2017 International Conference on Matrix Inequalities and Matrix Equations (MIME2017)

2017矩阵不等式及矩阵方程国际会议

Shanghai University

Shanghai, China

June 6-8, 2017

Sponsors

International Research Center for Tensor and Matrix Theory (IRCTMT)

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Conference Venue

New Lehu Hotel, Shanghai University, 716 Jinqiu Road, Baoshan district, Shanghai
上海市宝山区锦秋路716号上海大学北大门乐乎新楼

All lectures will be held in the New Lehu Hotel 2nd building （乐乎新楼2号楼）

Accommodation

Campus accommodation:

New Lehu Hotel, Shanghai University, 716 Jinqiu Road, Baoshan district, Shanghai
上海市宝山区锦秋路716号上海大学北大门乐乎新楼

Alternative accommodation:

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Transportation

From Pudong Airport to Shanghai University (Baoshan Campus)

1. By Metro: Pudong airport by Metro Line 2 to Jing'an Temple, change to Metro Line 7 to Shanghai University. (Total price is 8 RMB.)

2. By Taxi: Directly take taxi to 716 Jingqiu Road, Shanghai University (Baoshan Campus, North Gate). (Total price is about 230 RMB.)

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1. By Metro: Hongqiao airport by Metro Line 2 to Jing'an Temple exchange to Metro Line 7 to Shanghai University. (Total price is 6 RMB.)

2. By Taxi: Directly take taxi to 716 Jingqiu Road, Shanghai University (Baoshan Campus, North Gate). (Total price is about 60 RMB.)

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1. By Metro Line 1 to Changshu Road exchange to Metro Line 7 to Shanghai University(Baoshan Campus). (Total price is 4 RMB.)

2. By Metro Line 3 to Zhenping Road exchange to Metro Line 7 to Shanghai University(Baoshan Campus). (Total price is 4 RMB.)

3. Directly take taxi to 716 Jingqiu Road, Shanghai University (Baoshan Campus, North Gate). (Total price is about 50 RMB.)

4. By Bus Route 58: Railway Station (Hengfeng Road) -> terminus (near 716 Jingqiu Road, Shanghai University, Baoshan Campus, North Gate). (Total price is 2 RMB.)

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Program

Tuesday, June 6

9:00-19:00 Registration

Lobby of the Lehu Hotel 乐乎新楼1号楼一楼

17:30-19:30 Dinner time

Wednesday, June 7

Chair: Qing-Wen Wang Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

8:15-8:45 Opening Ceremony

Opening remarks by Prof. Chi-Kwong Li

Opening remarks by Prof. Er-Xiong Jiang

Welcome speech by the leader of SHU

8:45-9:00 Group Photo

Chair: Chi-Kwong Li Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

9:00-9:30 Speaker: Man-Duen Choi, University of Toronto, Canada (p. 10)

Title: Norm inequalities for summation of two matrices

9:30-10:00 Speaker: Frank Hansen, Tohoku University, Japan (p. 13)

Title: Peierls-Bogolyubov's inequality for deformed exponentials

10:00-10:15 Coffee break

Chair: Tin-Yau Tam Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

10:15-10:45 Speaker: Pei Yuan Wu, National Chiao Tung University, Taiwan, China (p. 21)

Title: Numerical radius inequalities

10:45-11:15 Speaker: Yiu-Tung Poon, Iowa State University, USA (p. 19)

Title: An elementary proof for the submultipicativity of the numerical radius of commuting matrices of order two

11:15-11:45 Speaker: Delin Chu, National University of Singapore, Singapore (p. 11)

Title: Least Squares Approach for Regularized Incremental Linear Discriminant Analysis on Large-Scale Data

11:45-12:15 Speaker: Frank Uhlig, Auburn University, USA (p. 20)
Title: The eight epochs of math as regards matrix computations

12:15-13:30 Lunch time

Parallel Sessions. Session one

Chair: Muddappa Seetharama Gowda Daxue Hall(大学厅)-乐乎新楼2号楼二楼

13:30-14:00 Speaker: Jianzhou Liu, Xiangtan University, China (p. 17)
Title: Lower bounds on eigenvalue summation for the solution of the Lyapunov matrix differential equation

14:00-14:30 Speaker: Shunpu Zhang, University of Central Florida, USA (p. 23)
Title: Risk Approximation and Vast Volatility Matrix Estimation Using High-Frequency Data for Portfolio Selection

14:30-15:00 Speaker: Alexander E. Guterman, Moscow State University, Russia (p. 13)
Title: Frobenius endomorphisms for the order relations on operators and matrices

15:00-15:30 Speaker: Jun-Feng Yin, Tongji University, China (p. 22)
Title: Preconditioners modified Hermitian and skew-Hermitian splitting method for the solution of fractional Schrödinger equations

15:30-15:45 Coffee break

Chair: Musheng Wei Daxue Hall(大学厅)-乐乎新楼2号楼二楼

15:45-16:15 Speaker: Jianhong Xu, Southern Illinois University Carbondale, USA (p. 22)
Title: On the Convergence of the Accelerated Riccati Iteration Method

16:15-16:45 Speaker: Jianlong Chen, Southeast University, China (p. 10)
Title: Inverses along to an element or two elements

