VC-GAN) architecture is used to build a reliable mapping between shape spaces. Finally, a similarity constraint is employed to ensure the mapping is consistent with visual similarity, achieved by learning a similarity neural network that takes the embedding vectors from the source and target latent spaces and predicts the lightfield distance between the corresponding shapes. Experimental results show that our fully automatic method is able to obtain high-quality deformation transfer results with unpaired data sets, comparable or better than existing methods where strict correspondences are required.

Learning on hypergraph: method and applications

SPEAKER: Yue Gao, *Tsinghua University*

SCHEDULED: Tuesday, December 11, 16:15-16:50

DETAILS: Minisymposium talk 3

ABSTRACT: Hypergraph is a general graph structure and has been widely applied in data classification, image segmentation and retrieval due to its superior performance on high-order correlation modelling. In recent years, extensive research efforts have been dedicated to hypergraph based learning methods. In this presentation, we will first introduce the hypergraph construction methods, considering both single modality and multi-modality scenarios. After that, we will present the learning methods on hypergraph structure, from traditional transductive learning to hypergraph structure learning, including the information about vertex, hyperedge and multi-hypergraphs. We then introduce the hypergraph neural network framework for data representation learning, which can encode high-order data correlation in a hypergraph structure. In this part, a hyperedge convolution operation is designed to handle the data correlation during representation learning. In this way, traditional hypergraph learning procedure can be conducted using hyperedge convolution operations efficiently. HGNN is able to learn the hidden layer representation considering the high-order data structure, which is a general framework considering the complex data correlations. Finally, we will introduce the applications of hypergraph learning.

On some more robust image selective segmentation models

SPEAKER: Ke Chen, *University of Liverpool, United Kingdom*

SCHEDULED: Tuesday, December 11, 16:50-17:25

DETAILS: Minisymposium talk 3

ABSTRACT: Image segmentation is one important problem in mathematical imaging research and computer vision applications. As the fast-growing technologies of imaging generate increasingly higher precision images, demand for fast and accurate solution techniques is equally high. This talk will first discuss some models in variational image segmentation. Then it will focus on more recent works done at our Liverpool group to design robust models for segmentation of images with weak contrast. Our work can be used to help preparation of AI training data which is a crucial step in deep learning.

Signal recovery through noise/loss modeling

SPEAKER:	Deyu Meng, *Xi'an Jiaotong University*
SCHEDULED:	Tuesday, December 11, 17:25-18:00
DETAILS:	Minisymposium talk 3
ABSTRACT:	The loss function used in a conventional machine learning problem is generally specified as an easy fixed form, like L2 norm or L1 norm, which intrinsically assumes the noises contained in data are generated from a simple distribution, like an i.i.d. Gaussian or Laplacian. However, in practical scenarios with complex noise configurations, such modeling inclines to encounter the robustness issue, that is, such modeling manner tends to make the related learning algorithm sensitive to complex noises. In this talk, I will introduce some developments of our research team on noise/loss modeling, which aims to make a machine learning model capable of adaptively learning an appropriate loss function/noise distribution from data, so as to alleviate the robustness issue of generally machine learning regimes. Such loss/noise modeling paradigms have been used on multiple image/video/hyper-spectral image restoration tasks, and achieved state-of-the-art performance on hyper-spectral image denoising, online background subtraction on surveillance videos, low-dose CT image enhancement and video deraining. Such a fundamental regime is expected to inspire useful learning algorithms for more machine learning tasks.

Minisymposium 3（Computer Vision with Applications）

Talks are arranged at Juxing Room, Lakeview Xuanwu Hotel.

Wednesday, December 12

Intelligent processing and display of future 3D video

SPEAKER:	Shaoping Lu, *Nankai University*
SCHEDULED:	Wednesday, December 12, 14:00-14:35
DETAILS:	Minisymposium talk 3
ABSTRACT:	Modern multiview and 3D multimedia systems offer great potential of immersive experience for users compared to classical monocular or stereoscopic ones, and such systems are quickly boosting numerous creative applications such as 3D media creation, augmented and mixed reality, gaming, medical visualization, to name a few. The multiview and 3D video related display opens the door for such future applications, but it remains a challenge to acquire, store, transmit, represent and process this type of data in an efficient and effect manner. In this talk, I will present some research topics on multiview video and 3D capturing, compression for transmission and interactive display.

