The 5th International Conference on Matrix Inequalities and Matrix Equations (MIME2019)

第五届矩阵不等式和矩阵方程国际会议

Guilin University of Electronic Technology

Shanghai University

Guilin, China

June 7-10, 2019

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International Research Center for Tensor and Matrix Theory (IRCTMT), Shanghai University, China.

Guilin University of Electronic Technology , Guilin, China.

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Conference Venue

Guilin Bravo Hotel，No.14 Ronghu South Road, Guilin, Guangxi, China
广西桂林市榕湖南路14号，桂林宾馆。

All lectures will be held in the Guilin Bravo Hotel （桂林宾馆）

Accommodation

Guilin Bravo Hotel
No.14 Ronghu South Road, Guilin, Guangxi, China. 桂林宾馆：桂林市榕湖南路14号。

Transportation

A: Guilin Liangjiang International Airport （桂林两江机场）-> Guilin Bravo Hotel (桂林宾馆）

1. By shuttle bus: Take airport shuttle bus from Liangjiang International Airport to Guilin Civil Aviation Building (the terminal station), then take taxi to Guilin Bravo Hotel.
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B: Guilin Railway Station (桂林站)-> Guilin Bravo Hotel (桂林宾馆）

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2. By taxi: Directly take taxi to Guilin Bravo Hotel (Total price is about 60RMB

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Program

Friday, June 7

9:00-19:00 Registration

Saturday, June 8

Chair: Xuefeng Duan Guilin Bravo Hotel (Jingui Hall) 桂林宾馆二楼金桂厅

8:00-8:30 Opening Ceremony

Opening remarks by Professor Qing-Wen Wang

Opening remarks by Professor Chi-Kwong Li

Opening remarks by Professor Man-Duen Choi

Opening remarks by vice president of Guilin University Of Electronic Technology

8:30-8:50 Group Photo

Chair: Tin-Yau Tam Guilin Bravo Hotel (Jingui Hall) 桂林宾馆二楼金桂厅

8:50-9:30 Speaker: Rajendra Bhatia, Ashoka University, India (p. 10)

Title: Matrix versions of the Hellinger distance

Chair: Chi-Kwong Li Guilin Bravo Hotel (Jingui Hall) 桂林宾馆二楼金桂厅

9:30-9:55 Speaker: Man-Duen Choi, University of Toronto, Canada (p. 12)

Title: The Taming of the Shrew – Who is Afraid of Quantum Entanglements

9:55-10:20 Speaker: Michael Ng, Hong Kong Baptist University (p. 25)

Title: Robust Tensor Completion and Its Applications

10:20-10:30 Coffee Break

Chair: Yiu-Tung Poon Guilin Bravo Hotel (Jingui Hall)桂林宾馆二楼金桂厅

10:30-10:55 Speaker: Pei Yuan Wu, National Chiao Tung University (p. 30)

Title: Numerical Ranges of Foguel Operators

10:55-11:20 Speaker: Yongdo Lim, Sungkyunkwan University, Korea (p. 23)

Title: Polar decompositions

11:20-11:45 Speaker: Hiroyuki Osaka, Ritsumeikan University, Japan (p. 26)

Title: Positive linear maps on low dimensional matrix algebras

11:45-12:10 Speaker: Musheng Wei, Shanghai Normal University, (p. 29)

Title: Pole assignment in the regular row-by-row decoupling problem

12:10-13:30 Lunch

Parallel afternoon sessions for June 8. Session One

Chair: Mohammad Sal Moslehian Guilin Bravo Hotel (Jingui Hall)桂林宾馆二楼金桂厅

13:30-13:55 Speaker: Jinchuan Hou, Taiyuan University of Technology (p. 17)
Title: Constructing entanglement witnesses for infinite-dimensional systems

13:55-14:20 Speaker: Seung-Hyeok Kye, Seoul National University, Korea (p. 20)
Title: On the convex cones arising from classifications of partial entanglement in the three qubit system

14:20-14:45 Speaker: Chi-Kwong Li, College of William and Mary, USA (p. 21)
Title: Numerical ranges and numerical radii of matrices of small sizes

14:45-15:10 Speaker: Yiu-Tung Poon, Iowa State University, USA (p. 26)
Title: Determining system Hamiltonians from eigenstate measurements without correlation functions

15:10-15:35 Speaker: Raymond Nung-Sing Sze, The Hong Kong Polytechnic University (p. 28)
Title: The k-th Operator Norms in Bipartite Quantum System

15:35-15:50 Coffee Break

Chair: Xin Liu Guilin Bravo Hotel (Jingui Hall)桂林宾馆二楼金桂厅

15:50-16:15 Speaker: Dragana Cvetković Ilić, University of Niš, Serbia (p. 18)
Title: Douglas' + Zoltán's lemmas = a tool for solving an operator equation problem

16:15-16:40 Speaker: Jianlong Chen, Southeast University (p. 11)
Title: Generalized inverses and clean decompositions

16:40-17:05 Speaker: Qingxiang Xu, Shanghai Normal University (p. 31)
Title: Douglas range inclusion theorem and the weighted Moore-Penrose inverse in indefinite inner spaces

17:05-17:30 Speaker: Yan-Fei Jing, University of Electronic Science and Technology of China (p. 19)
Title: Two BCG-like variants for conquering loss of orthogonality

17:30-17:45 Speaker: Xiaofeng Chen, Southeast University, (p. 11)
Title: The right core inverses of a product and a companion matrix

17:45-18:00 Speaker: Ting-Ting Feng, East China Normal University (p. 14)
Title: Newton's Method for Coupled Continuous-Time Algebraic Riccati Equations

18:00-19:30 Dinner

Parallel afternoon sessions for June 8. Session Two

Chair: Michael Ng Guilin Bravo Hotel (Duxiu Hall)桂林宾馆二楼独秀厅

13:30-13:55 Speaker: Wen Li, South China Normal University (p. 22)
Title: Perturbation Analysis for Eigenpairs, and (Generalized) Singular Values and Singular Vectors

13:55-14:20 Speaker: Jianzhou Liu, Xiangtan University (p. 24)
Title: A new C-eigenvalue localization set for piezoelectric-type tensors

14:20-14:45 Speaker: Changqing Xu, Suzhou University of Science and Technology (p. 31)
Title: From Matrix Normal Distribution to Tensor Normal Ditributions

14:45-15:10 Speaker: Weiyang Ding, Hong Kong Baptist University (p. 12)
Title: P-tensor and its application in tensor complementarity problems

15:10-15:35 Speaker: Zhenhua Lyu, Hunan University (p. 25)
Title: 0-1 matrices whose k-th powers have bounded entries

15:35-15:50 Coffee Break

Chair: Raymond Nung-Sing Sze Guilin Bravo Hotel (Duxiu Hall)桂林宾馆二楼独秀厅

15:50-16:15 Speaker: Hongke Du, Shaanxi Normal University (p. 13)
Title: Two projections theory based on operator spectrum theory

16:15-16:40 Speaker: Bing Zheng, Lanzhou University (p. 33)
Title: Structured condition numbers for the Tikhonov regularization of discrete ill-posed problems

16:40-17:05 Speaker: Chuanlong Wang, Taiyuan Normal University (p. 29)
Title: Matrix Recovery with Incomplete Samples via Non-monotone Alternating Directional Method

17:05-17:30 Speaker: Zeng-Qi Wang, Shanghai Jiao Tong University (p. 29)
Title: Preconditioned Iteration Method for Stokes Control Problems

17:30-17:45 Speaker: Wei-Ru Xu, East China Normal University (p. 31)
Title: On the construction of real non-self adjoint tridiagonal matrices with prescribed three spectra

17:45-18:00 Speaker: Wen-Ya Shi, China University of Mining and Technology (p. 27)
Title: PCA Plus Graph Embedding Methods Can Be Unstable for Dimensionality Reduction

18:00-19:30 Dinner

Sunday, June 9

Parallel morning sessions for June 9. Session One

Chair: Zhongshan Li Guilin Bravo Hotel (Jingui Hall)桂林宾馆二楼金桂厅

8:00-8:25 Speaker: Yang Zhang, University of Manitoba, Canada (p. 32)
Title: Solving some matrix equations over quaternion and split quaternion

8:25-8:50 Speaker: Yichuan Yang, Beihang University (p. 32)
Title: Hereditary l-ideals of matrix rings over l-rings

8:50-9:15 Speaker: Tongsong Jiang, Heze University (p. 19)
Title: A structure-preserving method for the split quaternion LU decomposition and its applications

9:15-9:40 Speaker: Zhigang Jia, Jiangsu Normal University (p. 20)
Title: Structure-preserving Algorithms for Quaternion Eigenvalue Problem and Applications

