湖南大學
HUNAN UNIVERSITY

2017 Workshop on Matrices and Operators

Changsha, China
June 9-12, 2017

Purpose

The purpose of the workshop is to stimulate research and foster interaction of researchers interested in matrix theory, operator theory, and their applications. Hopefully, the informal workshop atmosphere will ensure the exchange of ideas from different research areas.

Organized by

College of Mathematics and Econometrics, Hunan University, China

Sponsored by

Institute of Mathematics, Hunan University

National Natural Science Foundation of China:

No. 11371072 (PI: Li-Ping Huang), No. 11401197 (PI: Zejun Huang)

Organizing Committee Members

Li-Ping Huang, Changsha University of Science and Technology.

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Anping Liao, Hunan University.

Jianzhou Liu, Xiangtan University.

Yuejian Peng, Hunan University.

Invited Participants

Tsuyoshi Ando	Hokkaido University, Japan
Changjiang Bu	Harbin Engineering University, China
Jianlong Chen	Southeast University, China
Guoliang Chen	East China Normal University, China
Man-Duen Choi	University of Toronto, Canada
Delin Chu	National University of Singapore, Singapore
Hongke Du	Shaanxi Normal University, China
Xue-Feng Duan	Guilin University of Electronic Technology, China
Hwa-Long Gau	National Central University, Taiwan, China
Jinchuan Hou	Taiyuan University of Technology, China
Yaoping Hou	Hunan Normal University, China
Li-Ping Huang	Changsha University of Science and Technology, China
Dragana Cvetković Ilić	University of Niš, Serbia
Seung-Hyeok Kye	Seoul National University, Korea
Chi-Kwong Li	College of William and Mary, USA
Lei Li	Nankai University, China
Minghua Lin	Shanghai University, China
Jianzhou Liu	Xiangtan University, China
Chi-Keung Ng	Nankai University, China
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Yiu-Tung Poon	Iowa State University, USA
Raymond Nung-Sing Sze	The Hong Kong Polytechnic University, Hong Kong, China
Bit-Shun Tam	Tamkang University, Taiwan, China
Tin-Yau Tam	Auburn University, USA
Kuo-Zhong Wang	National Chiao Tung University, Taiwan, China

Qing-Wen Wang	Shanghai University, China
Ya-Shu Wang	National Chung Hsing University, Taiwan, China
Ngai-Ching Wong	National Sun Yat-sen University, Taiwan, China
Pei Yuan Wu	National Chiao Tung University, Taiwan, China
Changqing Xu	Suzhou University of Science and Technology, China
Xingzhi Zhan	East China Normal University, China
Fuzhen Zhang	Nova Southeastern University, USA
Bo Zhou	South China Normal University, China

Meeting Place and Accommodation

Fenglin Hotel, 43 Fenglin 1st Road (Fenglin Yi Lu), Changsha

Transportation

- **Changsha Huanghua International Airport--> Fenglin Hotel**

  (1) Take Airport Bus to Hunan Civil Aviation Hotel ->transfer to Metro Line 2: from Railway Station to Yingwanzhen (Exit No. 1). It takes about two hours.

  (2) Take taxi to 43 Fenglin 1st Road (Fenglin Yi Lu). It takes about one hour.

- **Changsha South Railway Station--> Fenglin Hotel**

  (1) Changsha South Railway Station by Metro Line 2 to Yingwanzhen (Exit No. 1). It takes 40 minutes.

(2) Take taxi to 43 Fenglin 1st Road (Fenglin Yi Lu). It takes about 40 minutes.

- **Changsha Railway Station--> Fenglin Hotel**

  (1) Changsha Railway Station by Metro Line 2 to Yingwanzhen (Exit No. 1). It takes 20 minutes.

  (2) Take taxi to 43 Fenglin 1st Road (Fenglin Yi Lu). It takes about 20 minutes.

Contact

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Program

June 9, 2017 (Friday)

Time	**Lobby of Fenglin Hotel (枫林宾馆)**
9:00-21:00	**Registration**
17:30-19:00	**Dinner: Man Ting Fang (满庭芳), 2nd Floor, Fenglin Hotel**

June 10 (Saturday)

Meeting place: Changsha Hall (长沙厅), 4th Floor, Fenglin Hotel		
Time	Speaker & Title	Chair
8:20-8:40	**Opening Ceremony**	
8:40-9:10	**Group Photo**	
9:10-9:40	**Man-Duen Choi** *The non-commutative geometry of two by two matrices*	**Chi-Kwong Li**
9:40-10:10	**Tsuyoshi Ando** *Positive map as difference of two completely positive or super-positive maps*	
10:10-10:30	**Coffee/Tea Break**	
10:30-11:00	**Pei Yuan Wu** *Operators with real parts at least -1/2*	**Xingzhi Zhan**
11:00-11:30	**Chi-Kwong Li** *Numerical range and dilation*	
11:30-12:00	**Fuzhen Zhang** *Harnack Inequalities: From Harmonic Analysis through Poincare Conjecture to Matrix Determinant*	
12:00-13:30	**Lunch: Western Restaurant, 1st Floor, Fenglin Hotel**	

Parallel Sessions

June 10 (Saturday)