Fast construction of discrete geodesic graph

SPEAKER:	Ying He, *Nanyang Technological University*
SCHEDULED	Wednesday, December 12, 14:35-15:10
DETAILS:	Minisymposium talk 3
ABSTRACT:	I will introduce a new method for constructing Discrete Geodesic Graph (DGG) - an undirected, sparse graph for computing discrete geodesic distances and paths on triangle meshes. Based on a novel accuracy aware window propagation scheme, our method is able to compute DGG edges in a direct and efficient manner. Let M be a manifold triangle mesh with n vertices and surface area A. Define the unit area $\mathring{A} = A/n$ and the unit length $\mathring{l} = \sqrt{\mathring{A}}$. Assuming that the triangular faces of M have $O(1)$ edge length and $\Theta(1)$ area (i.e., the lengths and areas are bounded by some resolution independent constant), we prove that our method produces a DGG with $O(\frac{n}{\sqrt{\varepsilon}})$ edges in $O(\frac{n}{\varepsilon^{0.75}} \log \frac{1}{\varepsilon})$ time, greatly improving the time complexity $O(\frac{n}{\varepsilon} \log \frac{1}{\varepsilon})$ of the existing approach, where ε is the user-specified parameter for accuracy control. Through extensive evaluation, we demonstrate that our method produces DGGs with size and accuracy comparable to the existing method, but it runs up to 2 orders of magnitude faster for meshes with 1 million vertices. Moreover, our algorithm can handle meshes of moderate degree of anisotropy directly, whereas the existing methods must add a large number of pseudo vertices to maintain the graph or mesh quality.

Estimating geometry and illumination from multi-view images

SPEAKER:	Jianmin Zheng, *Nanyang Technological University*
SCHEDULED:	Wednesday, December 12, 15:10-15:45
DETAILS:	Minisymposium talk 3
ABSTRACT:	Reconstructing the shape of a 3D object from multi-view images under general illumination is a fundamental problem in computer vision and graphics. High quality reconstruction is usually challenging especially when fine detail is needed and the albedo of the object is non-uniform. In this talk, I will present some of our recent work in estimating the shape and the unknown illumination as well. The talk will be focused on the computational model for reconstruction and the representation of the surface and illumination. In particular, a concept of per-vertex overall illumination is introduced to model the overall effect of the general illumination, subdivision schemes are employed to represent the geometry and illumination, and a total variation based model is proposed for reconstruction. All these are integrated to provide a robust and efficient surface reconstruction method that can well recover the surface details even for objects with varying albedo.

TBA

SPEAKER:	Laurent Younes, *The Johns Hopkins University*
SCHEDULED:	Wednesday, December 12, 16:15-16:50
DETAILS:	Minisymposium talk 3
ABSTRACT:	

TBA

SPEAKER:	Giuseppe Patane, *The Johns Hopkins University*
SCHEDULED:	Wednesday, December 12, 16:50-17:25
DETAILS:	Minisymposium talk 3
ABSTRACT:	

Signal and image recovery from saturated measurements

SPEAKER:	Ming Yan, *Michigan State University*
SCHEDULED:	Wednesday, December 12, 17:25-18:00
DETAILS:	Minisymposium talk 3
ABSTRACT:	When a measurement falls outside the quantization or measurable range, it becomes saturated and cannot be used in classical reconstruction methods. E.g., the limited dynamic range of C-arm flat detectors leads to overexposure in some projections during an acquisition, such as imaging relatively thin body parts (e.g., the knee). Aiming at overexposure correction for computed tomography (CT) reconstruction and spare signal recovery, we propose mixed one-bit compressive sensing (M1bit-CS) approaches to acquire information from both regular and saturated measurements. In this talk, I will introduce several approaches and their applications in CT reconstruction.

Minisymposium 3（Computer Vision with Applications）

Talks are arranged at Juxing Room, Lakeview Xuanwu Hotel.

Thursday, December 13

Data-driven sketch interpretation

SPEAKER:	Hongbo Fu, *City University of Hong Kong*
SCHEDULED:	Thursday, December 13, 14:00-14:35
DETAILS:	Minisymposium talk 3
ABSTRACT:	Freehand sketching provides an easy tool for communication between people. While human viewers can easily interpret the semantics of a freehand sketch, it is often difficult to teach machines understand sketches like we do, especially because of different levels of abstraction, drawing styles, and various sources of drawing errors. In this talk, we will introduce how data-driven approaches can help us address various sketch understanding tasks, including the beautification, classification, segmentation, animation, and 3D interpretation of freehand sketches.