16:45-17:15 Speaker: Changjiang Bu, Harbin Engineering University, China (p. 9)
Title: Recent results on the generalized inverse and spectral properties of tensors

17:15-17:45 Speaker: Zhuo-Heng He, Auburn University, USA (p. 14)
Title: Some simultaneous decompositions for quaternion matrices and their applications

17:45-19:00 Dinner time

Parallel Sessions. Session two

Chair: Fuzhen Zhang Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

13:30-14:00 Speaker: Hiroyuki Osaka, Ritsumeikan University, Japan (p. 18)
Title: Matrix functions, matrix means, and matrix inequalities

14:00-14:30 Speaker: Jiyuan Tao, Loyola University Maryland, USA (p. 20)
Title: A generalization of the Craig-Sakamoto theorem to Euclidean Jordan algebras

14:30-15:00 Speaker: Raymond Nung-Sing Sze, The Hong Kong Polytechnic University, Hong Kong, China (p. 19)
Title: An interpolation problem for completely positive maps on matrices

15:00-15:30 Speaker: Zhigang Jia, Jiangsu Normal University, China (p. 15)
Title: Structured Condition Number for Self-adjoint Polynomial Matrix Equations from Linear Control

15:30-15:45 Coffee break

Chair: Minghua Lin Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

15:45-16:15 Speaker: Olga Y. Kushel, Shanghai University, China (p. 16)
Title: Transversal pairs one-rank perturbations of matrices

16:15-16:45 Speaker: Tomohiro Hayashi, Nagoya Institute of Technology, Japan (p. 14)
Title: On the norm Schwarz inequality

16:45-17:15 Speaker: Qingxiang Xu, Shanghai Normal University, China (p. 22)
Title: Representations and perturbation analysis for the Moore-Penrose inverse of multiplicative perturbations of matrices

17:15-17:45 Speaker: Zhihua Zhang, Jiangsu University, China (p. 24)
Title: Some operator convex functions of several variables

17:45-19:00 Dinner time

Thursday, June 8

Chair: Pei Yuan Wu — Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

8:00-8:30 Speaker: Chi-Kwong Li, College of William and Mary, USA (p. 16)
Title: Matrix inequalities and optimization problems in quantum information science

8:30-9:00 Speaker: Muddappa Seetharama Gowda, University of Maryland, USA (p. 12)
Title: On the solvability of matrix equations over the semidefinite cone

9:00-9:30 Speaker: Mohammad Sal Moslehian, Ferdowsi University of Mashhad, Iran (p. 18)
Title: Operator Birkhoff–James Orthogonality

9:30-10:00 Speaker: Musheng Wei, Shanghai Normal University, China (p. 20)
Title: Quaternion matrix computations

10:00-10:15 Coffee break

Chair: Hwa-Long Gau — Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

10:15-10:45 Speaker: Tin-Yau Tam, Auburn University, USA (p. 19)
Title: Fiedler's theorem and Marcus-Oliveira conjecture on the sum of two normal matrices

10:45-11:15 Speaker: Dragana Cvetković Ilić, University of Niš, Serbia (p. 14)
Title: Completion problems of operator matrices and its different applications

11:15-11:45 Speaker: Natalia Bebiano, University of Coimbra, Portugal (p. 9)
Title: Rényi quantum thermo dynamical inequalities

11:45-12:15 Speaker: Yunfeng Cai, Peking University, China (p. 10)
Title: Solving general joint block diagonalization problem via linearly independent eigenvectors of a matrix polynomial

12:15-13:30 Lunch time

Parallel Sessions. Session one

Chair: Yiu-Tung Poon Daxue Hall(大学厅)-乐乎新楼2号楼二楼

13:30-14:00 Speaker: Ngai-Ching Wong, National Sun Yat-sen University, Taiwan, China (p. 21)
Title: Quantum information theory and preserver problems

14:00-14:30 Speaker: Yang Zhang, University of Manitoba, Canada (p. 24)
Title: Generalized Inverses of Ore Matrices

14:30-15:00 Speaker: Zhongyun Liu, Changsha University of Science and Technology, China (p. 17)
Title: The ALU splitting preconditioners for positive definite linear systems

15:00-15:30 Speaker: Xiaoji Liu, Guangxi University for Nationalities, China (p. 17)
Title: Some results on the partial ordering of matrices

15:30-15:45 Coffee break

Parallel Sessions. Session two

Chair: Natalia Bebiano Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

13:30-14:00 Speaker: Mahdi Dehaghni, University of Kashan, Iran (p. 11)
Title: Counterparts to the information monotonicity of the matrix power means

14:00-14:30 Speaker: Hwa-Long Gau, National Central University, Taiwan, China (p. 12)
Title: Extremality of numerical radii of matrix commutators and Jordan products

14:30-15:00 Speaker: Mojtaba Bakherad, University of Sistan and Baluchestan, Iran (p. 9)
Title: Numerical radius inequalities for operators and operator matrices

15:00-15:30 Speaker: Elena M. Kreines, Moscow State University, Russia (p. 16)
Title: Grothendick dessins d'enfants: systems of equations and their solutions

15:30-15:45 Coffee break

Chair: Chi-Kwong Li Xuehai Hall(学海厅)-乐乎新楼2号楼二楼

15:45-16:15 Speaker: Mohsen Kian, University of Bojnord, Iran (p. 15)
Title: Matrix Extension of convex sets and functions

16:15-16:45 Speaker: Fuzhen Zhang, Nova Southeastern University, USA (p. 23)
Title: Quaternions and Matrices of Quaternions –2017 Survey

16:45-17:00 Concluding remarks

17:45-19:00 Dinner time

Goodbye

Abstracts

Mojtaba Bakherad

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University of Sistan and Baluchestan, Iran

Title: Numerical radius inequalities for operators and operator matrices

Abstract: In this talk, we establish some upper bounds for numerical radius inequalities including of 2×2 operator matrices and their off-diagonal parts. Also we generalize the definition of Aluthge transform for non-negative continuous functions f, g such that $f(x)g(x) = x$ $(x \geq 0)$. Then, by using of this definition, we get some numerical radius inequalities.