Session 1	**Meeting Room No. 1, 3rd Floor, Fenglin Hotel**	
Time	Speaker & Title	Chair
14:00-14:30	**Jianzhou Liu** *The disc theorem for the Schur complement of two class submatrices with r-diagonally dominant properties*	**Li-Ping Huang**
14:30-15:00	**Delin Chu** *Least Squares Approach for Regularized Incremental Linear Discriminant Analysis on Large-Scale Data*	
15:00-15:30	**Qing-Wen Wang** D*ecompositions of some matrices over an arbitrary division ring with applications*	
15:30-15:50	**Coffee/Tea Break**	
15:50-16:20	**Bo Zhou** *Sharp bounds for spectral radius of nonnegative matrices*	**Jianzhou Liu**
16:20-16:50	**Changjiang Bu** *Recent results on the generalized inverse and spectral properties of tensors*	
16:50-17:20	**Changqing Xu** *Covariance matrices and covariance tensors*	
17:20 -17:50	**Jianlong Chen** *From EP matrices, EP operators to EP elements in rings*	
18:00-19:30	**Dinner: Man Ting Fang (满庭芳), 2nd Floor, Fenglin Hotel**	

Session 2	**Meeting Room No. 3, 3rd Floor, Fenglin Hotel**	
Time	Speaker & Title	Chair
14:00-14:30	**Tin-Yau Tam** *Weak log majorization and determinantal inequalities*	**Ngai-Ching Wong**

14:30-15:00	**Yiu-Tung Poon** *A Generalized Hölder Type Eigenvalue Inequality*	**Ngai-Ching Wong**
15:00-15:30	**Minghua Lin** *A trace inequality for block positive semidefinite matrices*	
15:30-15:50	**Coffee/Tea Break**	
15:50-16:20	**Ngai-Ching Wong** *Generalized circular projections*	**Tin-Yau Tam**
16:20-16:50	**Chi-Keung Ng** *Metric preserving bijection between normal state spaces (the type I case)*	
16:50-17:20	**Ya-Shu Wang** *Orthogonally additive maps on Figá-Talamanca-Herz algebras*	
17:20 -17:50	**Xiaofei Qi** *k-skew Lie products on prime rings with involution*	
18:00-19:30	**Dinner: Man Ting Fang (满庭芳), 2nd Floor, Fenglin Hotel**	

June 11 (Sunday)

Session 1	**Meeting Room No. 1, 3rd Floor, Fenglin Hotel**	
Time	Speaker & Title	Chair
8:00-8:30	**Bit-Shun Tam** *Nullities of Graphs with Given Order, Matching Number and Cyclomatic Number Revisited*	**Yiu-Tung Poon**
8:30-9:00	**Raymond Nung-Sing Sze** *Time-energy costs of quantum channels*	
9:00-9:30	**Seung-Hyeok Kye** *Separability criterion for three-qubit states with a four dimensional norm*	

9:30-10:00	**Dragana Cvetković Ilić** *Completion problems of operator matrices to Fredholm, Weyl and Kato operators*	**Yiu-Tung Poon**
10:00-10:20	**Coffee/Tea Break**	
10:20-10:50	**Hwa-Long Gau** *Lower bounds for the numerical radius*	**Raymond Nung-Sing Sze**
10:50-11:20	**Kuo-Zhong Wang** *Numerical radius of matrix commutators and Jordan products*	
11:20-11:50	**Olga Y. Kushel** *Positive pairs matrix perturbations*	
12:00-13:30	**Lunch: Man Ting Fang (满庭芳), 2nd Floor, Fenglin Hotel**	
14:00-14:30	**Jianxing Zhao** *Singular value inclusion sets for rectangular tensors*	**Changqing Xu**
14:30-15:00	**Mengmeng Zhou** *Integral representations of two generalized core inverses*	
15:00-15:30	**Tingting Li** *Core and Dual Core Inverses of a Sum of Morphisms*	
15:30-15:50	**Coffee/Tea Break**	
15:50-16:20	**Mohammad Sal Moslehian** *Operator Birkhoff--James Orthogonality*	**Hwa-Long Gau**
16:20-16:50	**Mohsen Kian** *Matrix extension of convex sets and functions*	
16:50-17:20	**Mahdi Dehghani** *Counterparts to the information monotonicity of the matrix power means*	

Session 2	**Meeting Room No. 3, 3rd Floor, Fenglin Hotel**	
Time	Speaker & Title	Chair
8:00-8:30	**Jinchuan Hou** *Strong 3-skew commutativity preserving maps on prime rings with involution*	**Qing-Wen Wang**
8:30-9:00	**Hongke Du** *Idempotents and regular subspaces in Krein space*	
9:00-9:30	**Li-Ping Huang** *Generalized bilinear forms graphs over residue class rings*	
9:30-10:00	**Lei Li** *Weak 2-local isometries on function algebras*	
10:00-10:20	**Coffee/Tea Break**	
10:20-10:50	**Xue-Feng Duan** *Numerical methods for solving a class of matrix feasibility problem*	**Guoliang Chen**
10:50-11:20	**Zhi-Gang Jia** *A New TV-Stokes Model for Image Deblurring and Denoising with Fast Algorithms*	
11:20-11:50	**Jin Zhong** *Minimum rank problem for the regular classes of (0,1)-matrices*	
12:00-13:30	**Lunch: Man Ting Fang (满庭芳), 2nd Floor, Fenglin Hotel**	
14:00-14:30	**Yuan Li** *Decompositions of completely bounded maps into completely positive maps*	**Delin Chu**
14:30-15:00	**Yu Yang** *Schmidt numbers under local projections and construction of positive partial transpose entangled states*	

15:00-15:30	**Qiting Li** *Entanglement monogamy in three qutrit systems*	**Delin Chu**
15:30-15:50	**Coffee/Tea Break**	
15:50-16:20	**Zhen Chao** *On the semi-convergence of regularized HSS iteration methods for singular saddle point problems*	**Minghua Lin**
16:20-16:50	**Wei-Ru Xu** *Procrustes problems and inverse eigenproblems for Multilevel block* α-circulants	
16:50-17:20	**An-Bao Xu** *Varied parametric quasi-soft thresholding for compressed sensing*	
17:20-17:30	**Closing Remarks**	
17:30-19:00	**Dinner: Man Ting Fang (满庭芳), 2nd Floor, Fenglin Hotel**	