9:40-10:05 Speaker: Xin Liu, Macao University of Science and Technology (p. 24)
Title: Real representation approach to quaternion matrix equation involving ϕ-Hermicity

10:05-10:20 Coffee Break

Chair: Yang Zhang Guilin Bravo Hotel (Jingui Hall)桂林宾馆二楼金桂厅

10:20-10:45 Speaker: Zhengda Huang, Zhengjiang University (p. 18)
Title: On the optimal convergence factor of the accelerated parameterized inexact Uzawa method with three parameters for augmented systems

10:45-11:10 Speaker: Milica Andelic, Kuwait University, Kuwait (p. 10)
Title: On eigenvalue inequalities of a matrix whose graph is bipartite

11:10-11:35 Speaker: Pan-Shun Lau, University of Nevada, Reno, USA (p. 21)
Title: Weakly log majorization and determinantal inequalities of unital TPCP maps

11:35-12:00 Speaker: Mengmeng Zhou, Southeast University (p. 33)
Title: The core inverses of linear combinations of two core invertible matrices

12:00-13:30 Lunch

Parallel morning sessions for June 9. Session Two

Chair: Ren-Cang Li Guilin Bravo Hotel (Duxiu Hall)桂林宾馆二楼独秀厅

8:00-8:25 Speaker: Chuan-Qing Gu, Shanghai University (p. 16)
Title: Generalized inverse tensor Padé approximation and tensor Padé-type approximation with application to compute tensor exponential function

8:25-8:50 Speaker: Zheng-jian Bai, Xiamen University (p. 10)
Title: A Riemannian Derivative-Free Polak-Ribiere-Polyak Method for Tangent Vector Field

8:50-9:15 Speaker: Zhaolin Jiang, Linyi University (p. 20)
Title: Inversion and generalized inversion of conjugate-Toeplitz matrices and conjugate-Hankel matrices

9:15-9:40 Speaker: Hong-Kui Pang, Jiangsu Normal University (p. 26)
Title: Fast randomized algorithms for the Teoplitz matrix exponential

9:40-10:05 Speaker: Xiaohui Fu, Hainan Normal University (p. 14)
Title: On some inequalities for sector matrices

10:05-10:20 Coffee Break

Chair: Ngai-Ching Wong Guilin Bravo Hotel (Duxiu Hall)桂林宾馆二楼独秀厅

10:20-10:45 Speaker: Seok-Zun Song, Jeju National University，Korea (p. 27)
Title: The genus of a graph and its linear preserving operator

10:45-11:10 Speaker: Zhongshan Li, Georgia State University, USA (p. 23)
Title: Minimum rank and cycle conditions for sign patterns that allow diagonalizability

11:10-11:35 Speaker: Libin Li, Yangzhou University (p. 22)
Title: The near group matrix equations

11:35-12:00 Speaker: Zhi Chen, Nanjing Agricultural University (p. 11)
Title: On the Maximum of the Permanent of $I - A$

12:00-13:30 Lunch

Parallel afternoon sessions for June 9. Session One

Chair: Ming-Huat Lim Guilin Bravo Hotel (Jingui Hall)桂林宾馆二楼金桂厅

13:30-13:55 Speaker: Tin-Yau Tam, University of Nevada, Reno, USA (p. 28)
Title: Ky Fan's dominance theorem and Eaton triple

13:55-14:20 Speaker: Mao-Ting Chien, Soochow University (p. 12)
Title: Linear matrix representations of ternary forms

14:20-14:45 Speaker: Carlos Fonseca, Kuwait College of Science and Technology, Kuwait (p. 14)
Title: The continuity of the maximum size of P-sets of acyclic matrices

14:45-15:10 Speaker: Guang-Xin Huang, Chengdu University of Technology (p. 17)
Title: Majorization-minimization generalized Krylov subspace methods for ℓ_p-ℓ_q optimization applied to image restoration

15:10-15:25 Coffee Break

Parallel afternoon sessions for June 9. Session Two

Chair: Soonhak Kwon Guilin Bravo Hotel (Duxiu Hall)桂林宾馆二楼独秀厅

13:30-13:55 Speaker: Ren-Cang Li, University of Texas at Arlington, USA (p. 22)
Title: Perturbation Analysis for Matrix Joint Block Diagonalization

13:55-14:20 Speaker: Ngai-Ching Wong, National Sun Yat-sen University (p. 30)
Title: Zero product preservers and homomorphisms between matrix algebras

14:20-14:45 Speaker: Sergey Goryainov, Chelyabinsk State University, Russia (p. 15)
Title: On PI-eigenfunctions of the Star graphs

14:45-15:10 Speaker: Olga Kushel, Shanghai University (p. 20)
Title: D-definite matrices: properties and applications

15:10-15:25 Coffee Break

Chair: Yongdo Lim Guilin Bravo Hotel (Jingui Hall)桂林宾馆二楼金桂厅

15:25-15:50 Speaker: Mohammad Sal Moslehian, Ferdowsi University of Mashhad, Iran (p. 25)
Title: Non-linear positive maps on C^*-algebras

15:50-16:15 Speaker: Soonhak Kwon, Sungkyunkwan University, Korea (p. 21)
Title: On quadratic APN functions and their differential properties

16:15-16:40 Speaker: Ming-Huat Lim, University of Malaya, Malaysia (p. 23)
Title: Some preserver problems on tensor products

16:40-17:05 Speaker: Zhuo-Heng He, Shanghai University (p. 16)
Title: Sylvester-type matrix equations and tensor equations over the quaternion algebra

17:05-17:30 Speaker: Xuefeng Duan, Guilin University of Electronic Technology (p. 13)
Title: Numerical methods for the Hankel tensor approximations

17:30-17:55 Speaker: Delin Chu, National University of Singapore, Singapore (p. 12)
Title: An SVD-Based Algorithm for Orthogonal Low Rank Approximation of Tensors

17:55-18:10 Concluding remarks

18:10-19:30 Dinner

Goodbye

Abstracts

Milica Andelic

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Kuwait University, Kuwait

Title: On eigenvalue inequalities of a matrix whose graph is bipartite

Abstract: We consider the set of real zero diagonal symmetric matrices whose underlying graph, if not told otherwise, is bipartite. Then we establish relations between the eigenvalues of such matrices and those arising from their bipartite complement. Some accounts on interval matrices are provided. We also provide a partial answer to the still open problem posed in (Zhan in SIAM J. Matrix Anal. Appl. 27:851–860, 2006).

Joint work with A. Alazemi and S. K. Simic

Zheng-jian Bai

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Xiamen University

Title: A Riemannian Derivative-Free Polak-Ribiere-Polyak Method for Tangent Vector Field

Abstract: In this talk, we consider the problem of finding a zero of a tangent vector field on a Riemannian manifold. The problem is reformulated as an equivalent Riemannian optimization problem. Then a Riemannian derivative-free Polak-Ribiere- Polyak method combined with a nonmonotone line search is proposed to solve the optimization problem and the global convergence is established under some assumptions. Finally, some numerical tests are reported to show the practical effectiveness of our method.

Rajendra Bhatia

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Ashoka University, India

Title: Matrix versions of the Hellinger distance

Abstract: The classical Hellinger distance between probability vectors p and q is defined as $\| \sqrt{p} - \sqrt{q} \|_2$. A matrix analog is $(tr\mathcal{A} - tr\mathcal{C})^{\frac{1}{2}}$ where $\mathcal{A}$ is the arithmetic mean and $\mathcal{G}$ a geometric mean of positive definite matrices A and B. While $\mathcal{A} = \frac{1}{2}(A + B)$ is uniquely defined, the mean $\mathcal{G}$ could take on different meanings. We discuss four such natural cases, and the interesting problems they lead to.

R. Bhatia, S. Gaubert and T. Jain, Matrix versions of the Hellinger distance, Letters in Math. Phys. (2019).

Jianlong Chen

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Southeast University

Title: Generalized inverses and clean decompositions

Abstract: It is well known that idempotents (projections) and units are very important in generalized inverses. In this talk, we will give the relations between Drazin inverses (group inverses) with clean decompositions, also get the relations between Moore-Penrose inverses (core inverses, dual core inverses) with *-clean decompositions. The expressions of these generalized inverses by using the clean(*-clean) decompositions are given.

Xiaofeng Chen

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Southeast University

Title: The right core inverses of a product and a companion matrix

Abstract: In this paper, characterizations of right core inverse by one-sided invertibility are given. The necessary and sufficient conditions, which guarantee that paq have right core inverses are investigated. Furthermore, characterizations of right core inverses of triangular matrices, 2×2 matrices and a companion matrix are considered.

This is joint work with Jianlong Chen.