Natalia Bebiano

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University of Coimbra, Portugal

Title: Rényi quantum thermo dynamical inequalities

Abstract: A theory of thermodynamics has been recently formulated and derived from Rényi entropy and its relative versions. In this framework, the concepts of partition function, internal energy, free energy are introduced, and fundamental quantum thermo dynamical inequalities are obtained. The Rényi maximum entropy principle is stated and the condition of equilibrium is formulated. A discussion of uncertainty relations on the measurements of an even number of observables is given. These inequalities extend the Heisenberg and Schrödinger uncertainty principles.

Changjiang Bu

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Harbin Engineering University, China

Title: Recent results on the generalized inverse and spectral properties of tensors

Abstract: In this talk, we report some recent results on the generalized inverse and spectral properties of tensors, including the Moore-Penrose inverse of tensors, the group inverse of tensors, eigenvalue inclusion sets of tensors, spectral radius of tensors and hypergraphs, and tensor spectra of hypergraphs.

Yunfeng Cai

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Peking University, China

Title: Solving general joint block diagonalization problem via linearly independent eigenvectors of a matrix polynomial

Abstract: In this talk, we consider the exact/approximate general joint block diagonalization (GJBD) problem of a matrix set $\{A_i\}_{i=0}^p$ ($p \geq 1$), where a nonsingular matrix W (often referred to as diagonalizer) needs to be found such that the matrices $W^H A_i W$'s are all exactly/approximately block diagonal matrices with as many diagonal blocks as possible.

We show that the diagonalizer of the exact GJBD problem can be given by $W = [x_1, x_2, \ldots, x_n]\Pi$, where Π is a permutation matrix, x_i's are eigenvectors of the matrix polynomial $P(\lambda) = \sum_{i=0}^p \lambda^i A_i$, satisfying that $[x_1, x_2, \ldots, x_n]$ is nonsingular, and the geometric multiplicity of each λ_i corresponding with x_i equals one. And the equivalence of all solutions to the exact GJBD problem is established. Moreover, theoretical proof is given to show why the approximate GJBD problem can be solved similarly to the exact GJBD problem. Based on the theoretical results, a three-stage method is proposed and numerical results show the merits of the method.

Jianlong Chen

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Southeast University, China

Title: Inverses along to an element or two elements

Abstract: In 2011, Mary introduced the notion of inverse along to an element, he proved the Moore-Penrose inverse, Drazin inverse and group inverse are some kind of the inverses along to an element. In 2012, Drazin introduced the notion of (b, c)-inverse, we call it the inverse along to two elements. In particular, the inverse along to an element d is same as (d, d)-inverse. Core inverse of a is (a, $a*$)-inverse. In this talk, we give some progress on the inverses along an element and (b, c)-inverses. Many results unify the results of Moore-Penrose inverses, Drazin inverses, group inverses and core inverses, respectively.

Man-Duen Choi

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University of Toronto, Canada

Title: Norm inequalities for summation of two matrices

Abstract: Here, the norm is the Hilbert-space operator norm. We re-examine some known results about the topic.

Delin Chu

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National University of Singapore, Singapore

Title: Least Squares Approach for Regularized Incremental Linear Discriminant Analysis on Large-Scale Data

Abstract: Over the past a few decades, much attention has been drawn to large-scale incremental data analysis, where researchers are faced with huge amount of high-dimensional data acquired incrementally. In such a case, conventional algorithms that compute the result from scratch whenever a new sample comes are highly inefficient. To conquer this problem, we propose a new incremental algorithm IRLS that incrementally computes the solution to the regularized least squares (RLS) problem with multiple columns on the right-hand side. More specifically, for a RLS problem with c ($c > 1$) columns on the right-hand side, we update its unique solution by solving a RLS problem with single column on the right-hand side whenever a new sample arrives, instead of solving a RLS problem with c columns on the right-hand side from scratch. As a direct application of IRLS, we consider the supervised dimensionality reduction of large-scale data and focus on linear discriminant analysis (LDA). We first propose a new batch LDA model that is closely related to RLS problem, and then apply IRLS to develop a new incremental LDA algorithm. Experimental results on real-world datasets demonstrate the effectiveness and efficiency of our algorithms.