June 12 (Monday)

Time	Speaker & Title
June 12	**Free Discussion**

Abstracts

Name: Tsuyoshi Ando

Affiliation: Hokkaido University, Japan

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Title: Positive map as difference of two completely positive or super-positive maps

Abstract: Given a positive linear map $\varphi : \mathbb{M}_m \to \mathbb{M}_n$, we construct completely positive linear maps $\varphi^{(j)} : \mathbb{M}_m \to \mathbb{M}_n$ $(j = 1, 2)$ such that

$$\varphi = \varphi^{(1)} - \varphi^{(2)} \quad \text{and} \quad \varphi^{(1)}(I_m) + \varphi^{(2)}(I_m) \ \leq \ m \cdot \varphi(I_m).$$

When complete positivity is replaced by super-positivity

$$\varphi^{(1)}(I_m) + \varphi^{(2)}(I_m) \ \leq \ (2m-1) \cdot \varphi(I_m).$$

Here a linear map is called super-positive if its Choi matrix is separable.

Name: Changjiang Bu

Affiliation: College of Science, Harbin Engineering University, P.R. China

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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.

Co-author(s): Lizhu Sun and Jiang Zhou.

Name: Zhen Chao

Affiliation: Department of Mathematics, East China Normal University, P.R. China

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Title: On the semi-convergence of regularized HSS iteration methods for singular saddle point problems

Abstract: Recently, Bai and Benzi proposed a class of regularized Hermitian and skew-Hermitian splitting (RHSS) iteration methods for solving the nonsingular saddle point problem. In this paper, we apply this method to solve the singular saddle point problem. In the process of the semi-convergence analysis, we get that the RHSS method and the HSS method are unconditionally semi-convergent, which has weaken the previous results. Then

some spectral properties of the corresponding preconditioned matrix and a class of improved preconditioned matrix are analyzed. Finally, some numerical experiments on linear systems arising from the discretization of the Stokes equations are presented to illustrate the feasibility and effectiveness of this method and preconditioners.

Co-author(s): Guoliang Chen.

Name: Jianlong Chen

Affiliation: School of Mathematics, Southeast University, P.R. China

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Title: From EP matrices, EP operators to EP elements in rings

Abstract: In this talk, we will give a survey of results concerning EP elements in complex matrices; in operators; in rings (semigroups) with involution and in C^*-algebras.

Name: Man-Duen Choi

Affiliation: Department of Mathematics, University of Toronto, Canada

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Title: The non-commutative geometry of two by two matrices

Abstract: The elementary structure of two by two complex matrices shows many deep aspects of NON-COMMUTATIVE geometry (alias, algebra, or probability, or topology), as needed in various applications.

Name: Delin Chu

Affiliation: Department of Mathematics, National University of Singapore, Singapore

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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.

Name: Mahdi Dehghani

Affiliation: Department of Pure Mathematics, Faculty of Mathematical Sciences, University of Kashan, Kashan, Iran

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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 $A = (A_1, \ldots, A_k)$ 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 $P_t(\omega; A)$ 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

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

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

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 $t \in (0, 1]$

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

where $\Phi(A) = (\Phi(A_1), \cdots, \Phi(A_k))$. 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 virtue of the generalized Kantorovich constant.

Name: Hongke Du

Affiliation: Department of Mathematics and Information Science, Shaanxi Normal University, P.R. China

Email: hkdu@snnu.edu.cn

Title: Idempotents and regular subspaces in Krein space

Abstract: In this talking, we will show that how to study and uncover closed relationship between Idempotents and regular subspaces in Krein spaces using block-operator matrix technique, spectral theory and two projections theory.

Name: Xue-Feng Duan

Affiliation: College of Mathematics and Computational Science, Guilin University of Electronic Technology, P.R. China

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Title: Numerical methods for solving a class of matrix feasibility problem

Abstract: In this talk, we design two numerical methods for solving some matrix feasibility problems, which arise in the quantum information science. By making use of the structured properties of linear constraints and the minimization theorem of symmetric matrix on manifold, the projection formulas of a matrix onto the feasible sets are given, and then the relaxed alternating projection algorithm and alternating projection algorithm on manifolds are designed to solve these problems. Numerical examples show that the new methods are feasible and effective.

Name: Hwa-Long Gau

Affiliation: Department of Mathematics, National Central University, Taiwan

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Title: Lower bounds for the numerical radius

Abstract: We show that if $A = [a_{ij}]_{i,j=1}^n$ is an n-by-n complex matrix and $A' = [a'_{ij}]_{i,j=1}^n$, where

$$a'_{ij} = \begin{cases} a_{ij} & \text{if } (i,j) = (1,2), \ldots, (n-1,n) \text{ or } (n,1), \\ 0 & \text{otherwise,} \end{cases}$$

then $w(A) \geq w(A')$, where $w(\cdot)$ denotes the numerical radius of a matrix. Moreover, if n is odd and $a_{12}, \ldots, a_{n-1,n}, a_{n1}$ are all nonzero, then $w(A) = w(A')$ if and only if $A = A'$. For an even n, under the same nonzero assumption, we have $W(A) = W(A')$ if and only if $A = A'$, where $W(\cdot)$ is the numerical range of a matrix.