Reconstruction of 3D human body pose

SPEAKER:	Shihong Xia, *Institute of Computing Technology, Chinese Academy of Sciences*
SCHEDULED:	Thursday, December 13, 14:35-15:10
DETAILS:	Minisymposium talk 3
ABSTRACT:	3D human body pose has applications in computer graphics, computer vision, robotics, virtual reality, and sports science. Many efforts have been made in this research community. However, it remains challenging to synthesize natural 3D pose with fewer constraints, and estimate 3D pose with accuracy and efficiency, because human body is very complex and has self-occlusion in general. In this talk, I will present our recent works on reconstruction of 3D human body pose with kinematic motion modeling techniques, which include data-driven inverse kinematics and pose regression from RGB-D images. Also I will introduce mathematical foundations on inverse kinematics, and discuss pose and shape reconstruction from RGB-D video.

Geodesic voronoi diagrams and intrinsic delaunay triangulation

SPEAKER:	Yong-Jin Liu, *Tsinghua University*
SCHEDULED:	Thursday, December 13, 15:10-15:45
DETAILS:	Minisymposium talk 3
ABSTRACT:	In machine perception and computer vision, three-dimensional objects are usually represented by 2-manifold meshes M. Compared to Euclidean metric spaces, the Voronoi diagrams based on geodesic metric on M exhibit many distinct properties that fail all existing Euclidean Voronoi diagram. In this talk, the combinatorial structure of geodesic Voronoi diagrams with complexity analysis is presented. We also present some recent study on intrinsic Delaunay trangulation from the dual of geodesic Voronoi diagram. Finally practical algorithms for constructing geodesic Voronoi diagram and its dual IDT on M, as well as some applications in computer vision and pattern analysis are presented.

Data-driven indoor scene 3D modeling and simulation

SPEAKER:	Yanwen Guo, *Nanjing University*
SCHEDULED:	Thursday, December 13, 16:15-16:50
DETAILS:	Minisymposium talk 3
ABSTRACT:	Indoor scene modeling and simulation have received considerable attention due to the wide applications in interior design, smart home, and virtual and augmented reality. In this talk, I will present systematically our work on indoor scene modeling and simulation. First, we present a data-driven indoor scene modeling method from a single color image with iterative object segmentation and model retrieval. Second, given a 3D indoor scene, a data-driven approach that colorizes 3D furniture models and indoor scenes by leveraging indoor images on the internet will be introduced. I will finally introduce our material-scanning system used for obtaining the surface micro-scale geometry and physics attributes for visual effect simulation in product design.

Advances in unstructured mesh generation and adaptation

SPEAKER:	Hang Si, *Weierstrass Institute for Applied Analysis and Stochastics*
SCHEDULED:	Thursday, December 13, 16:50-17:25
DETAILS:	Minisymposium talk 3
ABSTRACT:	Mesh generation and adaptation are key steps in many applications such as numerical methods like finite element and finite volume methods. It is itself a research topic with background in mathematics, computer science, and engineering. In this talk, we will first review triangle mesh generation and adaptation in the plane. This problem has been well studied. Efficient algorithms are developed. We then introduce tetrahedral mesh generation in 3d, which is still challenged by many theoretical and practical issues. In this talk, we will highlight some recent development in this field.

Atomic scale crystal analysis: methodology and discovery

SPEAKER:	Haizhao Yang, *National University of Singapore*
SCHEDULED:	Thursday, December 13, 17:25-18:00
DETAILS:	Minisymposium talk 3
ABSTRACT:	Recent developments in imaging techniques enable researchers to visualize materials at the atomic resolution to better understand the microscopic structures of materials. This talk focuses on the automatic and quantitative characterization of potentially complicated microscopic crystal images, providing feedback to tweak theories and improve synthesis in materials science. As such, we introduce an efficient toolbox, SynCrystal, based on phase-space analysis and optimization for automatic information learning for atomistic structures, including crystal image segmentation, classification, defect detection, rotation, and deformation estimation.

4 About Shing-Tung Yau Center of Southeast University

Shing-Tung Yau Center of Southeast University

The Shing-Tung Yau Center at Southeast University (the SEU-Yau Cneter) was officially inaugurated on July 7, 2017. It is managed by the Southeast University. Prof. Shing-Tung Yau, a famous mathematician who won the Fields Medal in 1982, heads the new research center.