Mahdi Dehaghni

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University of Kashan, Iran

Title: Counterparts to the information monotonicity of the matrix power means

Abstract: In [Matrix power means and the Karcher mean, J. Funct. Anal., **262**(2012), 1498–1514], Lim and Pálfia established the notion of the matrix power means for k positive definite matrices ($k \geq 3$): Let $\mathbb{A} = (A_1, \ldots, A_k)$ be a k-tuple of positive definite matrices and $\omega = (\omega_1, \ldots, \omega_k)$ a weight vector with nonnegative numbers $\omega_i \geq 0$ and $\sum_{i=1}^{k} \omega_i = 1$. The matrix power mean $P_t(\omega; \mathbb{A})$ is defined by the unique positive definite solution of the following non-linear equation:

$$X = \sum_{i=1}^{k} \omega_i (X \sharp_t A_i) \qquad \text{for } t \in (0, 1].$$

For $t \in [-1, 0)$, it is defined by

$$P_t(\omega; \mathbb{A}) = P_{-t}(\omega; \mathbb{A}^{-1})^{-1},$$

where $\mathbb{A}^{-1} = (A_1^{-1}, \ldots, A_k^{-1})$.

For a unital positive linear mapping $\Phi : \mathcal{M}_n \to \mathcal{M}_p$, the matrix power means satisfy the following information monotonicity: For each $t \in (0, 1]$

$$\Phi(P_t(\omega; \mathbb{A})) \leq P_t(\omega; \Phi(\mathbb{A})), \tag{1}$$

where $\Phi(\mathbb{A}) = (\Phi(A_1), \cdots, \Phi(A_k))$. However, it is not known whether (1) holds for $t \in [-1, 0)$ or not.

In this talk, complementary inequality of the information monotonicity of the matrix power means are presented. Also, we improve this inequality, by virture of the generalized Kantorovich constant.

Hwa-Long Gau

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National Central University, Taiwan, China

Title: Extremality of numerical radii of matrix commutators and Jordan products

Abstract: It is known that the numerical radius of the commutator (resp., Jordan product) $AB - BA$ (resp., $AB + BA$) of two n-by-n matrices A and B is related to those of A and B by $w(AB \pm BA) \leq 4w(A)w(B)$. In this talk, we give complete characterizations of A and B for which the equality is attained. The matrices involved can be considered as elaborate generalizations of the equality-attaining $A = \begin{bmatrix} 0 & a \\ 0 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 0 \\ b & 0 \end{bmatrix}$.

Co-author(s): Kuo-Zhong Wang

Muddappa Seetharama Gowda

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University of Maryland, USA

Title: On the solvability of matrix equations over the semidefinite cone

Abstract: In matrix theory, various algebraic, fixed point, and degree theory methods have been used to study the solvability of equations of the form $f(X) = Q$, where f is a (nonlinear) function, Q is a semidefinite/definite matrix and X varies over the cone of semidefinite matrices. In this talk, we describe a new method based on complementarity ideas. Our method can be used to study functions $f(X)$ of the form $AX + XA^T$ (studied by Lypaunov), $X - AXA^T$ (Stein), $X - \sum AX^{\delta_i}A^T$ (Lim

et al), $X^{r_m}A_m \cdots X^{r_2}A_2X^{r_1}A_1X^{r_1}A_2X^{r_2} \cdots A_mX^{r_m}$ (Hillar and Johnson); it also works in a more general setting of proper cones and, in particular, on symmetric cones in Euclidean Jordan algebras.

Alexander E. Guterman

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Moscow State University, Russia

Title: Frobenius endomorphisms for the order relations on operators and matrices

Abstract: This talk is based on series of joint works with G. Dolinar, M. Efimov and J. Marovt.

The first results on transformations preserving matrix invariants is due to Frobenius. This result describes the structure of linear maps T preserving the determinant function, i.e., $\det X = \det T(X)$ for all X. Later on there were several extension of this result which are due to Diedonnie, Schur, Dynkin and others.

Along the same lines, there were intensive investigations of preservers of order relations on operator and matrix algebras during the past decades. There are many order relations on matrices which are important for the theoretical studies and applications. Some of them are originated in semigroup theory and some of them came from mathematical statistics. Monotone transformation with respect to a particular order relation is a map which preserves this order. We show that surjective monotone additive transformations on matrices with respect to several useful orders are automatically invertible and provide a complete characterization of such transformations. Also we provide natural extensions of these orders for bounded operators on infinite dimensional Hilbert spaces, prove that they are indeed extensions of classical orders under consideration, and investigate corresponding monotone transformations.

Frank Hansen

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Tohoku University, Japan

Title: Peierls-Bogolyubov's inequality for deformed exponentials

Abstract: We study convexity or concavity of certain trace functions for the deformed logarithmic and exponential functions, and obtain in this way new trace inequalities for deformed exponentials that may be considered as generalizations of Peierls-Bogolyubov's inequality. We use these results to improve previously known lower bounds for the Tsallis relative entropy.

Tomohiro Hayashi

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Nagoya Institute of Technology, Japan

Title: On the norm Schwarz inequality

Abstract: For a positive definite matrix A and a matrix B, the inequality

$$||A\sharp(B^*A^{-1}B)|| \geq ||B||$$

is called the norm Schwarz inequality. Ando showed that if B satisfies this inequality for any A, then B must be normaloid. It is natural to wonder whether this inequality holds whenever B is normal. In this talk I will answer this question by constructing a counterexample.