Zhi Chen

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Nanjing Agricultural University

Title: On the Maximum of the Permanent of $I - A$

Abstract: Let ω_n^s and $\tilde{\omega}_n^s$ denote the convex sets of $n \times n$ doubly substochastic matrices and row substochastic matrices with the sum of all entries equal to s, respectively. In this talk, we give the upper bound of the permanent of $I - A$ for $A \in \tilde{\omega}_n^s$. We also give the upper bound of the permanent of $I - A$ for $A \in \omega_n^s$, where either n is even, or n is odd and $s \leq n - 1$. For the case when n is odd and $n - 1 < s \leq n$, we give some discussion and conjectures.

Co-author(s): Lei Cao (lcao@georgian.edu, Department of Mathematics, Georgian Court University, Lakewood, NJ 08701, USA).

Mao-Ting Chien

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Soochow University

Title: Linear matrix representations of ternary forms

Abstract: Peter Lax in 1958 conjectured that every hyperbolic ternary form $F(t,x,y)$ admits a determinantal linear matrix representation, i.e., given a hyperbolic ternary form $F(t,x,y)$ of degree n there exist n-by-n real symmetric matrices H and K satisfying $F(t,x,y) = \det(tI_n + xH + yK)$. Recently, Helton and Vinnikov confirmed the Lax conjecture is true. In this talk, we discuss the linear matrix representations of hyperbolic ternary forms associated to some matrices.

This is joint work with Hiroshi Nakazato.

Man-Duen Choi

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University of Toronto, Canada

Title: The Taming of the Shrew – Who is Afraid of Quantum Entanglements

Abstract: I wish to tame the physical quantum entanglements (in disguise of non-commutative geometry), by means of pure mathematics. In particular, I seek the sense and sensibility of quantum computers, with pride and prejudice in terms of matrix inequalities and matrix equations.

Delin Chu

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National University of Singapore, Singapore

Title: An SVD-Based Algorithm for Orthogonal Low Rank Approximation of Tensors

Abstract: In this talk we study the orthogonal low rank approximation problem of tensors in the general setting in the sense that more than one matrix factor is required to be mutually orthonormal, which includes the completely orthogonal low rank approximation and semi-orthogonal low rank approximation as two special cases. We present an SVD-based algorithm. Our SVD-based algorithm updates two vectors simultaneously and maintains the required orthogonality conditions by means of the polar decomposition. The convergence behavior of our algorithm is analyzed for both objective function and iterates themselves and is illustrated by numerical experiments.

Weiyang Ding

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Hong Kong Baptist University

Title: P-tensor and its application in tensor complementarity problems

Abstract: P- and P_0-matrix classes have wide applications in mathematical analysis, linear and nonlinear complementarity problems, etc., since they contain many important special matrices, such as positive (semi-)definite matrices, M-matrices, diagonally dominant matrices, etc. By modifying the existing definitions of P- and P_0-tensors that work only for even order tensors, in this talk, we propose a homogeneous formula for the definition of P- and P_0-tensors. The proposed P- and P_0-tensor classes coincide the existing ones of even orders and include many important structured tensors of odd orders. We show that many checkable classes of structured tensors, such as the nonsingular M-tensors, the nonsingular H-tensors with positive diagonal entries, the strictly diagonally dominant tensors with positive diagonal entries, are P-tensors under the new definition, regardless of whether the order is even or odd. In the odd order case, our definition of P0-tensors, to some extent, can be regarded as an extension of positive semidefinite (PSD) tensors. The theoretical applications of P- and P_0-tensors under the new definition to tensor complementarity problems and spectral hypergraph theory are also studied.

Hongke Du

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Shaanxi Normal University

Title: Two projections theory based on operator spectrum theory

Abstract: In this talk， we will give different proofs of some theorems which are involving with two projections theorems. The new proofs will discover more definite geometry structure of operators.

Xuefeng Duan

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Guilin University of Electronic Technology

Title: Numerical methods for the Hankel tensor approximations

Abstract: Hankel tensor and their approximation problems are of particular interest in the multi-dimensional seismic trace interpolator problem and the asset portfolio.In this paper, we investigate the numerical methods for two kinds of the best Hankel tensor approximation problems. Based on the Vandermonde decomposition of Hankel tensors, the Hankel tensor approximation problem with missing data is transformed into an unconstrained optimization problem, and then the BFGS method is used to solve it. For the Hankel tensor approximation problems with the interval constraint and box constraint, Dykstra's algorithm and its acceleration versions are designed to solve them. Numerical examples illustrate that these methods are feasible and effective.

Ting-Ting Feng

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East China Normal University

Title: Newton's Method for Coupled Continuous-Time Algebraic Riccati Equations

Abstract: We are interested in the solution of the coupled continuous-time algebraic Riccati equations, arising in the optimal control of Markovian jump linear systems. Newton's method is applied to construct the solution, leading to some coupled Lyapunov equations. Several iterative methods for the coupled Lyapunov equations and Newton's method for the coupled continuous-time algebraic Riccati equations have been analyzed. Numerical examples are presented to show the efficiency of new methods.

Carlos Fonseca

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Kuwait College of Science and Technology, Kuwait

Title: The continuity of the maximum size of P-sets of acyclic matrices

Abstract: For a given n-by-n real symmetric matrix A, if the nullity of the principal submatrix of A, obtained from the deletion of a row and a column of the same index, goes up by one, we call such index P-vertex. In this talk, we discuss the problem of characterizing the trees for which there is an acyclic matrix of maximum nullity with an extremal number of P-vertices. The range of possible values for the number of P-vertices is determined as well. Some applications are also discussed.

With Zhibin Du, School of Mathematics and Statistics, Zhaoqing University, China

Xiaohui Fu

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Hainan Normal University

Title: On some inequalities for sector matrices

Abstract: A matrix $T \in \mathbb{M}_{2n}(\mathbb{C})$ can be partitioned as a 2×2 block matrix

$$T = \begin{pmatrix} T_{11} & T_{12} \\ T_{21} & T_{22} \end{pmatrix}, \tag{1}$$

where $T_{jk} \in \mathbb{M}_n(\mathbb{C})$, $j, k = 1, 2$. Gumus et al. proved the following Schatten p-norm and quasinorm inequalities.

Theorem 1. Let $T \in \mathbb{M}_n(\mathbb{C})$ be accretive-dissipative partitioned as in (1). Then

$$\|T_{12}\|_p^p + \|T_{21}\|_p^p \leq 2^{p-1} \|T_{11}\|_p^{\frac{p}{2}} \|T_{22}\|_p^{\frac{p}{2}} \quad \text{for} \ \ p \geq 2 \tag{2}$$

and

$$\|T_{12}\|_p^p + \|T_{21}\|_p^p \leq 2^{3-p}\|T_{11}\|_p^{\frac{p}{2}}\|T_{22}\|_p^{\frac{p}{2}} \quad \text{for } 0 < p \leq 2. \tag{3}$$

Basing on the above theorem, Kittaneh and Sakkijha presented the following norm inequalities, which compares the Schatten p-norms and the quasinorms of the off diagonal blocks and those of the diagonal blocks, respectively.

Theorem 2. For $i, j = 1, 2, \ldots, n$, let T_{ij} be square matrices of the same size such that the block matrix

$$T = \begin{pmatrix} T_{11} & T_{12} & \cdots & T_{1n} \\ T_{21} & T_{22} & \cdots & T_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ T_{n1} & T_{n2} & \cdots & T_{nn} \end{pmatrix}$$

is accretive-dissipative. Then

$$\sum_{i \neq j} \|T_{ij}\|_p^p \leq (n-1)2^{p-2} \sum_{i=1}^{n} \|T_{ii}\|_p^p \quad \text{for } p \geq 2, \tag{4}$$

and

$$\sum_{i \neq j} \|T_{ij}\|_p^p \leq (n-1)2^{2-p} \sum_{i=1}^{n} \|T_{ii}\|_p^p \quad \text{for } 0 < p \leq 2. \tag{5}$$

In this talk, we first extend their results to sector matrices. We also simplify their proofs on two determinant inequalities.

Sergey Goryainov

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Chelyabinsk State University, Russia

Title: On PI-eigenfunctions of the Star graphs

Abstract: Denote by Sym_n the symmetric group on $\{1, 2, \ldots, n\}$. We investigate eigenfunctions of the Star graph $S_n = Cay(\mathrm{Sym}_n, S)$, $n \geqslant 2$, which is the Cayley graph on Sym_n with generating set $S = \{(1\ i) \mid 2 \leqslant i \leqslant n\}$. For any $n \geqslant 4$, the spectrum of the Star graph S_n is integral and consists of all integers in the range $-(n-1), \ldots, n-1$ (see [1]). This follows from the fact that the adjacency matrix of S_n coincides with the transformation matrix of the Jucys-Murphy element $J_n = (1\ n) + \ldots + (n-1\ n)$ acting on the group algebra $\mathbb{C}[\mathrm{Sym}_n]$.