Co-author(s): Pei Yuan Wu

Name: Jinchuan Hou

Affiliation: Department of Mathematics, Taiyuan University of Technology, P.R. China

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Title: Strong 3-skew commutativity preserving maps on prime rings with involution

Abstract: Let $\mathcal{R}$ be a unital prime $*$-ring of the first kind containing two nontrivial symmetric idempotent P, Q with $PQ = QP = 0$ and $0 < P+Q < 1$ or a unital prime $*$-ring of the second kind containing a nontrivial symmetric idempotent P. For $A, B \in \mathcal{R}$, the 3-skew commutator is defined by ${}_*[A, B]_3 = {}_*[A, {}_*[A, B]_2] = {}_*[A, {}_*[A, {}_*[A, B]]] = A^3B - 3A^2BA^* + 3AB(A^*)^2 - B(A^*)^3$. Let $\Phi : \mathcal{R} \to \mathcal{R}$ be a surjective map. We show that Φ satisfies ${}_*[\Phi(A), \Phi(B)]_3 = {}_*[A, B]_3$ for all $A, B \in \mathcal{R}$ if and only if there exists $\lambda \in \mathcal{C}_S$ with $\lambda^4 = I$ such that $\Phi(A) = \lambda A$ for all $A \in \mathcal{R}$. Where I is the unit of $\mathcal{R}$ and $\mathcal{C}_S$ is the symmetric extend centroid of $\mathcal{R}$. This result then is applied to matrix algebras and operator algebras.

Co-author(s): Xiaofei Qi, Wei Wang.

Name: Li-Ping Huang

Affiliation: School of Mathematics and Statistics, Changsha University of Science and Technology, P.R.China

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Title: Generalized bilinear forms graphs over residue class rings

Abstract: We investigate the generalized bilinear forms graph Γ over a residue class ring modulo p^s (where p is a prime number and s is a positive integer). The generalized bilinear forms graph Γ is a connected vertex transitive graph, and its core is complete. We determine the clique number, the independence number, the chromatic number, and the maximum cliques of Γ, respectively.

Co-author(s): Huadong Su, Gaohua Tang, Jia-Bin Wang.

Name: Dragana Cvetković Ilić

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Title: Completion problems of operator matrices to Fredholm, Weyl and Kato operators

Abstract: We will address some recent results on certain problems of completions of operator matrices. In particular, we will consider the problems of completions of operator matrices to Fredholm, Weyl and Kato operators.

Name: Zhi-Gang Jia

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Title: A New TV-Stokes Model for Image Deblurring and Denoising with Fast Algorithms

Abstract: The famous TV-Stokes models, which improve the restored images comfortable, have been very successful in image denoising. In this paper, we propose a new TV-Stokes model for image deblurring with a good geometry explanation. In the tangential field smoothing, the data fidelity term is chosen to measure the distance between the solution and the orthogonal projection of the tangential field of the observation image onto the range of the conjugate of the blurry operator, while the total variation of the solution is chosen as the regularization term. In the image reconstruction, we compute the smoothing part of the image from the smoothed tangential field for the first step, and use an anisotropic TV model to obtain the "texture" part of the deblurred image. The solvability properties for the minimization problems in two steps are established, and fast algorithms are presented. Numerical experiments demonstrate that the new deblurring model can capture the details of images hidden in the blurry and noisy image, and the fast algorithms are efficient and robust.

Co-author(s): Musheng Wei (SHNU).

Name: Mohsen Kian

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Title: Matrix Extension of convex sets and functions

Abstract: 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.

Name: Olga Y. Kushel

Affiliation: Department of Mathematics, Shanghai University, P.R. China

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Title: Positive pairs matrix perturbations

Abstract: We present a highly applicable method for studying spectral properties of structured matrices and their submatrices. The method is based on the theory of transversal and positive rank-one perturbations, developed by Y. Barkovsky.

Co-author(s): Mikhail Tyaglov

Name: Seung-Hyeok Kye

Affiliation: Seoul National University, Korea

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Title: Separability criterion for three-qubit states with a four dimensional norm

Abstract: We give a separability criterion for three qubit states in terms of diagonal and anti-diagonal entries. This gives us a complete characterization of separability when all the entries are zero except for diagonal and anti-diagonals. The criterion is expressed in terms of a norm arising from anti-diagonal entries. We compute this norm in several cases, so that we get criteria with which we can decide the separability by routine computations.

Co-author(s): Lin Chen and Kyung Hoon Han

Name: Chi-Kwong Li

Affiliation: Department of Mathematics, College of William and Mary, USA

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Title: Numerical range and dilation

Abstract: We survey some results concerning the use of numerical ranges to study dilation theory of operators. Connections to problems arising in quantum information science will be mentioned.

Name: Lei Li

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Title: Weak 2-local isometries on function algebras

Abstract: We establish spherical variants of the Gleason-Kahane-Zelazko and Kowalski-Slodkowski theorems and we prove that every weak-2-local isometry between two uniform algebras is a linear map. Moreover, we apply our method to Lipschitz algebras.

Co-author(s): A.M. Peralta, Liguang Wang and Ya-Shu Wang.

Name: Qiting Li

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Title: Entanglement monogamy in three qutrit systems

Abstract: Quantum information, as a rising interdisciplinary field which combines quantum mechanics, informatics and mathematics, becomes a new frontier science for information processing. The key concept of quantum information is the quantum entanglement and one of the most fundamental parts of quantum entanglement is the entanglement measure. Quantum entanglement, differing from classical correlation, is not shareable at liberty when distributed among three or more parties. There is constraint on distributed entanglement among many parties: if two bodies are maximally entangled, they can not share any entanglement with other subsystems. This property is called entanglement monogamy, which is of paramount importance in many protocols of quantum information and quantum communication. By introducing an arbitrary-dimensional multipartite entanglement measure, which is defined in terms of the reduced density matrices corresponding to all possible two partitions of the entire system, we prove that multipartite entanglement cannot be freely shared among the parties in both n-qubit systems and three-qutrit systems. Furthermore, our result implies that the satisfaction of the entanglement monogamy is related to the number of particles in the quantum system. As an application of three-qutrit monogamy inequality, we give a condition for the separability of a class of two-qutrit mixed states in a $3 \otimes 3$ system.

