



数学科学学院

School of Mathematical Sciences

张量及其应用研讨会

2017年11月24日-----11月27日

广州

会议手册

主办：广东省数据科学工程技术研究中心

华南师范大学数学科学学院

目 录

会议日程	-----	3
会议日程简版	-----	3
会议详细日程	-----	4
11月25日, 星期六	-----	4
11月26日, 星期日	-----	5
报告题目与摘要	-----	6
到华师大厦交通	-----	18
参会人员通讯录	-----	19

会议日程

会议日程简版

11月24日： 报到注册，地点：华师大厦大堂

11月25日： 上午 9:00—9:30 致辞、合影

上午 09:30---11:40 报告

下午 15:00---17:50 报告

晚上 6:30 晚宴

11月26日： 上午 09:00---11:50 报告

下午 15:00---17:50 报告

11月27日： 离开

会议详细日程

11月25日上午，星期六

主持人 钟柳强	09:00---09:15	华南师大数学科学学院院长致辞
	09:15--09:30	合影
主持人 李董辉	09:30--10:10	报告人：张福振 题目：Polytopes of stochastic tensors
	10:10--10:50	报告人：金小庆 题目：Some norm inequalities for commutators of contracted tensor products
茶 歇 10: 50---11: 00		
主持人 金小庆	11:00--11:40	报告人：倪谷炎 题目：复张量特征对计算

11月25日下午，星期六

主持人 凌 晨	15:00---15:40	报告人：魏益民 题目：Partial Orthogonal Rank-One Decomposition of Complex Symmetric Tensors Based on the Takagi Factorization
	15:40---16:20	报告人：宋义生 题 目：Structured properities of B-Tensors
茶 歇 16:20---16:30		
主持人 魏益民	16:30---17:10	报告人：喻高航 题目：高阶马尔科夫链极限概率分布问题的快速算法
	17:10---17:50	报告人：崔鲁宾 题目： On the extreme point of m-stochastic tensors

11月26日上午，星期日

主持人 张福振	09:00---09:40	报告人：白敏茹 题目：An Adaptive Correction Approach for Tensor Completion
	09:40---10:20	报告人：凌晨 题目：Generalized polynomial complementarity problems with structured tensors
茶 歇 10: 20---10: 30		
主持人 黄正海	10:30--11:10	报告人：黄锡荣 题目：The tensor splitting with application to solve multi-linear systems
	11:10--11:50	报告人：丁维洋 题目：Computing the p-Spectral Radii of Uniform Hypergraphs with Applications

11月26日下午，星期日

主持人 李耀堂	15:00--15:40	报告人：胡胜龙 题目：Convergence rate of HOPM for the best rank one approximation of a real tensor
	15:40--16:20	报告人：段雪峰 题目：Riemannian Spectral Conjugate Gradient Method for Computing the Best Low Multilinear Rank Approximation of Symmetric Tensors
茶 歇 16:20---16:30		
主持人 黎 稳	16:30--17:10	报告人：李耀堂 题目：Eigenvalue Inclusion Sets for Tensors with Its Applications
	17:10--17:50	报告人：倪勤 题目：A cubically convergent method for solving the largest eigenvalue of a nonnegative irreducible tensor

On the extreme point of m -stochastic tensors

崔鲁宾

(河南师范大学)

Abstract: In this paper, we study the properties of extreme points of m -stochastic tensors. We give the Birkhoff-von Neumann theorem of the m -stochastic tensor. Some equivalent characterizations for an m -stochastic tensor to be an extreme point are proposed. The number of permutation tensors is also discussed.

Structured properties of B-Tensors

宋义生

(河南师范大学)

Abstract: Each B tensor is strictly semi-positive and each B_0 tensor is semi-positive. So, the solution set of tensor complementarity problem with B tensor is bounded. We give the strictly lower and upper bounds of different operator norms for two positively homogeneous operators defined by B tensor. By means of such the upper bounds, we establish the strictly lower bound of solution set of tensor complementarity problem with B tensor. Furthermore, we achieve our another objective with the help of upper bounds of operator norms. That is, we obtain the upper bounds of spectral radius and E-spectral radius of B (B_0) tensor, which only depend on the principal diagonal entries of tensors.