In this talk, for any positive integers $n \geqslant 3$ and m with $n > 2m$, we present a family of $(1, -1, 0)$-eigenfunctions (we call them *PI-eigenfunctions*) of the Star graph S_n with eigenvalue $n - m - 1$, and establish a connection between these eigenfunctions and the standard basis of a Specht module.

More precisely, we embed a permutation module into $\mathbb{C}[\mathrm{Sym}_n]$ and prove that an eigenfunction of the Jucys-Murphy operator J_n with eigenvalue $n-m-1$, $n>2m$, given by a polytabloid can be expressed as a sum of PI-eigenfunctions of S_n. The discussed results are presented in [2].

Based on joint work in progress with

Vladislav Kabanov, Elena Konstantinova, Leonid Shalaginov and Alexandr Valyuzhenich

References

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Shanghai University

Title: Generalized inverse tensor Padé approximation and tensor Padé-type approximation with application to compute tensor exponential function

Abstract: Tensor exponential functions have been widely used in cybernetics and various engineering fields. In this paper, an effective generalized tensor inverse is presented to define the generalized inverse tensor Padé approximation (GTPA). In addition, a continuous fractional algorithm and ϵ-algorithm are constructed for GTPA. These two algorithms can be programmed to implement recursive calculations, which are characterized by the fact that it is not necessary to calculate the product of the tensors in the calculation nor to calculate the inverse of tensors. And, furthermore, tensor Padé-type approximation (TPTA) is defined by introducing a generalized linear functional for the first time. The expression of TPTA is provided with the generating function form. Moreover, by means of formal orthogonal polynomials, we propose an efficient algorithm for computing TPTA. As an application, the GTPA and TPTA for computing the tensor exponential function are presented. Numerical examples are given to demonstrate the efficiency of these two algorithms.

Co-author(s): Yi-Zheng Huang, Peng-Fei Tang, Xiang-Long Jiang, Yong Liu

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Title: Sylvester-type matrix equations and tensor equations over the quaternion algebra

Abstract:

Sylvester-type equations have many applications in neural network, robust control, output feedback control, the almost noninteracting control by measurement feedback problem, graph theory, and so on.

In this talk, we consider some Sylvester-type matrix equations and tensor equations over the quaternion algebra. We present some necessary and sufficient conditions for the solvability to these Sylvester-type matrix equations and tensor equations over the quaternion algebra. Moreover, the general solutions to these quaternion matrix equations and tensor equations are explicitly given when they are solvable. We also provide some numerical examples to illustrate our results.

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Title: Constructing entanglement witnesses for infinite-dimensional systems

Abstract: Let H and K be infinite-dimensional complex Hilbert spaces. For $\{A_n\}_{n=1}^{\infty} \subset \mathcal{B}(H)$ and $\{B_n\}_{n=1}^{\infty} \subset \mathcal{B}(K)$, we show that, under some mild condition, $\Phi = \sum_{n=1}^{\infty} A_n \otimes B_n$ is self-adjoint if and only if there are self-adjoint operators $\{C_n\}_{n=1}^{\infty} \subset \mathcal{B}(H)$ and $\{D_n\}_{n=1}^{\infty} \subset \mathcal{B}(K)$ such that $\Phi = \sum_{n=1}^{\infty} C_n \otimes D_n$. This result is then applied to prove that, (1) for any orthonormal sequences $\{E_k\}_{k=1}^{\infty}$ and $\{F_k\}_{k=1}^{\infty}$ consist of observables respectively in $\mathcal{C}_2(H)$ and $\mathcal{C}_2(K)$, if $\sum_k E_k \otimes F_k$ converges under the weak operator topology and if $W = I - \sum_k E_k \otimes F_k$ is not positive, then W is a decomposable entanglement witness; (2) every state ρ of system $H \otimes K$ has a Schmidt decomposition $\rho = \sum_k \delta_k E_k \otimes F_k$ with $\{E_k\}$ and $\{F_k\}$ orthonormal sequences of observables. These generalize the results in [Phys. Rev. Lett. 95, 150504 (2005)] and [Int. J. Theor. Phy., 50 (2011), 1245-1254] to infinite-dimensional systems and answer a problem raised in the second paper.

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Title: Majorization-minimization generalized Krylov subspace methods for ℓ_p-ℓ_q optimization applied to image restoration

Abstract: We present a sample abstract. A new majorization-minimization framework for ℓ_p-ℓ_q image restoration is presented. The solution is sought in a generalized Krylov subspace that is build up during the solution process. Proof of convergence to a stationary point of the minimized ℓ_p-ℓ_q functional is provided for both convex and nonconvex problems. Computed examples illustrate that

high-quality restorations can be determined with a modest number of iterations and that the storage requirement of the method is not very large. A comparison with related methods shows the competitiveness of the method proposed.

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Title: On the optimal convergence factor of the accelerated parameterized inexact Uzawa method with three parameters for augmented systems

Abstract: nder the assumption that all eigenvalues of the preconditioned Schur complement are real, we present an analytical proof for obtaining the optimal convergence factor of the real accelerated parameterized inexact Uzawa (APIU) method when $P = A$. It is proved that the optimal convergence factor is the same as that of the GSOR method, which was published at the same time, and that it can be attained only at the unique optimum point of parameters, regardless of whether $m > n$ or $m = n$. In addition, we generalize the APIU method and analyse the relationship between the APIU method and other Uzawa-like methods.

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Title: Douglas' + Zoltán's lemmas = a tool for solving an operator equation problem

Abstract: The existence of a positive solution of the equation $AXB = C$ was considered in different settings but only under additional conditions including that of regularity, as well as under certain range conditions such as $\mathcal{R}(B) \subseteq \overline{\mathcal{R}(A^*)}$. In this talk we will answer this open question of the existence of a positive solution of the operator equation $AXB = C$ without any additional range or regularity assumptions using two well-known results of Douglas and Zoltán. Also we will give a general form of a positive solution and consider some possible applications.

Joint work with professors Qingxiang Xu and Qing-Wen Wang

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Title: A structure-preserving method for the split quaternion LU decomposition and its applications

Abstract: In this paper, for the first time, the structure-preserving Gauss transformation is defined. Then by means of its real representation matrix, we present a novel structure-preserving algorithm for the triangular decomposition (LU decomposition) of the split quaternion matrix. Numerical experiments show that the structure-preserving algorithm is effective.

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Title: Two BCG-like variants for conquering loss of orthogonality

Abstract: The block conjugate gradient (BCG) method has always been considered to be attractive for solving symmetric positive definite (SPD) linear systems with multiple right-hand sides given simultaneously. When applied to ill-conditioned matrices (or rank deficiency situation, which can result ill-conditioned matrices) in finite precision arithmetic, the theoretical orthogonality among the computed vectors in the BCG-like methods may be lost, which may deteriorate the convergence rate seriously. In this talk, we introduce two effective BCG variants by employing two strategies to respectively handle two common cases of loss of orthogonality.

This is joint work with Yan-fei Xiang, Ting-zhu huang.

Zhigang Jia

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Jiangsu Normal University

Title: Structure-preserving Algorithms for Quaternion Eigenvalue Problem and Applications

Abstract: In this talk, we present some structure-preserving algorithms for quaternion eigenvalue problem, and indicate their applications to color face recognition, watermarking, etc.

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Linyi University

Title: Inversion and generalized inversion of conjugate-Toeplitz matrices and conjugate-Hankel matrices

Abstract: In this talk, the inverses and generalized inversion of conjugate-Toeplitz (CT) and conjugate-Hankel (CH) matrices can be expressed by the Gohberg-Heinig type formula. We obtain an explicit inverse and generalize dinversion formulas of conjugate Toeplitz matrix. Similarly, the formula and the decomposition of the inverse and generalized inversion of a conjugate-Hankel matrix are provided. Also the stability of the inverse and generalized inversion formulas of CT and CH matrices are discussed. Examples are provided to verify the feasibility of the algorithms.

Olga Kushel

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Title: D-definite matrices: properties and applications

Abstract: Given an LMI region D, we define the class of D-definite matrices, generalizing the class of positive (negative) definite matrices. We study the properties of the obtained matrix class. Basing on these properties, we study the factorization of D-stable matrices, in particular, the connection between D-stability of a matrix $\mathbf{A}$ and spectra localization of the unitary factor $\mathbf{U}$ in its polar decomposition $\mathbf{A} = \mathbf{UP}$. We apply the obtained results to the study of robust properties of linear dynamical systems.