Zhuo-Heng He

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Auburn University, USA

Title: Some simultaneous decompositions for quaternion matrices and their applications

Abstract: In this talk, we investigate and analyze in detail the structures and properties of some simultaneous decompositions for quaternion matrices with compatible sizes. As applications of these decompositions, we derive some practical necessary and sufficient conditions for the solvability to some systems of generalized Sylvester quaternion matrix equations using the ranks of their coefficient matrices. We also give the expressions of the general solutions to these systems of quaternion matrix equations when they are solvable. Moreover, we provide some numerical examples to illustrate our results.

Dragana Cvetković Ilić

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University of Niš, Serbia

Title: Completion problems of operator matrices and its different applications

Abstract: We will address some recent results on certain problems of completions of operator matrices and show interesting applications of these results in solving some problems related to the reverse order law for generalized inverses and invertibility and Fredholmness of linear combinations of operators from $\mathcal{B}(\mathcal{H})$, in particular those of idempotents and projectors.

Zhigang Jia

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Jiangsu Normal University, China

Title: Structured Condition Number for Self-adjoint Polynomial Matrix Equations from Linear Control

Abstract: A structured condition number is defined in the Froubenius norm for the symmetric positive definite solution of one self-adjoint polynomial matrix equation, which unifies continuous-time algebraic Riccati equations (CARE), discrete-time algebraic Lyapunov equation (DALE) and many other nonlinear matrix equations. Defining two new linear operators which can preserve the positive definiteness, we derive the explicit formulae of the structured condition number in a uniform manner. Applied to the CARE and the DALE, the newly defined condition number can detect the ill-conditioned matrix equation and the sensitivity of the numerical solution very well.

Mohsen Kian

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University of Bojnord, Iran

Title: Matrix Extension of convex sets and functions

Abstract: The numerical range of a Hilbert space operator T is defined by

$$W(T) = \{\langle Tx, x\rangle : \|x\| = 1\}.$$

This set is a powerful tool in study of operators. $W(T)$ has many properties, which probably the most famous of them is the Toeplitz-Hausdorff theorem. It asserts that $W(T)$ is a convex set.

As a non-commutative extension of the numerical range, Arveson [*Subalgebras of C*-algebras*, Acta Math. **123** (1969), 141–224] defined the matricial ranges of an operator T by

$$W^n(T) = \{\Phi(T);\ \ \Phi : C^*(T) \to \mathbb{M}_n \text{ is a unital completely positive linear map}\}$$

in which $C^*(T)$ is the unital C^*-algebra generated by T. As a non-commutative Toeplitz-Hausdorff theorem, It is known that $W^n(T)$ enjoys a type of convexity, called C^*-convexity.

A set $\mathcal{K} \subseteq \mathbb{B}(\mathscr{H})$ is called C^*-convex, if $X_1, \ldots, X_m \in \mathcal{K}$ and $A_1, \ldots, A_m \in \mathbb{B}(\mathscr{H})$ with $\sum_{j=1}^m A_j^* A_j = I$ imply that $\sum_{j=1}^m A_j^* X_j A_j \in \mathcal{K}$.

In this work, we study the C^*-convexity of some basic sets. The relation between C^*-convexity of sets and matrix convex functions is also presented. Moreover, some other generalization of convexity has been given and compared.

Elena M. Kreines

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Moscow State University, Russia

Title: Grothendick dessins d'enfants: systems of equations and their solutions

Abstract: Classically Grothendieck dessin d'enfant is an embedded graph Γ on a smooth compact oriented surface M such that the complement $M \setminus \Gamma$ is homeomorphic to a disjoint union of open discs. Each Grothendieck dessin d'enfant is in a natural correspondence to a unique (up to a linear-fractional transformation) Belyi pair. Belyi pair is an algebraic curve together with a non-constant meromorphic function on this curve with at most 3 critical values. This correspondence is actual for various applications. We investigate the systems of equations relating concrete dessins with concrete Belyi pairs and some special solutions of these equations, called parasitic solutions.

In the talk we provide the introduction to the theory of dessins d'enfants and formulate some new results concerning the aforesaid systems of equations. Series of examples will be provided. In particular, so-called anti-Vandermonde systems will be considered and investigated.

The talk is based on the results of our joint work with N. Ya. Amburg and G.B. Shabat.

Olga Y. Kushel

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Shanghai University, China

Title: Transversal pairs one-rank perturbations of matrices

Abstract: Method of one-dimensional perturbations developed by Yu. Barkovsky for compact operators is considered and extended in detail for matrices. Applications of this method to different problems concerning matrix spectra and polynomial roots localization are considered.

Co-author(s): Mikhail Tyaglov

Chi-Kwong Li

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College of William and Mary, USA

Title: Matrix inequalities and optimization problems in Quantum Information Science

Abstract: We discuss some matrix inequalities concerning unitary similarity orbits of matrices that are useful in the study of some optimization problems in quantum information sciences. Recent results and open problems will be discussed.

Jianzhou Liu

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Xiangtan University, China

Title: Lower bounds on eigenvalue summation for the solution of the Lyapunov matrix differential equation

Abstract: In this talk, by using eigenvalue inequality and majorization inequalities, in terms of Cauchy and Hölder inequality, we obtain upper and lower bounds on summation of eigenvalues (including the trace) of the solution for the Lyapunov matrix differential equation. Finally, we give corresponding numerical examples to show the effectiveness of the derived bounds.