**Partial Orthogonal Rank-One Decomposition of Complex
Symmetric Tensors Based on the Takagi Factorization**

魏益民

(复旦大学)

Abstract: This talk is devoted to the computation of rank-one decomposition of complex symmetric tensors. Based on the Takagi factorization of complex symmetric matrices, we derive an algorithm for computing the partial orthogonal rank-one decomposition of complex symmetric tensors with an order being a power of two, denoted by CSTPOROD. We explore the properties for CSTPOROD. We design a strategy (tensor embedding) to compute the partial orthogonal rank-one decomposition of complex symmetric tensors, whose order is not the power of two. Similar to the case of complex symmetric tensors, we investigate how to compute the partial orthogonal rank-one decomposition of general complex tensors. We illustrate our algorithms via numerical examples.

Computing the p -Spectral Radii of Uniform
Hypergraphs with Applications

丁维洋

(香港浸会大学)

Abstract: The p -spectral radius of a uniform hypergraph covers many important concepts, such as Lagrangian and spectral radius of the hypergraph, and is crucial for solving spectral extremal problems of hypergraphs. In this talk, we establish a spherically constrained maximization model and propose a first-order conjugate gradient algorithm to compute the p -spectral radius of a uniform hypergraph (CSRH). By the semialgebraic nature of the adjacency tensor of a uniform hypergraph, CSRH is globally convergent and obtains the global maximizer with a high probability. When computing the spectral radius of the adjacency tensor of a uniform hypergraph, CSRH outperforms existing approaches. Furthermore, CSRH is competent to calculate the p -spectral radius of a hypergraph with millions of vertices and to approximate the Lagrangian of a hypergraph. Finally, we show that the CSRH method is capable of ranking real-world data set based on solutions generated by the p -spectral radius model.

Eigenvalue Inclusion Sets for Tensors with Its Applications

李耀堂

(云南大学)

Abstract: In this talk, some results of eigenvalue inclusion sets for tensors are showed. The relationship among these eigenvalue inclusion sets is discussed and some applications on structured tensors and on the positive definiteness identification problem of an even-order real symmetric tensor are given.

The tensor splitting with application to

Solve multi-linear systems

黄锡荣

(澳门大学)

Abstract: In this talk, we propose some tensor splitting algorithms for solving multi-linear systems with coefficient tensor being a strong M-tensor. Numerical examples are given to demonstrate the efficiency of the proposed algorithms.

Generalized polynomial complementarity problems
with structured tensors

凌 晨

(杭州电子科技大学)

Abstract: In this talk, we consider the generalized polynomial complementarity problem (GPCP), which covers the recently introduced polynomial complementarity problem (PCP) and the well studied tensor complementarity problem (TCP) as special cases. By exploiting structure of tensors, we first show that the solution set of GPCPs is nonempty and compact when a pair of leading tensors is cone ER. Then, we study some topological properties of the solution set of GPCPs under the condition that the leading tensor pair is cone \mathbb{R}^0 . Finally, we study a notable global Lipschitzian error bound of the solution set of GPCPs, which is better than the results obtained in the current PCPs and TCPs literature and also is beneficial for finding and analyzing numerical solutions to the problem under consideration.

高阶马尔科夫链极限概率分布问题的快速算法

喻高航

(杭州电子科技大学)

摘要：一阶马尔科夫链在对未来进行预测时，仅用到了当前的信息而忽略了庞大的历史信息，这使得一阶马尔科夫链在许多实际应用中有着很大的时间局限性，进而影响预测的准确性。为了能够更加准确的预测未来，近年来，高阶马尔科夫链模型与相关算法的研究受到了广泛的关注，并在实际应用领域，如：DNA 序列分析、高阶 PageRank 等方面有直接的应用。

针对已经存在的幂法和反幂法，我们给出了高阶马尔科夫链极限概率分布问题的外推算法。另外我们也从约束张量方程组的角度出发，基于最小二乘方法给出了该问题的一个高斯牛顿算法。数值实验表明，我们的算法是有效的。

An Adaptive Correction Approach for Tensor Completion

白敏茹

(湖南大学)

Abstract: In this talk, we study the tensor completion problem on recovery of the multilinear data under limited sampling. A popular convex relaxation of this problem is to minimize the nuclear norm of the more square matrix produced by matricizing a tensor. However, it may fail to produce a high accurate solution under low sample ratio. In order to get a recovery with high accuracy, we propose an adaptive correction approach for tensor completion. Firstly, a corrected model for matrix completion with bound constraint is proposed and its error bound is established. Then, we extend it to tensor completion with bound constraint and propose a corrected model for tensor completion. The adaptive correction approach consists of solving a series of corrected models with an initial estimator where the initial estimator used for the next step is computed from the value of the current solution. Moreover, the error bound of the corrected model for tensor completion is also established. A convergent 3-block alternating direction method of multipliers (ADMM) is applied to solve the dual problem of the corrected model. Numerical experiments on both random data and real world data validate the efficiency of our proposed correction approach.