Co-author(s): Jianlian Cui, jcui@math.tsinghua.edu.cn

Name: Tingting Li

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Title: Core and Dual Core Inverses of a Sum of Morphisms

Abstract: Let $\mathscr{C}$ be an additive category with an involution $*$. Suppose that $\varphi : X \to X$ is a morphism of $\mathscr{C}$ with core inverse $\varphi^{\oplus} : X \to X$ and $\eta : X \to X$ is a morphism of $\mathscr{C}$ such that $1_X + \varphi^{\oplus}\eta$ is invertible. Let $\alpha = (1_X + \varphi^{\oplus}\eta)^{-1}$, $\beta = (1_X + \eta\varphi^{\oplus})^{-1}$, $\varepsilon = (1_X - \varphi\varphi^{\oplus})\eta\alpha(1_X - \varphi^{\oplus}\varphi)$, $\gamma = \alpha(1_X - \varphi^{\oplus}\varphi)\beta^{-1}\varphi\varphi^{\oplus}\beta$, $\sigma = \alpha\varphi^{\oplus}\varphi\alpha^{-1}(1_X - \varphi\varphi^{\oplus})\beta$, $\delta = \beta^{*}(\varphi^{\oplus})^{*}\eta^{*}(1_X - \varphi\varphi^{\oplus})\beta$. Then $f = \varphi + \eta - \varepsilon$ has a core inverse if and only if $1_X - \gamma$, $1_X - \sigma$ and $1_X - \delta$ are invertible. Moreover, the expression of the core inverse of f is presented. Let R be a unital $*$-ring and $J(R)$ its Jacobson radical, if $a \in R^{\oplus}$ with core inverse $a^{\oplus}$ and $j \in J(R)$, then $a + j \in R^{\oplus}$ if and only if $(1 - aa^{\oplus})j(1 + a^{\oplus}j)^{-1}(1 - a^{\oplus}a) = 0$. We also give the similar results for the dual core inverse.

Co-author: Jianlong Chen.

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Title: Decompositions of completely bounded maps into completely positive maps

Abstract: Let $K(\mathcal{H})$ and $\mathcal{B}(\mathcal{H})$ be the sets of all compact operators and all bounded linear operators on the Hilbert space $\mathcal{H}$, respectively. We mainly show that if $\Phi \in CB(K(\mathcal{H})^*, B(\mathcal{K}))$, then there exist $\Phi_i \in CP(K(\mathcal{H})^*, \mathcal{B}(\mathcal{K}))$ for $i = 1, 2, 3, 4$, such that $\Phi = (\Phi_1 - \Phi_2) + \sqrt{-1}(\Phi_3 - \Phi_4)$. However, $CP(K(\mathcal{H})^*, \mathcal{B}(\mathcal{K})) \nsubseteq CB(K(\mathcal{H})^*, B(\mathcal{K}))$, where $CB(V, W)$ and $CP(V, W)$ are the sets of all completely bounded maps and all completely positive maps from V into W, respectively.

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Title: A trace inequality for block positive semidefinite matrices

Abstract: This talk concerns a trace inequality formulated by Besenyei http://abesenyei.web.elte.hu /publications/trace.pdf. The talk consists of different proofs, extensions and related results of the trace inequality.

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Title: The disc theorem for the Schur complement of two class submatrices with r-diagonally dominant properties

Abstract: The distribution for eigenvalues of Schur complement of matrices plays an important role in many mathematical problems. In this talk, we firstly present some criteria for H-matrix. Then as application, for two class matrices whose submatrices are r-diagonally dominant and product r-diagonally dominant, we show that the eigenvalues of the Schur complement are located in the Geršgorin discs and the Ostrowski discs of the original matrices under certain conditions.

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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.

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Title: Metric preserving bijection between normal state spaces (the type I case)

Abstract: Let M and N be type I von Neumann algebras with normal state spaces S_M and S_N respectively. Using von Neumann algebra technique as well as argument involving matrix valued measurable functions, we show that any metric preserving bijection from S_M to S_N is automatically affine and hence is induced by a Jordan *-isomorphism.

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Title: A Generalized Hölder Type Eigenvalue Inequality

Abstract: In this note, we prove that if $A_1, \ldots, A_m$ are $n \times n$ contractive matrices and $p_1, \ldots, p_m > 0$ with $\frac{1}{p_1} + \frac{1}{p_2} + \cdots + \frac{1}{p_m} = 1$, then

$$\prod_{j=1}^{k} (1 - \lambda_j(|A_1 \cdots A_m|)^r) \geq \prod_{i=1}^{m} \prod_{j=1}^{k} (1 - \lambda_j(|A_i|)^{rp_i})^{\frac{1}{p_i}}$$

for each $k = 1, 2, \ldots, n$. This generalizes an inequality due to Marcus (1958).