Xiaoji Liu

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Guangxi University for Nationalities, China

Title: Some results on the partial ordering of matrices

Abstract: In this talk, (1) we study partial orders in terms of the core-nilpotent decomposition. We derive some characterizations of the C-N partial ordering, create a new partial ordering (the G-Drazin partial ordering) which is a generalization of C-N partial ordering, and give some properties and characterizations of the G-Drazin partial ordering. (2) we use the well-known Löwner order and the core partial order to introduce a new partial order on the class of core matrices which is not dominated by any of the known matrix partial orders. We characterize the partial order and study its relations with the Löwner partial order under constraints, and exemplify its differences with other partial orders.

Zhongyun Liu

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Changsha University of Science and Technology, China

Title: The ALU splitting preconditioners for positive definite linear systems

Abstract: Let A be a positive definite and strictly or irreducibly diagonally dominant matrix. Based upon the so-called alternating lower-upper (ALU) splitting introduced by others, we propose a new preconditioner for $Ax = b$. Numerical results using the preconditioned conjugate gradient (PCG) method show that our preconditioner increases the convergence rate of these methods and works better than T. Chan's preconditioner when A is Toeplitz.

Mohammad Sal Moslehian

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Ferdowsi University of Mashhad, Iran

Title: Operator Birkhoff–James Orthogonality

Abstract: Inner product C^*-modules generalize inner product spaces by allowing inner products to take values in an arbitrary C^*-algebra A instead of the C^*-algebra of complex numbers $\mathbf{C}$. The classical Birkhoff–James orthogonality says that if x, y are elements of a complex normed linear space $(X, \|\cdot\|)$, then x is orthogonal to y in the Birkhoff–James sense, in short $x \perp_B y$, if $\|x + \lambda y\| \geq \|x\|$ $(\lambda \in \mathbf{C})$. As a natural generalization of this notion, the concept of strong Birkhoff–James orthogonality, which involves modular structure of a Hilbert C^*-module, states that if x and y are elements of a Hilbert A-module X, x is orthogonal to y in the strong Birkhoff–James sense, in short $x \perp_B^s y$, if $\|x + ya\| \geq \|x\|$ $(a \in A)$. In this talk, we present some characterizations of the (strong) Birkhoff–James orthogonality for elements of Hilbert C^*-modules and certain elements of $B(H)$. We also discuss some types of approximate orthogonality.

Co-author(s): Ali Zamani, Farhangian University.

Hiroyuki Osaka

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Title: Matrix functions, matrix means, and matrix inequalities

Abstract: Let I be an interval of the real line $\mathbf{R}$. We have, then, the following deceasing sequences:

$$P_1(I) \supset P_2(I) \supset \cdots \supset P_n(I) \supset \cdots \supset P_\infty(I)$$
$$K_1(I) \supset K_2(I) \supset \cdots \supset K_n(I) \supset \cdots \supset K_\infty(I),$$

where $P_n(I)$ (resp.$K_n(I)$) and $P_\infty(I)$ (resp.$K_\infty(I)$) mean the set of all n-monotone functions (resp.the set of all n-convex functions) and the set of all operator monotone functions (resp.the set of all operator convex functions). We note that $P_\infty(I) = \cap_{n=1}^\infty P_n(I)$ and $K_\infty(I) = \cap_{n=1}^\infty K_n(I)$.

There are some relations between $\{P_n(I)\}_{n\in\mathbf{N}}$ and $\{K_n(I)\}_{n\in\mathbf{N}}$, which is called a Double pilling structure by Osaka and Tomiyama [*Double piling structure of matrix monotone functions and of matrix convex functions*, Linear Algebra and Appl. 431(2009), 1825-1832].

In this talk we present some relations between matrix functions, matrix means, and matrix inequalities.

Yiu-Tung Poon

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Title: An elementary proof for the submultipicativity of the numerical radius of commuting matrices of order two

Abstract: Denote by $w(T)$ the numerical radius of a matrix T. An elementary proof is given to the fact that $w(AB) \leq w(A)w(B)$ for a pair of commuting matrices of order two. Characterization is given to commuting matrices A and B, which attain the equality $w(AB) = w(A)w(B)$.
Co-author(s): Chi-Kwong Li

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Title: An interpolation problem for completely positive maps on matrices

Abstract: Given two sets of quantum states $\{A_1, \ldots, A_k\}$ and $\{B_1, \ldots B_k\}$, represented as sets of density matrices, quantum information scientists concerned with the necessary and sufficient conditions for the existence of a quantum channel ϕ, represented as a trace-preserving completely positive map, such that $\phi(A_i) = B_i$ for $i = 1, \ldots, k$. This can be regarded as an interpolation problem for completely positive maps. In this talk, some results on this problem will be presented.
Co-author(s): H.F. Chau, C.H.F. Fung, Z. Huang, C.K. Li, and E. Poon.

Tin-Yau Tam

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Title: Fiedler's theorem and Marcus-Oliveira conjecture on the sum of two normal matrices

Abstract: We will survey some recent results evolved from Fiedler's well-known theorem on the determinants of sums of two Hermitian matrices with prescribed eigenvalues. Then we give an update of Marcus-de Oliverira Conjecture on the determinants of sums of normal matrices with prescribed eigenvalues, hoping that the talk will draw attention of the participants and ultimately the conjecture will be solved.