Seung-Hyeok Kye

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Title: On the convex cones arising from classifications of partial entanglement in the three qubit system

Abstract: In order to classify partial entanglement of multi-partite states, it is natural to consider the convex hulls, intersections and differences of basic convex cones obtained from partially separable states with respect to partitions of systems. In this paper, we consider convex cones consisting of X-shaped three qubit states arising in this way. The class of X-shaped states includes important classes like Greenberger-Horne-Zeilinger diagonal states. We find all the extreme rays of those convex cones to exhibit corresponding partially separable states. We also give characterizations for those cones which give rise to necessary criteria in terms of diagonal and anti-diagonal entries for general three qubit states.

This is co-worked with Kyung Hoon Han.

Soonhak Kwon

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Title: On quadratic APN functions and their differential properties

Abstract: APN(almost perfect nonlinear) functions over binary finite fields play an important role in constructing block ciphers such as AES. A differential of quadratic APN function becomes linearized polynomial (which can be viewed as a linear transformation) whose kernel is of dimension 1. We discuss the relations between quadratic APN functions and it's corresponding linearized polynomials.

Pan-Shun Lau

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Title: Weakly log majorization and determinantal inequalities of unital TPCP maps

Abstract: Let $\Phi : \mathbf{M}_n \to \mathbf{M}_n$ be a unital trace preserving completely positive (TCPC) map and $A \in \mathbf{M}_n$ be a positive definite matrix. We study weakly log majorization between $\Phi(A)$ and A. Determinantal inequalities of $\Phi(A)$ and A are obatined. Moreover, by considering some special classes of unital TPCP maps, some new and known matrix inequalities are given. This is joint work with Tin-Yau Tam (UNR).

Chi-Kwong Li

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Title: Numerical ranges and numerical radii of matrices of small sizes

Abstract: We describe some problems and results involving numerical ranges and numerical radii of

matrices of size at most three.

Libin Li

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Yangzhou University

Title: The near group matrix equations

Abstract: The the non-integer matrix (NIM) solutions of matrix equations are closely related to the NIM representations over fusion rings and the module categories over tensor categories. In this talk we shall introduce a general theory of irreducible NIM representations over near group fusion rings. We give the minimum upper the bound of rank of NIM representation over a near group fusion ring, and the general classification methods of irreducible NIM representations over near group fusion rings. We give explicitly the classifications of irreducible NIM representations over some near group fusion rings.

Ren-Cang Li

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Title: Perturbation Analysis for Matrix Joint Block Diagonalization

Abstract: The matrix joint block diagonalization problem (JBDP) of a given matrix set $\mathcal{A} = \{A_i\}_{i=1}^m$ is about finding a nonsingular matrix W such that all $W^{\mathrm{T}}A_iW$ are block diagonal. It includes the matrix joint diagonalization problem (JDP) as a special case for which all $W^{\mathrm{T}}A_iW$ are required diagonal. Generically, such a matrix W may not exist, but there are practically applications such as multidimensional independent component analysis (MICA) for which it does exist under the ideal situation, i.e., no noise is presented. However, in practice noises do get in and, as a consequence, the matrix set is only approximately block diagonalizable, i.e., one can only make all $\widetilde{W}^{\mathrm{T}}A_i\widetilde{W}$ nearly block diagonal at best, where $\widetilde{W}$ is an approximation to W, obtained usually by computation. This motivates us to develop a perturbation theory for JBDP to address, among others, the question: how accurate this $\widetilde{W}$ is. Previously such a theory for JDP has been discussed, but no effort has been attempted for JBDP yet. In this talk, we will present an error bound and propose a condition number for JBDP. Numerical tests validate the theoretical results.

This is a joint work with Yunfeng Cai (Peking University).

Wen Li

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South China Normal University

Title: Perturbation Analysis for Eigenpairs, and (Generalized) Singular Values and Singular Vectors

Abstract: In this talk, we summarize some works in recent years on the perturbation analysis of eigenpairs, and (generalized) singular values and singular vectors for some spectral matrices.

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Title: Minimum rank and cycle conditions for sign patterns that allow diagonalizability

Abstract: A sign pattern (matrix) is a matrix whose entries are from the set $\{+, -, 0\}$. A square sign pattern $\mathcal{A}$ is said to allow diagonalization if there is a diagonalizable real matrix whose entries have signs specified by the corresponding entries of $\mathcal{A}$. It is known that for every sign pattern that allows diagonalization, its maximum composite cycle length is greater than or equal to its minimum rank. It is also known that a sign pattern allows diagonalization if and only if it allows rank-principality. Characterization of sign patterns that allow diagonalization has been a long-standing open problem. In this talk, we establish some new necessary/sufficient conditions for a sign pattern to allow diagonalization, and explore possible ranks of diagonalizable matrices with a specified sign pattern. In particular, it is shown that every irreducible sign pattern with minimum rank 2 allows diagonalization at rank 2 and also at the maximum rank. Sign patterns whose maximal zero submatrices are "strongly disjoint" are shown to have a composite cycle consisting of 1-cycles, 2-cycles, and at most one 3-cycle, with total length equal to the maximum rank; for such sign patterns, the maximum composite cycle length is invariant under row and column permutations.

Ming-Huat Lim

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Title: Some preserver problems on tensor products

Abstract: In this talk we discuss the structure theorem of R.Westwick regarding linear maps between tensor product spaces that send decomposable elements to decomposable elements and survey some results about linear maps on tensor products of matrices that preserve a certain rank property. Some works, joint with J. Lau, concerning the above topics will be presented.

Yongdo Lim

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Title: Polar decompositions

Abstract: We present several polar decompositions on the Lie group of invertible matrices of the form $M = f(P)UP$, where U is a unitary matrix, P is a positive definite matrix, and f is a self-map on the convex cone of positive definite matrices. We discuss some basic properties of the corresponding unitary factor, absolute value and Aluthge transform in comparison with the classical polar decomposition.

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Xiangtan University

Title: A new C-eigenvalue localization set for piezoelectric-type tensors

Abstract: It is well known that C-eigenvalues and C-eigenvectors have become increasingly significant in piezoelectric effect and converse piezoelectric effect. In this talk, we give a new localization theorem to capture all C-eigenvalues for a piezoelectric-type tensor basing on the components of C-eigenvectors. Moreover, numerical examples are shown that our new C-eigenvalue localization set is more precise than existing results.

Xin Liu

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Macao University of Science and Technology

Title: Real representation approach to quaternion matrix equation involving ϕ-Hermicity

Abstract: Let $H^{m\times n}$ denote the set of all $m \times n$ matrices over the real quaternion algebra H. For $A \in H^{m\times n}$, we denote by A_ϕ the $n \times m$ matrix obtained by applying ϕ entrywise to the transposed matrix A^T, where ϕ is a nonstandard involution of H. $A \in H^{n\times n}$ is said to be ϕ-Hermitian or ϕ-skew-Hermitian if $A = A_\phi$ or $A = -A_\phi$, respectively. We give a complete characterization of the nonstandard involutions ϕ of H and their conjugacy properties, then we establish a new real representation of a quaternion matrix which mapping a ϕ-Hermitian or ϕ-skew-Hermitian quaternion matrix into a skew-symmetric or symmetric real matrix, respectively. By using this approach, we derive some necessary and sufficient conditions for existence of a ϕ-Hermitian solution or ϕ-skew-Hermitian solution to the quaternion matrix equation $AX = B$. Moreover, we give the solutions to the quaternion equation when it is solvable.

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Title: 0-1 matrices whose k-th powers have bounded entries

Abstract: Let $\Gamma(n,k,t)$ be the set of 0-1 matrices of order n such that each entry of the k-th powers of these matrices is bounded by t. Let $\gamma(n,k,t)$ be the maximum number of nonzero entries of a matrix in $\Gamma(n,k,t)$. Given any positive integer t, we prove that $\gamma(n,k,t) = n(n-1)/2$ for $k \geq n-1$ when n is sufficiently large, and this maximum number is attained at A if and only if A is permutation similar to the upper triangular tournament matrix of order n.