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Title: k-skew Lie products on prime rings with involution

Abstract: Let $\mathcal{R}$ be a ring with an involution $*$ and k a positive integer. The k-skew Lie product of $a, b \in \mathcal{R}$ is defined by ${}_*[a,b]_k = {}_*[a, {}_*[a,b]_{k-1}]$, where ${}_*[a,b]_0 = b$ and ${}_*[a,b]_1 = ab - ba^*$. In this paper, some useful properties of the k-skew Lie products on prime *-rings are given. Then, as an application of these results, k-skew commuting additive maps on prime *-rings are characterized.

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Title: Time-energy costs of quantum channels

Abstract: A time-energy cost of a $r \times r$ unitary matrix U is defined as

$$\|U\|_{\max} = \max_{1 \le j \le r} |\theta_j|,$$

where $e^{i\theta_1}, \ldots, e^{i\theta_r}$ are the eigenvalues of U with $\theta_j \in (-\pi, \pi]$. A time-energy cost for a quantum channel K is defined as

$$\|K\|_{\max} = \min_{U} \|U\|_{\max} \quad \text{such that} \quad K(\rho_A) = \mathrm{Tr}_B \left(U(|0\rangle_B \langle 0| \otimes \rho_A) U^* \right),$$

where the channel K acts on quantum state ρ_A in system A, the unitary extension U acts on the composite system $A \otimes B$, and Tr_B is the partial trace over the system B. In this talk, we discuss some recent development in the time-energy cost and its connection to some fidelity function on quantum channels.

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Title: Nullities of Graphs with Given Order, Matching Number and Cyclomatic Number Revisited

Abstract: For a (simple) graph G, we denote by $|V(G)|, |E(G)|, \eta(G)$ and $m(G)$ respectively the order, the number of edges, the nulliy, and the matching number of G. It was shown by Wang and Wong (2014) that for every graph G, $|V(G)| - 2m(G) - c(G) \leq \eta(G) \leq |V(G)| - 2m(G) + 2c(G)$, where $c(G) := |E(G)| - |V(G)| + \theta(G)$ is the cyclomatic number of G, $\theta(G)$, being the number of components of G. Graphs G for which $\eta(G)$ attain the upper bound have been characterized by Song et.al. (2015), and graphs G for which $\eta(G)$ attain the lower bound have also been characterized independently by Rula et.al. (2016) and Wang (2016). Earlier Guo et.al. (2009) had also shown that for a unicyclic graph G, $\eta(G) - |V(G)| + 2m(G)$ can take only one of the values $-1, 0$ or 2, and they characterized the corresponding types of unicyclic graphs. In this paper, exploiting the concepts of canonical star associated with a rooted tree, the canonical unicyclic graph associated with a unicyclic graph and a crucial subgraph of a graph, we correct, complete and extend the work of previous authors on this topic. More complete lists of characterizations for the three types of unicyclic graphs, for nonsingular unicyclic graphs, and for graphs with the minimal or maximal nullity conditions are found. It is shown that if c, n are given positive integers with $n \geq 6c + 2$, then for any integer $k, -c \leq k \leq 2c, k \neq 2c - 1$, there exists a connected graph G of order n that satisfies $c(G) = c$ and $\eta(G) - |V(G)| + 2m(G) = k$, but there is no graph G of any order that satisfies $c(G) = c$ and $\eta(G) - |V(G)| + 2m(G) = 2c - 1$.

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Title: Weak log majorization and determinantal inequalities

Abstract: We will discuss a determinantal inequality of I. Matic and its generalization. We will also discuss a weak majorization result which is complementary to a determinantal inequality of D. Choi.

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Title: Numerical radius 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 $n \times n$ matrices A and B is related to those of A and B

by $w(AB \pm BA) \leq 2\sqrt{2}w(A)\|B\|$. In this talk, we give complete characterizations of A and B for which the equality is attained.

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Title: Decompositions of some matrices over an arbitrary division ring with applications

Abstract: In this talk, we give all the dimensions of identity matrices in the equivalence canonical form of four matrices over an arbitrary division ring F with compatible sizes: $A \in \mathbb{F}^{m\times n}$,$B \in \mathbb{F}^{m\times p_1}, E \in \mathbb{F}^{q_1\times n}, F \in \mathbb{F}^{q_2\times n}$ and $G \in \mathbb{F}^{q_3\times n}$. As applications, we derive some necessary and sufficient conditions for the solvability to some well known systems of matrix equations over an arbitrary division ring using rank conditions. We also construct a simultaneous decomposition for a set of seven general matrices over an arbitrary division ring F with compatible sizes: $A \in \mathbb{F}^{m\times n}, B \in \mathbb{F}^{m\times p_1}, C \in \mathbb{F}^{m\times p_2}, D \in \mathbb{F}^{m\times p_3}, E \in \mathbb{F}^{q_1\times n}, F \in \mathbb{F}^{q_2\times n}$ and $G \in \mathbb{F}^{q_3\times n}$. As applications of the simultaneous matrix decomposition, we give some solvability conditions, general solutions, as well as the range of ranks of the general solutions to some generalized Sylvester matrix equations over an arbitrary division ring F.

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Title: Orthogonally additive maps on Figá-Talamanca-Herz algebras

Abstract: In this talk, we will introduce the Figá-Talamanca-Herz algebras $A_p(G)$ and the representation of linear orthogonally multiplicative maps on $A_p(G)$.

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Title: Generalized circular projections

Abstract: Being expected as Banach space substitutes of the orthogonal projections on Hilbert spaces, generalized bicircular projections also extend bicontractive projections on JB*-triples. In this talk, we study some geometric properties related to them. In particular, we provide some structure theorems of generalized circular projections on continuous functions,

and an often mentioned special case of JB*-triples, i.e., Hilbert C*-modules over continuous functions.