Jiyuan Tao

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Title: A generalization of the Craig-Sakamoto theorem to Euclidean Jordan algebras

Abstract: Letac and Massam extended the Craig-Sakamoto theorem to Euclidean Jordan algebras. In this talk, we present another proof of this generalization by reformulating the result in terms of rank and determinant equalities and by proving the result in each of the simple Euclidean Jordan algebras.
Co-author(s): Guoqiang Wang, Shanghai University of Engineering Science

Frank Uhlig

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Title: The Eight Epochs of Math as regards Matrix Computations

Abstract: This talk gives a personal selection and assessment of Epoch making advances in Matrix Computations from antiquity through tomorrow. We trace the development of number systems, the uses of Gaussian Elimination methods from 2000 BC on to current real-time Neural Network computations to solve time-varying equations. We include relevant advances from China during the 3rd century AD, from India and Persia in the 9th, discuss the conceptual genesis of vectors and matrices in central Europe and Japan in the 14th through 17th century AD, followed by the 150 year cul-de-sac of using polynomial root finders on the characteristic polynomial of matrices to find their eigenvalues, as well as 20th century matrix iterative methods and the Francis Algorithm of 55 years ago. This is followed by an outlook upon new hardware schemes with multilevel processors that go beyond the 0-1 base 2 framework that all our past and current electronic computers have used. We end with explaining the use of initial value problem solvers to master time-varying matrix equations via Neural Networks.

Musheng Wei

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Shanghai Normal University, China

Title: Quaternion matrix computations

Abstract: In this talk, we describe our new findings on quaternion matrix computations, and outline the contents of our coming monoghraph.

Ngai-Ching Wong

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National Sun Yat-sen University, Taiwan, China

Title: Quantum information theory and preserver problems

Abstract: I will present some of my works on the quantum information theory. Here, quantum data refers to positive density matrices/operators and quantum channels refer to completely positive maps The story starts with the Wigner theorem on transition probability. My study on several preserver problems of function, matrix and operator algebras follow. A typical problem states that whether two quantum systems modeled von Neumann algebras are isomorphic if they share identical transition probability structures. The talk will end by a briefing of my recent works on divergence preserver problem, which are applications of Bregman distances developed in the optimization theory.

Pei Yuan Wu

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Title: Numerical radius inequalities

Abstract: In this talk, we will discuss some of the tentative results on various inequalities involving numerical radii of finite matrices. There are more open questions than definite answers as the research projects, jointly with Hwa-Long Gau and Kuo-Zhong Wang, are still ongoing. They center around the following topics: (1) characterizing the numerical radii of powers of a matrix, (2) comparing the numerical radii of a matrix and its associated entrywise-modulus matrix, and (3) general information on the numereical ranges and numerical radii of Foguel operators.

Changqing Xu[1]

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Suzhou University of Science and Technology, China

Title: Commutation matrices and commutation tensors

Abstract: We all know that there must be some good relationship between a matrix and its transpose. An easy fact is that they are permutation similar to each other when the matrix is square. But can we write this relationship as an equation using a fixed general form of transformation? In this talk I will introduce the commutation matrix which plays such a role to connect a matrix and its transpose. Some nice properties related to the commutation matrices such as the usage of a commutaion

[1] Unfortunately, due to other commitments, he is unable to attend the conference

matrix in connection with the Kronecker product and the vectorization of matrices are also deduced. Furthermore, we generalize the commutation matrix to a commutation tensor.

Jianhong Xu

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Southern Illinois University Carbondale, USA

Title: On the Convergence of the Accelerated Riccati Iteration Method

Abstract: In this talk, we present results addressing two open problems, proposed recently by I.G. Ivanov, concerning the convergence of the accelerated Riccati iteration method for solving the continuous coupled algebraic Riccati equation, or CCARE for short. These results confirm a number of desirable features of that method, namely the monotonicity and boundedness of the sequences it produces, its capability of determining whether the CCARE has a solution, the extremal solutions it computes under certain circumstances, and its faster convergence compared to the regular Riccati iteration method. This is a joint work with Prasanthan Rajasingam of University of Jaffna, Sri Lanka.

Qingxiang Xu

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Title: Representations and perturbation analysis for the Moore-Penrose inverse of multiplicative perturbations of matrices

Abstract: For a matrix A, let A^+ denote its Moore-Penrose inverse. A matrix M is called a multiplicative perturbation of T in $\mathbb{C}^{m\times n}$ if $M = ETF^*$ for some E in $\mathbb{C}^{m\times m}$ and F in $\mathbb{C}^{n\times n}$. It is interesting to derive a general formula for M+ without any restrictions on the square matrices E and F. In this talk, we will first focus on such a topic. Based on the derived formula for M+, we will then report our some recent results on the perturbation analysis for the Moore-Penrose inverse of multiplicative perturbations of matrices.