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Title: Non-linear positive maps on C^*-algebras

Abstract: The aim of this talk is to present some basic properties of (not necessarily linear) positive maps between C^*-algebras. We study some classes of n-positive maps. We show that for every unital 3-positive map $\Phi : \mathcal{A} \to \mathcal{B}$ between C^*-algebras the validity of $\Phi(A^*A) = \Phi(A)^*\Phi(A)$ for some $A \in \mathcal{A}$ implies that $\Phi(XA) = \Phi(X)\Phi(A)$ for all $X \in \mathcal{A}$. Moreover, we show that this result does not hold for non-linear 2-positive maps, in general. We then prove that every 3-positive map $\Phi : \mathcal{A} \to \mathcal{B}$ is superadditive on positive elements whenever $\Phi(0) = 0$, and yield some new results on the n-positivity of any C^*-norm. Finally, we introduce a class of positive maps $\Phi : \mathcal{A} \to \mathcal{B}$, and show that the inequality $\Phi(\alpha A) \leq \alpha\Phi(A)$ holds for all $\alpha \in [0,1]$ and all positive elements $A \in \mathcal{A}$ if and only if $\Phi(0) = 0$. Furthermore, we show that if for some α in either the unit ball of the complex plane or the positive real numbers with $|\alpha| \neq 0, 1$, the equality $\Phi(\alpha I) = \alpha I$ holds, then Φ is additive on positive elements of $\mathcal{A}$.

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Hong Kong Baptist University

Title: Robust Tensor Completion and Its Applications

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.

Hiroyuki Osaka

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Title: Positive linear maps on low dimensional matrix algebras

Abstract: For $n \in N$ let M_n be the algebra of square $n \times n$ matrices and $\phi : M_m \times M_n$ be a linear map. We say ϕ is positive if $\phi(M + m) \times M + n$, where $M + n$ is the set of all positive semi-definite matrices. Moreover, ϕ is called a k-positive map if the canonical extension map $id_k\ \phi$ of ϕ which is defined by $M_k(M_m) \times [x_{ij}] \mapsto [\phi(x_{ij})]$, is positive. If ϕ is k-positive for each $k \in N$ then we say that ϕ is completely positive. In this talk we present a survey about positive linear maps on matrix algebras. We give an algorithm for the construction of k-positive maps that are not completely positive. Using this characterization we try to construct 2-positive that is not decomposable. We also explain its application to Quantum Information Theory.

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Title: Fast randomized algorithms for the Teoplitz matrix exponential

Abstract: In this talk, we propose a randomization based algorithms for large scale Toeplitz matrix exponentials. A randomized algorithms combined with the shift-invert Krylov subspace method is developed to fast compute the Toeplitz matrix exponential. The effect of the inexact computation of Toeplitz matrix exponential and vector products to the final accuracy is investigated theoretically. Numerical experiments are performed to verify the effectiveness and accuracy of the proposed algorithm.

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Title: Determining system Hamiltonians from eigenstate measurements without correlation functions

Abstract: For a local Hamiltonian $H = \sum_i c_i A_i$, with A_is being local operators, it is known that H could be encoded in a single (non-degenerate) eigenstate $|\psi\rangle$ in certain cases. One case is that the system satisfies the Eigenstate Thermalization Hypothesis (ETH), where the local reduced density matrix asymptotically become equal to the thermal reduced density matrix. In this case, one can reproduce H (i.e. c_is) from local measurement results $\langle\psi|A_i|\psi\rangle = a_i$. Another case is that the two-

point correlation functions $\langle\psi|A_iA_j|\psi\rangle$ are known, one can reproduce H without satisfying ETH. However, in practice, nonlocal correlation functions $\langle\psi|A_iA_j|\psi\rangle$ are not easy to obtain. In this work, we develop a method to determine H (i.e. c_is) with local measurement results $\langle\psi|A_i|\psi\rangle = a_i$ and without the ETH assumption, by reformulating the task as an unconstrained optimization problem of some target function of c_is. Our method applies in general cases for known form of A_is, and is tested numerically for both randomly generated A_is and also the case that A_is are local operators. Our result shed light on the important question of how a single eigenstate can encode the full system Hamiltonian, indicating a rather surprising answer that only local measurements are enough without additional assumptions, for generic cases.

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Title: PCA Plus Graph Embedding Methods Can Be Unstable for Dimensionality Reduction

Abstract: PCA plus graph embedding methods such as PCA+LDA, PCA+LDE, PCA+LPP and PCA+MFA are very popular techniques for dimensionality reduction. In these type of methods, the principal component analysis (PCA) is used first, and then the graph embedding methods are applied. In practice, however, the data is often perturbed or contaminated. In this work, we point out that the PCA plus graph embedding methods can be unstable in terms of classification performance. A condition number on the distance between the exact projection matrix and the perturbed one is introduced, to interpret this phenomenon from a theoretical point of view. To overcome the difficulty, we propose a framework of PCA plus *exponential* graph embedding methods to take the place of PCA plus graph embedding methods. The computational overhead of the proposed methods is comparable to that of their original counterpart, but the former are much more stable than the latter. Numerical experiments show the effectiveness of our theoretical results, and demonstrate the efficiency of the new methods on real-world data bases.

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Title: The genus of a graph and its linear preserving operator

Abstract: A graph has genus k if it can be embedded without edge crossings on a smooth orientable surface of genus k and not on one of genus $k-1$. A mapping of the set of graphs on n vertices to

itself is called a linear operator if the image of a union of graphs is the union of their images and if it maps the edgeless graph to the edgeless graph. We investigate linear operators on the set of graphs on n vertices that map graphs of genus k to graphs of genus k and graphs of genus $k+1$ to graphs of genus $k+1$. We show that such linear operators are necessarily vertex permutations. Similar results with different restrictions on the genus k preserving operators give the same conclusion.

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Raymond Nung-Sing Sze

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Title: The k-th Operator Norms in Bipartite Quantum System

Abstract: In a bipartite quantum system, the Schmidt number of a pure state is the least number of nonzero Schmidt coefficients in the Schmidt decomposition. Also, the Schmidt number of a mixed state is defined to be the least number k such that the mixed state can be written as a convex combination of pure state with Schmidt number at most k. Notice that a mixed state is separable if and only if the Schmidt number of the state is one. Related to Schmidt number, researchers recently considered the so-called k-th operator norm of an operator X defined by

$$\|X\|_{S(k)} = \sup\{\, |\langle\psi_1|X|\psi_2\rangle| : |\psi_1\rangle \text{ and } |\psi_2\rangle \text{ have Schmidt number at most } k\}.$$

In this talk, we will present some basic properties of k-th operator norm and its connection to other topics in quantum information.

Tin-Yau Tam

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Title: Ky Fan's dominance theorem and Eaton triple

Abstract: A generalization of the Dominance Theorem of Ky Fan on the unitarily invariant norm is obtained in the content of Eaton triple. The results of Zietak on the characterization of the set of dual matrices of a given matrix and the faces of the unit ball, both with respect to a unitarily invariant norm, are also extended in the same context. The notion of dual matrices of a given matrix A with respect to a unitarily invariant norm is related to the subdifferential of the norm at A. A generalization of So's characterization of the extreme points of the unit ball is given.

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Title: Matrix Recovery with Incomplete Samples via Non-monotone Alternating Directional Method

Abstract: Low-rank and sparse structures have been frequently exploited in matrix recovery and robust matrix completion. In this paper, we develop an alternating directional method and its variant equipped with the non-monotone search procedure for solving low-rank and sparse structure matrix completion problems, where the concerned matrix with incomplete data is separable into a low-rank part and a sparse part. To some extent, the non-monotone strategy greatly improves the performance of the alternating directional method. Theoretically, we proof the global convergence of the two proposed algorithms under some mild conditions. The efficiency and effectiveness of the proposed algorithms are demonstrated by solving some instances of random incomplete matrix recovery problems.

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Shanghai Jiao Tong University

Title: Preconditioned Iteration Method for Stokes Control Problems

Abstract: In this talk, we study the numerical behavior of preconditioned modified Hermitian/skew-Hermitian splitting (PMHSS) iteration method and PMHSS preconditioner for solving the Stokes control problems. The theoretical results show that PMHSS iteration method is convergent as the spectral radius of the iterative matrix is less than $\sqrt{2}/2$. The PMHSS preconditioner clusters the eigenvalues on a unitary line segment. The PMHSS preconditioner induces parameter-free and mesh-size free flexible GMRES method. A more practical preconditioner is proposed to avoid the inner iteration. The eigenvalues distribution of the preconditioned matrix is described to guarantee the efficiency.

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Title: Pole assignment in the regular row-by-row decoupling problem

Abstract: By applying the canonical decomposition of the right invertible system C,A,B, in this talk we derive a general formula of all solutions to the regular row-by-row decoupling problem. Based on this formula we characterize all attainable transfer function matrices for the decoupling and pole assignment problem in general cases. The results obtained in this paper extend those in the literature.

This is a joint work with Dongmei Shen.