The main research mission of the SEU-Yau Center is to conduct high level AI-oriented interdisciplinary scientific researches, with special focuses on the applications of modern mathematical theory and methods for solving important and critical engineering problems including, but not limited to, biomedical imaging, modern data-analysis and data extraction, and scientific computations at extreme large scales. At its official launch, the SEU-Yau Center established five research directions to undertake for its near future. They cover the areas of computational sciences, information sciences, data analysis, medical imaging and other related research fields. The center will foster strong interdisciplinary collaborations among researchers in pure mathematics, artificial intelligence, data mining, intelligent control, image processing, among others. Educationally, under the unwavering support of Southeast University and guidance of Prof. Shing-Tung Yau, the SEU-Yau Center strives to attract high-level young talents and train them to become the next generation world class scientists. Competitive supports will be provided to these young researchers while they are enrolled with the center.

The SEU-Yau Center is composed of faculty members from various departments of Southeast University whose research interests align with the main missions of the center, postdoctoral researchers and postgraduates home and abroad, and short-term visitors around the globe. The faculty members are with the center part time while their primary employments are still with their home departments at the university, and postdoctoral researchers and postgraduates are full time employees of the center.

For more details, please visit yauc.seu.edu.cn.

5 Introduction on School of Mathematics, Southeast University

School of Mathematics, Southeast University

The mathematics faculty of Southeast University (SEU) was established in 1921 and created by the famous mathematician Mr Xiong Qinglai. After the adjustment of the institutes and faculties in the year of 1952, it has been developed into the School of Mathematics with the great emphasis on both the teaching and scientific research, the overall development of multiple subjects and the strong teaching power today from the basic science faculty, the mathematics and mechanics faculty and the applied mathematics faculty.

There are totally 86 professional teachers and 9 working staffs in the entire school (including 1 distinguished professor of university, 2 young distinguished professors of SEU). Among them, there are 1 academician of the European Academy of science, 1 IEEE fellow, 3 global highly cited scientists of Thomson Reuters, 4 Chinese highly cited scholars of Elsevier, 1 expert of national natural science foundation's subject evaluation group, 1 young top talent of ten thousand national talents, 1 leading talent of 333 high-level talent's cultivation project of Jiangsu Province, 2 winner of national excellent youth fund, 1 winner of Chinese female young scientist, 1 winner of young teacher prize of the higher institutes of the Education Ministry, 3 persons of the new century outstanding talents supporting plans of the Education Ministry, 4 persons of the outstanding prizes of Bao Gang's Education Fund, 1 winner of Huo Yingdong's Young Teachers Foundation Sponsorship, 1 winner of German Humboldt foundation sponsorship, 4 persons of "the Six-talent summit" of Jiangsu Province, 1 winner of the outstanding young scientific foundation of Jiangsu Province, 4 leading persons of "the Blue project" academy of the higher institutes of Jiangsu Province etc. There are a huge batch of the scientific research elites and capable teachers. Meanwhile, the department also owns a batch of the visiting professors and industry professors with the world first-rate academic levels, including 1 academician of European academy of science, 1 academician of the third world academy of science, 2 persons of IEEE Fellow, 4 experts of "Thousand talents program".

Currently, there are three undergraduate majors: the mathematics and applied mathematics major, information and computer science major, and statistics major. All these majors execute large class enrollment, implement the wide aperture training mode, strengthen the general education, set a solid mathematics foundation, focus on the specialty intersecting and intensify the creativity capacities. The specific major can be reselected by the students after one-year entrance study. The overall toll of undergraduate enrollment of this year is about 90 persons.

The cultivation quality of the talents of bachelor, master and doctor degrees has been improving continuously. In recent 5 years, we have won a series of high-level awards, such as 1 item of the nomination prize of the national outstanding doctoral dissertation award, 1 item of the new person prize of the doctoral postgraduate academy of education department, 3 articles have won the outstanding doctoral dissertation prize of Jiangsu Province, 2 items of China's most influential international academic paper award, 2 items of the second prize of

national university" the challenging cup" (All the participants are the undergraduates of our faculty) etc. The mathematical modeling results of the university students guided by the teachers of our faculty are quite outstanding, 2 items of the grand prize of modeling competition of international university students were won by our school in the academic year of 2014, which ranked the second at home, second only to Tsinghua University and realized the historical breakthrough. The undergraduate students have been sent to make an academic exchange visit to many famous high institutes in USA, UK, Hongkong and Taiwan. We also have had the deep cooperation in the domains like the joint project research, academic exchange and visit, the students exchange cultivation and mutual sharing of teaching and scientific research information.

6 Author index

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