Jun-Feng Yin

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Title: Preconditioners modified Hermitian and skew-Hermitian splitting method for the solution of fractional Schrödinger equations

Abstract: After discretized by an implicit conservative difference scheme, a complex linear equa-

tions with Toeplitz-like structure is obtained from fractional Schrödinger equations. A class of preconditioned modified Hermitian and skew-Hermitian splitting iteration method is proposed to solve the discretized linear system without complex arithmetics. Theoretical analyses show that the preconditioned modified Hermitian and skew-Hermitian splitting iteration methods are unconditionally convergent. In particular, we give a special case of the preconditioned modified Hermitian and skew-Hermitian splitting iteration method and study in details the choices of the optimal parameters to minimized the upper bound of the spectral radius of iteration matrix. Numerical examples are given to further confirm the efficiency of our approaches and show the performances of the corresponding preconditioners.

Co-author(s): Zeng-Qi Wang and Quan-Yu Dou

Fuzhen Zhang

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Title: Quaternions and Matrices of Quaternions –2017 Survey

Abstract: Quaternions form noncommutative division algebra (skew field). As part of contemporary mathematics, they find uses not only in theoretical and applied mathematics but also in computer graphics, control theory, signal processing, physics, and mechanics.

This talk briefly reviews basic theory on quaternions and matrices of quaternions, presents important results, propose open questions, and survey recent developments and publications in the area.

Shunpu Zhang

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Title: Risk Approximation and Vast Volatility Matrix Estimation Using High-Frequency Data for Portfolio Selection

Abstract: Recently, with the advances in computer technology, High Frequency Trading firms have grown considerably. Subject matter experts can access transaction by transaction data, which may occur in few seconds apart. Trading at this scale requires not only sophisticated technology to extract and process real time information, but also sophisticated mathematical and statistical tools for risk management. In this particular context, data observed for a set of assets are not synchronized, therefore, the volatility or covariance estimation becomes very challenging.

In this talk, we first provide a survey of different synchronization methods and covariance matrix estimators in the literature. The common criticism of the synchronization methods is that they discard

many observations. We will then suggest a better synchronization method called the Pseudo-refresh method. It does not discard any observation, provides a better convergence rate of the most current covariance estimator called the Two Scales Covariance (Fan, Li, & Yu, 2012), and provides a portfolio risk closer to a benchmark portfolio risk. Simulations show that the proposed method provides a better estimator of the covariance matrix.

Co-author(s): Cyrille Nzouda

Yang Zhang

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Title: Generalized Inverses of Ore Matrices

Abstract: We first discuss some necessary and sufficient conditions for extending involutions to skew polynomials, and explore all possible forms. Then we define Moore-Penrose inverses for Ore matrices as well as other generalized inverses. Using Jacobson forms, we give some necessary and sufficient conditions for existence of generalized inverses and design computing algorithms. As applications, we consider solving Ore matrix equations. Some examples are presented by Maple.

Zhihua Zhang

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Title: Some operator convex functions of several variables

Abstract: We obtain operator concavity (convexity) of some functions of two or three variables by using perspectives of regular operator mappings of one or several variables. As an application, we obtain, for $0 < p < 1$, concavity, respectively convexity, of the Fréchet differential mapping associated with the functions $t \to t^{1+p}$ and $t \to t^{1-p}$.

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Introduction to the Department of Mathematics

Shanghai University is a member university of the national project 211 and is a research-intensive and comprehensive university. It is administered by both the Ministry of Education of China and the Education Commission of Shanghai Municipal.

Authorized by the Ministry of Education of China, the Department of Mathematics of Shanghai University launched Ph.D. programs in Computational Mathematics in 1984 and Ph.D. programs in Operational Research and Cybernetics in 1990. In 2006 the department was approved by the Ministry of Education to confer Ph.D. degrees in all the sub-disciplines within mathematics.

The department currently has 25 professors, 32 associate professors and 23 lecturers. Among them, 2 are National Thousand-Talents Plan Experts, 1 is Cheung Kong Scholar, 2 are National Distinguished Young Scholar. The department also has 11 postdoctoral researchers, 76 Ph.D. students, 171 master students, and more than 400 undergraduate students. Five research centers including Shanghai Institute for Applied Mathematics and Systems Science are affiliated with the department. Moreover, the Mathematics Station of Shanghai University for Youths, sponsored by the Science and Technology Commission of Shanghai Municipality, marked the first base for mathematical popular science in China.

The main research interests in the Department of Mathematics are the following: algebraic theory and geometrical analysis; scientific computation and data analysis; differential equations and complex systems; optimization theory and algorithm design. Since 2012, more than 500 papers have been published in SCI-indexed journals, including Adv Math, Trans AMS, J Diff Geom, J Algebra, SIAM J Numer Anal, SIAM J Sci Comput, SIAM J Appl Math, SIAM J Optim, J Math Biol, Automatica, IEEE Trans Auto Contr etc. Meanwhile staff members have obtained 74 grants from the National Nature Science Foundation of China, including 1 Key Project. As a result, the department received 1 2nd-class and 1 3rd-class rewards from Shanghai Municipal Government.

In 2017 USNEWS ranked the department 80th in the world and 9th in China in the Mathematics ranking; in the world university ranking in Mathematics from QS, the department is 201st ranked globally and 10th ranked nationally. The latest ESI data showed that, 245 institutions are figured in the top 1% of mathematical research institutions over the world, among which the department is ranked 120th making it globally top $5\%_{\circ}$.

The Department is active in academic exchanges. Every year there are more than 160 experts coming to the department for collaboration and nearly 10 (inter)national conferences are hosted by the department.

Shanghai University Map (Baoshan Campus)