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National Sun Yat-sen University

Title: Zero product preservers and homomorphisms between matrix algebras

Abstract: we give concrete description of the structures of ring, algebra and Jordan homomorphisms, and linear disjointness preservers between real or complex matrix algebras of different sizes. After giving full descriptions of ring, algebra and Jordan homomorphisms between matrices, we show that a linear map $\Phi : M_n \to M_r$ preserving zero products carries the form

$$\Phi(A) = S \begin{pmatrix} R \otimes A & 0 \\ 0 & \Phi_0(A) \end{pmatrix} S^{-1},$$

for some invertible matrices R in M_k, S in M_r and a zero product preserving linear map $\Phi_0 : M_n \to M_{r-nk}$ with range consisting of nilpotent matrices. When $\Phi(I_n)$ is diagonalizable, especially self-adjoint, complex normal, or an idempotent, we have $\Phi_0(X)\Phi_0(Y) = 0$ for all X, Y in M_n. If Φ preserves self-adjoint matrices, then we can assume $S^{-1} = S^*$, $R^* = R$ and $\Phi_0 = 0$. Similar results for double zero product preservers and orthogonality preservers are obtained.

This is a joint work with Chi-Kwong Li (College of William and Mary), Ming-Cheng Tsai (National Taipei University of Science and Technology) and Ya-Shu Wang (National Chung Hsing University).

Pei Yuan Wu

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National Chiao Tung University

Title: Numerical Ranges of Foguel Operators

Abstract: A Foguel operator F_T is a 2-by-2 operator matrix whose entry at the $(1,1), (1,2), (2,1)$ and $(2,2)$ position is $S*$, $T, 0$ and S, respectively, where S denotes the simple unilateral shift. Such operators arise from works of Foguel and Halmos in 1960s in constructing counterexamples to Sz.-Nagy' s conjecture that every power-bounded operator is similar to a contraction. Here we report our recent work on the numerical ranges W(.) and numerical radii w(.) of such operators. For example, we show that (1) $1 <= w(F_T) <= 1 + (IITII/2)$ for any T, (2) if T is compact, then $w(F_T) < 1 + (IITII/2)$ if and only if T is nonzero, (3) if T is a unitary diagonal operator, then $sqrt(5)/2 < w(F_T) <= 3/2$.

A Foguel-Halmos operator is an F_T with $T = diag(a_1, a_2, \cdots)$ such that $a_n = 1$ if $n = 3^k$ for some $k >= 1$, and $a_n = 0$ otherwise. For such operators, we show that (1) $W(F_T)$ is neither open nor

closed, (2) the closure of $W(F_T)$ is not an elliptic disc, (3) $w(F_T)$ is strictly between $1.1180\cdots(=sqrt(5)/2)$ and $1.1392\cdots$, and (4) $W(F_T)$ contains the circular disc $z : IzI < sqrt(5)/2$.

Changqing Xu

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Suzhou University of Science and Technology

Title: From Matrix Normal Distribution to Tensor Normal Ditributions

Abstract: By a multivariate normal distribution, we usually mean a normal distribution of a random vector. A multivariate normal distribution of a random matrix X, which comprises the normal vector version, was formally put forward in 2005 in a monograph [1] by T. Kollo and D. von Rosen, and can be regarded as the bilinear form of a vector version, where the rows distribution and columns distribution are separately required to follow some uniform (not the same) multivariate normal distributions. In this talk, we will review some important properties of a matrix normal distribution (MND). Then we define the tensor normal distribution (TND) and extend some results to TND. We show that all the multivariate normal distribution of the other version can be regarded as a special case of TND.

[1] T. Kollo and D. von Rosen, Advanced Multivariate Statistics with Matrices, Springer, Amsterdam, 2005.

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Shanghai Normal University

Title: Douglas range inclusion theorem and the weighted Moore-Penrose inverse in indefinite inner spaces

Abstract: The weights appearing in the literatures are usually supposed to be positive definite. Little has been done in the case when the weights are only invertible and self-adjoint. In this talk, we will focus on the indefinite inner-products induced by the latter kind of weights on Hilbert C*-modules. The talk will focus on the generalizations of Douglas range inclusion theorem as well as the weighted Moore-Penrose inverse in indefinite inner spaces.

Wei-Ru Xu

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East China Normal University

Title: On the construction of real non-selfadjoint tridiagonal matrices with prescribed three spectra

Abstract: Non-selfadjoint tridiagonal matrices play a role in the discretization and truncation of the

Schrödinger equation in some extensions of quantum mechanics, a research field particularly active in the last two decades. In this report, we consider an inverse eigenvalue problem that consists of the reconstruction of such a real non-selfadjoint matrix from its prescribed eigenvalues and those of two complementary principal submatrices. Necessary and sufficient conditions under which the problem has solution are presented, and uniqueness is discussed. The reconstruction is performed by using a modified unsymmetric Lanczos algorithm, designed to solve the proposed inverse eigenvalue problem. Some illustrative numerical examples are given to test the efficiency and feasibility of our reconstruction algorithm.

Co-author(s): Prof. Natália Bebiano and Prof. Guo-Liang Chen.

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Beihang University

Title: Hereditary l-ideals of matrix rings over l-rings

Abstract: Let R be an l-ring and let $M_n(R)$ be the matrix ring over R. An l-ideal I of $M_n(R)$ is called hereditary if $I = M_n(I)$ for some l-ideal I of R. In this talk, we consider the following question: Which conditions on R determine that any l-ideal of $M_n(R)(n > 1)$ is hereditary? We first show that if R has the identity element 1 then all l-ideals of $M_n(R)$ are hereditary. It is natural to guess that the result also holds for arbitrary l-rings. However, using infinitesimal continuous function rings, we construct counterexamples to show that it is not the case if R does not contain 1. Finally, we answer the question completely.

This is a joint work with R. Bai, and the paper has been published in LINEAR AND MULTILINEAR ALGEBRA https://doi.org/10.1080/03081087.2018.1497583

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Title: Solving some matrix equations over quaternion and split quaternion

Abstract: In this talk we present some methods to solve several classes of matrix equations over quaternion and split quaternion which involve conjugate transposes. The conditions for the existence and uniqueness of solutions to these (split) quaternion matrix equations are derived. Also, we provide some numerical examples.

Co-author(s): Xin Liu and Qing-Wen Wang

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Lanzhou University,

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

Abstract: The possibly most popular regularization method for solving the least squares problem $\min \|Ax - b\|_2$ with a highly ill-conditioned or rank deficient coefficient matrix A is the Tikhonov regularization method. In this paper we present the explicit expressions of the normwise, mixed and componentwise condition numbers for the Tikhonov regularization when A has linear structures. The structured condition numbers in the special cases of nonlinear structure i.e. Vandermonde and Cauchy matrices are also considered. Some comparisons between structured condition numbers and unstructured condition numbers are made by numerical experiments. In addition, we also derive the normwise, mixed and componentwise condition numbers for the Tikhonov regularization when the coefficient matrix, regularization matrix and right-hand side vector are all perturbed, which generalize the results obtained by Chu et al. [Numer. Linear Algebra Appl. 18 (2011) 87–103].

Co-author(s): Lingsheng Meng

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Southeast University

Title: The core inverses of linear combinations of two core invertible matrices

Abstract: In this talk, we present the core inverses of linear combinations of two core invertible matrices. Similarly, the dual core inverses of linear combinations of two dual core invertible matrices are also given. Furthermore, sufficient conditions, which guarantee that the difference of two core invertible matrices is core invertible, are presented.

This is joint work with Jianlong Chen.

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桂林电子科技大学数学与计算科学学院简介

桂林电子科技大学是省部共建高校、国家“中西部高校基础能力建设工程”入选高校、广西壮族自治区重点建设高校、四所电子科大之一。学校现有博士学位授权一级学科点 4 个，硕士学位授权一级学科点 17 个，具有硕士研究生推免资格高校。学校开设本科专业 70 个，有教职工 2900 余人。教师队伍中有中组部“千人计划”人选 2 人、“长江学者”特聘教授 3 人、“长江学者”讲座教授 2 人、国家杰出青年基金获得者 7 人、国家百千万人才工程人选 5 人、全国杰出专业技术人才 1 人、全国优秀科技工作者 2 人、国务院政府特殊津贴专家 34 人、中科院“百人计划”人选 4 人、教育部“新世纪优秀人才支持计划”人选 3 人、广西“八桂学者”8 人。，“工程学”学科进入 ESI 全球前 1%。学校现有全日制在校学生 40600 余人，其中硕博士研究生 4000 余人。