复张量特征对计算

倪谷炎

(国防科技大学)

Abstract: This talk introduces the computation of eigenpairs of high-order complex tensors, which is closely related to the best complex rank-one approximation of a tensor and quantum entanglement. It is also an optimization problem of real-valued functions with complex variables. We study the spherical optimization problem with complex variables including the first-order and the second-order Taylor polynomials, optimization conditions and convex functions of real-valued functions with complex variables. We propose an algorithm and show that it is guaranteed to approximate an eigenpair of a complex tensor. Moreover, if the number of eigenpairs is finite, then the algorithm is convergent to an eigenpair. Numerical examples are presented to demonstrate the effectiveness of the proposed method in finding eigenpairs.

Convergence rate of HOPM for the best rank one
approximation of a real tensor

胡胜龙

(天津大学)

Abstract: A popular and classical method for finding the best rank one approximation of a real tensor is the higher order power method (HOPM). It is known in the literature that the iterative sequence generated by HOPM converges globally, while it can converge locally superlinearly, linearly or sublinearly. In this talk, we examine the local convergence rate of HOPM in solving the best rank one approximation problem of real tensors. We first show that the iterative sequence of HOPM always converges globally and provide an explicit eventual sublinear convergence rate. The sublinear convergence rate estimate is in terms of the dimension and the order of the underlying tensor space. Then, we examine the concept of nondegenerate singular vector tuples and show that, if the sequence of HOPM converges to a nondegenerate singular vector tuple, then the local convergence rate is R -linear.

Polytopes of stochastic tensors

Fuzhen Zhang

(Nova Southeastern University, Fort Lauderdale, Florida, USA)

Abstract: We consider the generalization of the Birkhoff's theorem in higher dimensions. An $n \times n \times n$ stochastic tensor is a nonnegative array (hypermatrix) in which every sum over one index is 1. A permutation tensor can be identified with a Latin square (vice versa). We study the polytope of all these tensors, the convex set of all tensors with some positive diagonals, and the polytope generated by the permutation tensors. We present lower and upper bounds for the number of vertices of the polytopes, and discuss further questions on the topic.

Some norm inequalities for commutators of contracted tensor products

金小庆

(澳 门 大 学)

Abstract: The paper concerns generalizations of the Böttcher–Wenzel inequality to contracted products of tensors. We show that the best constant in the inequality is as expected in some cases and present an example where the best constant is larger than expected.

**Riemannian Spectral Conjugate Gradient Method for
Computing the Best Low Multilinear Rank Approximation
of Symmetric Tensors**

段雪峰

(桂林电子科技大学)

Abstract: In this talk, we consider the best low multilinear rank approximation of symmetric tensors, which arises in blind source separation problem in signal processing of mobile communication and surveillance of radio-communications. By making use of the invariance property of the objective function, this problem is reformulated as the minimization problem on the Riemannian manifold, and then the Riemannian spectral conjugate gradient (RSCG) method is designed for solving the equivalent minimization problem. The convergence analysis is also given. Numerical experiments illustrate that the new method is feasible and effective.

A cubically convergent method for solving the largest eigenvalue of a nonnegative irreducible tensor

倪勤

(南京航空航天大学)

Abstract : In this talk, we present a cubically convergent method for finding the largest eigenvalue of a nonnegative irreducible tensor. A cubically convergent method is used to solve an equivalent system of nonlinear equations which is transformed by the tensor eigenvalue problem. Due to particular structure of tensor, Chebyshev's direction is added to the method with a few extra computation. Two rules are designed such that the descendant property of the search directions is ensured. The global convergence is proved by using the line search technique. Numerical results indicate that the proposed method is competitive and efficient on some test problems.

到华师大厦酒店交通

- ① 白云国际机场：在白云机场乘去华师大厦酒店（原名：华师粤海酒店）的**机场大巴**到达，费用约 22 元。打的费用约 140 元。
- ② 广州火车东站：坐地铁 **1 号线**经 2 站到**体育西路站**转 **3 号线**经 3 站到**华师站**下，走 **E 出口**，步行穿过华师校园约 10 分钟到达华师大厦酒店。打的费用约 21 元。
- ③ 广州火车站：在火车站广场坐公交 **B2 路**经 8 站到**师大暨大站**下。打的费用约 32 元。
- ④ 广州南站（高铁站）：坐地铁 **7 号线**到**汉溪长隆站**（约 4 站）转 **3 号线**大约 11 个站到达**华师站**，走 **E 出口**，步行穿过华师校园约 10 分钟到达华师大厦酒店。 打的费用约 80 元。

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