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Title: Operators with real parts at least $-1/2$

Abstract: Matrices B of the form $B = A(I_n - A)^{-1}$ (n at least 3), where A is an S_n-matrix, that is, A is a contraction with eigenvalues in the open unit disc and with rank $(I_n - A^*A) = 1$, play the role of basic building blocks for general matrices C with real parts at least $-1/2$. In this talk, we will discuss properties of such matrices B and show how an extension model for a matrix C with Re C at least $-1/2$ can be built up from such B's.

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Title: Varied parametric quasi-soft thresholding for compressed sensing

Abstract: Compressed sensing is a new theory of signal acquisition and processing. l_0 norm minimization problem is the major problem of compressed sensing. Its purpose is to find the most sparsest solution in the infinite solutions of the underdetermined equation to construct the original signal (vector). This paper first analyzes four basic algorithms for this norm minimization problem: iterative soft thresholding algorithm, iterative hard thresholding algorithm, iterative firm thresholding algorithm and the quasi-soft thresholding algorithm (or MC+). Then the parametrization of the quasi-soft thresholding operator are updated adaptively to obtain the varied parametric quasi-soft thresholding algorithm. The convergence of the algorithm is proved. And the numerical results show that the new algorithm can effectively improve the accuracy of signal reconstruction.

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Title: Covariance matrices and covariance tensors

Abstract: In multivariate statistics, matrices play very important role. For example, covariance matrices and the generalized inverses of covariance matrices are extensively studied for

the probability density function and the estimation of the unknown parameters in the statistical models. On the one hand, a covariance matrix reflects the correlation of the random variables under investigation, which is crucial for us to simplify the model and make possible for the prediction of the incoming data. On the other hand, the shortage of the information in a covariance matrix on the multi-relation of a multiset of some variables (instead of a pair of variables) makes hard for us to guarantee the simplicity and the efficiency of the model. In this talk, we will introduce the concept of covariance tensor, which can be applied to tackle this issue. We will also show that a covariance tensor is a symmetric and positive semidefinite tensor.

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Title: Procrustes problems and inverse eigenproblems for Multilevel block $\boldsymbol{\alpha}$-circulants

Abstract: Let $\boldsymbol{n} = (n_1, n_2, \ldots, n_k)$ and $\boldsymbol{\alpha} = (\alpha_1, \alpha_2, \ldots, \alpha_k)$ be integer k-tuples with $\alpha_i \in \{1, 2, \ldots, n_i - 1\}$ and $n_i \geq 2$ for all $i = 1, 2, \ldots, k$. Multilevel block $\boldsymbol{\alpha}$-circulants (see, [LAA, 431 (2009) 1833-1847]) are $(k+1)$-level block matrices, where the first k levels have the block α_i-circulant structure with orders $n_1, n_2, \ldots, n_k \geq 2$ and the entries in the $(k+1)$-st level are unstructured rectangular matrices with the same size $d_1 \times d_2$ ($d_1, d_2 \geq 1$). When $k = 1$, Trench [NLAA, 20 (2013) 349-356] discussed Procrustes problems and inverse problems of unilevel block α-circulants (see, [LAA, 430 (2009) 2012-2025]) and their approximations. But the results are not perfect for the case $\gcd(\boldsymbol{\alpha}, \boldsymbol{n}) > 1$ (i.e. $\gcd(\alpha_1, n_1) > 1$). In this talk, I will discuss Procrustes problems for multilevel block $\boldsymbol{\alpha}$-circulants. The obtained results can further make up for the deficiency when $k = 1$. When $d_1 = d_2 \geq 1$, inverse eigenproblems for this kind of matrices are also solved. By using the related results, an artificial Hopfield neural network system can be designed such that it possesses the prescribed equilibria, where the Jacobian matrix of this system has the constrained multilevel $\boldsymbol{\alpha}$-circulative structure.

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Title: Schmidt numbers under local projections and construction of positive partial transpose entangled states.

Abstract: The Schmidt number is a fundamental parameter characterizing the properties of quantum states, and local projections are fundamental operations in quantum physics. We investigate the relation between the Schmidt numbers of bipartite states and their projected

states. We show that there exist bipartite positive-partial-transpose (PPT) entangled states of any prescribed Schmidt number.

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Title: Minimum rank problem for the regular classes of (0,1)-matrices

Abstract: Let $\mathscr{B}(n,k)$ be the set of all (0,1)-matrices of order n with constant line sum k and let $\tilde{\nu}(n,k)$ be the minimum rank over $\mathscr{B}(n,k)$. We prove that $\hat{\nu}(n,k) = \lfloor n/k \rfloor + k$ if and only if $n \equiv \pm 1 \pmod{k}$ and then answer a question posed by Pullman and Stanford. We also show that $\tilde{\nu}(n,k) = \lfloor n/k \rfloor + k$ if and only if (n,k) satisfies one of the following three relations: (i) $n \equiv \pm 1 \pmod{k}$, $k = 2$ or 3; (ii) $n = k+1$, $k \geq 2$; (iii) $n = 4q+3$, $k = 4$ and $q \geq 1$. Moreover, we obtain the exact values of $\tilde{\nu}(n,4)$ for all $n \geq 4$ and determine all the possible ranks of regular (0,1)-matrices in $\mathscr{B}(n,4)$. Finally, we also present some positive integer pairs (n,k) such that $\tilde{\nu}(n,k) < \hat{\nu}(n,k) < \lfloor n/k \rfloor + k$, which gives a positive answer to another question posed by Pullman and Stanford.