桂林电子科技大学数学与计算科学学院拥有“网络空间安全理论基础”二级学科方向博士点和数学、应用统计两个硕士点。学院开设有信息与计算科学、应用统计学、数学与应用数学三个本科专业。“应用数学”学科为广西重点学科，“信息与计算科学”专业为国家级特色专业，“工科数学教学团队”为广西区级教学团队。拥有广西密码学与信息安全重点实验室和广西数据分析与计算重点实验室。全院现有教职工 78 人，其中专任教师 68 人，教授 22 人，副教授 18 人，具有博士学位的教师 38 人。专任教师中有国务院特殊津贴专家 1 人，全国优秀教育工作者 1 人，广西高等学校教学名师 2 人，广西优秀教师 1 人，广西青年科技奖 2 人，广西杰出青年基金获得者 4 人，广西高校优秀人才资助计划 4 人，博士生导师 6 人。结合学校电子信息类学科的研究，已形成了微分方程与动力系统、科学与工程计算、优化与决策、信息处理与数据分析等 4 个稳定的学科方向，在通信技术与信号处理、电磁学计算和大数据分析中的应用研究具有自己的鲜明特色。近五年主持 30 多项国家自然科学基金项目，50 多项广西区自然科学基金项目，1 项广西创新团队基金项目，4 项广西杰出青年基金项目。拥有 1 门国家级精品课程，4 门自治区级精品课程，获 6 项广西区科技进步奖和 4 项自治区教学成果奖。学院现有本科生 900 余人，研究生 100 余人。

Introduction to College of Mathematics and Computational Science, Guilin University of Electronic Technology

Guilin University of Electronic Technology(GUET), one of the four universities focusing on electronic technology in China, is a university co-sponsored by the Ministry of Industry and Information Technology and Guangxi Zhuang Autonomous Region. It has been selected as one member university of National Basic Ability Construction Project of Western and Central China, and designated as one of the key construction universities in Guangxi Zhuang Autonomous Region. At the moment, the university boasts 4 disciplines authorized to confer doctoral degrees, and 17 disciplines authorized to confer master's degrees with the qualification of exemption from the postgraduate entrance examination. In GUET there are 70 majors for the undergraduates, and about 2,900 faculty members, among whom there are some talented ones: 2 members of the "Recruitment Program of Global Experts", 2 Distinguished Professors and 3 Visiting Professors of the Changjiang Scholars Project. Moreover, there are 7 professors gaining the grant of the National Science Fund for Excellent Young Scholars, 5 members of the National Talent Project, 1 member of the National Outstanding Professional and Technical Personnel, 2 National Outstanding Scientific and Technical Workers, 34 State Council Experts for Special Allowance, 4 members of the "Hundred Talents Program" of the Chinese Academy of Sciences. We also have 3 members of the "New Century Talent Supporting Project" by the Ministry of Education, and 8 members of the Bagui Scholars Project of Guangxi Zhuang Autonomous Region. The discipline "Engineering" is among the top 1% of ESI worldwide. Guilin University of Electronic technology now boasts more than 40,000 full-time students, including over 4,000 master and doctoral degree candidates.

The College of Mathematics and Computational Science of GUET offers a secondary-level doctorate degree program--Theoretical Basis of Cyberspace Security, and two master degree programs, that is, Mathematics and Applied Statistics. Also there are three undergraduate majors: Information and Computational Science (a

national specialty), Mathematics and Applied Mathematics (a key discipline of Guangxi) and Applied Statistics, with the engineering mathematics teaching team the province-level teaching team. The college boasts Guangxi Key Laboratories for Cryptography and Information Security, Data Analysis and Computing. In our college there are 78 faculty members, including 68 full-time teachers. Of all the full-time teachers, there are 22 professors and 18 associate professors, 38 of whom possess doctorates. Among the full-time teachers, there are some talents, such as 1 State Council expert for special allowance, 1 National Outstanding Educator, 2 Distinguished College Teachers of Guangxi, 1 Distinguished Teacher of Guangxi, 2 winners of Science and Technology Youth Awards of Guangxi, 4 grant winners of Guangxi Science Fund for Distinguished Young Scholars and 4 grant recipients of the Project of Excellent University Talents .there are 6 Ph.D. supervisors in our college. Integrated with the research of electronic and information discipline, 4 discipline directions have been stabilized: Differential Equations and Dynamic Systems, Scientific and Engineering Computing, Optimization and Decision-making, Information Processing and Data Analysis, etc. Distinct characteristics have been shown in the applied research of communication technology and signal processing, electromagnetic computing and big data analysis, etc. Over the past five years, more than 30 programs of the National Natural Science Foundation, over 50 projects of the Natural Science Foundation, 1 programs of the Innovation Team Foundation and 4 programs of the National Science Fund for Distinguished Young Scholars have been achieved by our college staff. Among them, 1 nation-level top-quality course, 4 top-quality courses in Guangxi, and 6 awards for scientific and technological advancement as well as 4 Teaching Achievement Awards of Guangxi have been achieved. So far, there are more than 900 undergraduates and 100 postgraduates in the college.

上海大学数学系简介

上海大学是国家“211 工程”重点建设高校之一。上海大学数学系现有教职工 116 人，专职教师 100 人，其中教授 26 名、博士生导师 25 人、副教授 35 人、院士 1 名、国家千人计划专家 2 名、上海千人 1 名、教育部长江学者 1 名、杰青 1 名、中国科学院百人计划 1 名、上海领军人才 1 名、曙光学者 1 名、上海浦江人才计划 4 名、上海青年东方学者 3 名，45 岁以下博士比例 100%，获得海外学位或有海外研究经历的人员比例为 95%；在校本科生 500 多人、硕士研究生 200 多人、博士研究生 60 多人。

数学系有数学一级学科博士点、数学博士后流动站，数学、统计学两个一级学科硕士点；有上海市教委重点学科、上海市重点学科、上海高校一流学科、上海市高校高原学科。上海市应用数学与系统科学研究所、上海大学核心数学研究所、上海大学优化开放实验室、上海大学数学与编码密码研究所、上海大学张量与矩阵研究中心、上海大学系统科学研究所均挂靠数学系；上海市青少年科技人才培养基地—上海大学数学科学实践工作站是全国首家数学工作站。

2017 年 USNEWS（《美国新闻和世界报导》）全球最佳大学数学学科排名上海大学位居第 80；美国 ESI 数据库最新数据，全球前 1%的数学研究机构有 241 个，上海大学排第 119，进入全球前 5‰行列。近年来数学系每年有近 300 位国内外著名专家学者前来讲学交流，包括菲尔兹奖得主 Zelmanov 及杨乐等 30 多位海内外院士来上海大学数学系访问和科学合作研究。主办或承办了包括“第 14 届国际线性代数协会年会”在内的大型国内外学术会议 40 多次。

The Department of Mathematics, Shanghai University

Shanghai University (SHU) is one of China's key universities of 'Project 211'. The Department of Mathematics is the home of 116 well qualified people, among them 100 are full-time faculty members. The team of faculty members is formed by 26 professors, 25 doctoral advisors, 35 associate professors, 1 academician, 2 National Thousand Talent Plan, 1 Shanghai Thousand Talent Plan, 1 Chang Jiang Scholars Program, 1 National Science Fund for Distinguished Young Scholars Program, 1 Chinese Academy of Sciences Hundred Talents Program, 1 Shanghai Leading Talent, 1 Dawn Program of Shanghai Education Commission, 4 Shanghai Pujiang Talent Program, 3 Shanghai Oriental distinguished professors, 100% of doctors under the age of 45, 95% of overseas graduates or staff with overseas research experience. It has over 500 undergraduates, 200 graduates, and 60 doctoral candidates.

The Department of Mathematics consists of one first-level doctoral program in mathematics, one mathematics postdoctoral research station , two first-level graduate programs in mathematics and statistics; and Shanghai municipal education commission key disciplines, Shanghai key disciplines, Shanghai first-class discipline, Shanghai plateau discipline. In addition, Shanghai Institute of Applied Mathematics and Systems Science,

Institute of Core Mathematical Research of Shanghai University, Shanghai University Open Laboratory for Operations Research & Optimization, Institute of Mathematics and Coding & Cryptography of Shanghai University, International Research Center for Tensor and Matrix Theory of Shanghai University, Institute of Systems Science of Shanghai University are all affiliated to the Department of Mathematics. Shanghai youth talent training base — the work station on mathematics practice workstation of Shanghai University is a pioneering under taking for the national mathematics workstation.

In 2017, SHU was ranked at the 80th place in the USNEWS World's Best University Mathematics Ranking. According to the latest data from the US ESI database, there are 241 mathematics research institutions are recognized as world's top 1% , among which, Shanghai University ranks 119, entering the top 5‰ in the world. In recent years, there are nearly 300 famous experts every year coming to the Department of Mathematics for extensive academic exchange and research cooperation. Among them, more than 30 domestic and foreign academicians including Fields Medal winner – Zelmanov and Professor Yang Le have visited the department. Besides, the Department of Mathematics hosted or undertook more than 40 large-scale international academic conferences including the 14th Conference of the International Linear Algebra Society.