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Title: Harnack Inequalities: From Harmonic Analysis through Poincare Conjecture to Matrix Determinant

Abstract: With a brief survey on the Harnack inequalities in various forms in Functional Analysis, in Partial Differential Equations, and in Perelmans solution of the Poincare Conjecture, we discuss the Harnack inequality in Linear Algebra and Matrix Analysis. We present an extension of Tungs inequality of Harnack type and study the equality case.

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Title: Singular value inclusion sets for rectangular tensors

Abstract: Two singular value inclusion sets for rectangular tensors are given. These sets provide two upper bounds and lower bounds for the largest singular value of nonnegative rectangular tensors, which can be taken as an initial value of an algorithm presented by Zhou *et al.* (Linear Algebra Appl. 2013; 438: 959–968) such that the sequences produced by this algorithm converge rapidly to the largest singular value of an irreducible nonnegative rectangular tensor.

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Title: Sharp bounds for spectral radius of nonnegative matrices

Abstract: We present sharp upper and lower bounds for spectral radius of nonnegative matrices using row sums, average 2-row sums, and average 3-row sums, respectively. Applications to various matrices associated to a graph are also considered.

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Title: Integral representations of two generalized core inverses

Abstract: In this talk, we present integral representations of the DMP and core-EP inverse, which based on the full-rank decomposition of a given matrix. In particular, integral representations of the core and dual core inverse are given. All of these integral representations do not require any restriction on the spectrum of matrix.

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Introduction to Hunan University

Hunan University is situated at the foot of the picturesque Yuelu Mountain and on the west bank of the rippling Xiangjiang River in the historically and culturally renowned City of Changsha, capital of Hunan Province. It enjoys the title of an "Ancient Millenarian Academy, Famous Centennial University". As one of the key and most comprehensive universities affiliated with the Ministry of Education, it has been included in the state's "Project 211" and "Project 985" for priority investment and construction.

Hunan University, an extension of one of the four famous Academies of the Song Dynasty, dates back to the period of the founding of Yuelu Academy in 976 AD. The university has maintained the glorious culture and education standards inherited from the historical institute in the process of the numerous changes faced with during the Song, Yuan, Ming and Qing dynasties. It was reconstructed into Hunan Institute of Higher Learning in 1903, renamed Hunan University in 1926, and subordinated to the Republic of China's Ministry of Education as one of several state universities in 1937. After liberation and the founding of the People's Republic of China, the Central People's Government appointed Li Da, a well-known philosopher and educator, as the first President of Hunan University. Chairman Mao Zedong inscribed the name of the University. In 1953, when readjusting China’s higher education institutions, Hunan University was named the Central-South Institute of Civil Engineering. Later it was renamed Hunan Polytechnic College, and was finally, named Hunan University in 1959. Since 1963, the University has been affiliated with the Ministry of Mechanical Industry and in 1978 it was approved as a key and comprehensive university of China, and became directly affiliated with the Ministry of Education in 1998. In 2000, Hunan University and Hunan Institute of Finance and Economics merged to give shape to a new wide-ranging Hunan University.

The University has a Graduate School and 23 colleges and departments. Professional disciplines involve 11 subject categories, namely philosophy, economics, law, education, literature, history, science, engineering, management, medicine and arts, which offer 24 first-order disciplines authorized to confer Ph.D. degrees, 36 first-order disciplines authorized to confer Master's degree, and 22 professional degree authorizations, 2 key first-order disciplines and 14 key second-order disciplines honored at the national level, as well as 25 post-doctoral research programs. It has more than 4,000 staffs, including more than 1,100 professors and associate professors, 8 members of the Chinese Academy of Sciences and Chinese Academy of Engineering. The full-time student body totals nearly 35,000, including more than 20,000 undergraduates and 15,000 graduates.

For more information about Hunan University please visit http://www-en.hnu.edu.cn.

湖南大学数学与计量经济学院简介

湖南大学数学学科始建于1908年湖南优级师范学堂（湖南大学的前身）设立的数学本科，2000年建立学院。已历经百年风雨，经过几代湖大数学人的不懈努力，在人才培养、科学研究、社会服务等方面都做出了重要贡献。

目前数学与计量经济学院下设数学与应用数学系、信息与计算科学系、公共数学系和数学研究所。学院拥有“智能信息处理与应用数学”湖南省重点实验室和“工业数学与应用数学”湖南省高校重点实验室及“信息科学中的关键数学问题”湖南省高校科技创新团队。

学院建有数学学科博士后科研流动站，拥有数学一级学科博士点，应用数学、基础数学、计算数学、概率统计、运筹学与控制论5个二级学科硕士点，数学与应用数学、信息与计算科学2个本科专业。其中，应用数学学科是湖南省重点学科，数学与应用数学专业是湖南省重点专业与特色专业，《高等数学》课程是国家级精品课程，“通识平台大学数学数学课程教学团队”为国家级教学团队。

学院一贯坚持以教学立院、以科研强院，始终把师资队伍建设放在首位，现有教职工101人，其中教师92人。教师中有千人计划入选者1名，国家杰出青年科学基金获得者1名，青年千人计划入选者1人，教授23人和副教授42人。

“十二五”期间，学院进一步巩固和发展了泛函微分方程、偏微分方程、拓扑代数、科学计算、组合图论和复几何与量子群等六个有特色的研究方向，承担国家级项目50余项，获得纵向科研经费1600万元；2012年，数学学科进入了 ESI 全球排名前1%。学术交流与科研合作活跃，与加拿大 York 大学、美国 Corolado 大学、Connecticut 大学、英国 Durham 大学、香港浸会大学、中科院数学所等国内外著名大学和研究机构建立了稳固的合作研究和学术交流关系，主办或承办一批高水平的国际和全国性学术会议，扩大了本学科在国内外的影响

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