2017 多项式与张量优化学术研讨会

会议程序册

主办单位：中国运筹学会数学规划分会

承办单位：天津大学

中国·天津

2017 年 12 月 22—24 日

会议日程安排

12 月 **23** 日 （地点：天津大学卫津路校区会议楼第八会议室）				
8:30—9:00		开幕式 集体拍照		主持人 黄正海
序号	时间	报告人	题目	主持人
1	**9:00—9:30**	聂家旺	Low Rank Symmetric Tensor Approximations	凌晨
2	**9:30—10:00**	周广路	A globally and quadratically convergent algorithm for solving multilinear systems with M-tensors	
10:00—10:20		茶 歇		
3	**10:20—11:50**	刘 歆	A Parallelizable Algorithm for Orthogonally Constrained Optimization Problems	魏益民
4	**10:50—11:20**	叶 科	Ranks and decompositions of Hankel tensors	
5	**11:20—11:50**	杨宇宁	张量优化中 ALS 和 SOR 算法收敛性的一些新认识	
12:00—14:00		午 餐		
6	**14:00—14:30**	宋义生	Infinite and finite dimensional generalized Hilbert tensors	杨庆之
7	**14:30—15:00**	罗自炎	Facial Expression Recognition using low rank sparse tensor completion	
15:00—15:20		茶 歇		

8	**15:20—15:50**	赵金玲	The Split Feasibility Problem with Polynomials	聂家旺
9	**15:50—16:20**	郭　峰	LP and SDP relaxations for linear semi-infinite polynomial programming problems	
10	**16:20—16:50**	周安娃	Completely positive separable matrices	
17:30—20:00		晚 餐		
12 月 **24** 日 （地点：天津大学卫津路校区会议楼第八会议室）				
序号	时间	报告人	题目	主持人
11	**9:00—9:30**	杨庆之	袁氏引理的推广和应用	支丽红
12	**9:30—10:00**	倪谷炎	Calculating entanglement eigenvalues for non-symmetric quantum pure states based on the Jacobian SDP relaxation method	
10:00—10:20		茶 歇		
13	**10:20—10:50**	陈海滨	An SOS Tensor-based Optimization Approach for Computing the Minimal H-eigenvalue of Tensors	黄正海
14	**10:50—11:20**	文　杰	On rank-r decomposition of symmetric tensors and applications	
11:20—11:40		闭幕式		
12:00—14:00		午 餐		
17:30—20:00		晚 餐		

报告题目和摘要

Low Rank Symmetric Tensor Approximations

聂家旺
美国加州大学圣地亚哥分校

Abstract: For a given symmetric tensor, we aim at finding a new one whose symmetric rank is small and that is close to the given one. There exist linear relations among the entries of low rank symmetric tensors. Such linear relations can be expressed by polynomials, which are called generating polynomials. We propose a new approach for computing low rank approximations by using generating polynomials. First, we estimate a set of generating polynomials that are approximately satisfied by the given tensor. Second, we find approximate common zeros of these polynomials. Third, we use these zeros to construct low rank tensor approximations. If the symmetric tensor to be approximated is sufficiently close to a low rank one, we show that the computed low rank approximations are quasi-optimal.

A globally and quadratically convergent algorithm for solving multilinear systems with M-tensors

周广路
澳大利亚科廷大学

Abstract: Multilinear systems of equations have many applications in engineering and scientific computing, such as data mining and numerical partial differential equations. In this talk, we show that solving multilinear systems with M-tensors is equivalent to solving nonlinear systems of equations where the involving functions are P-functions. Based on this result, we propose a Newton-type method to solve multilinear systems with M-tensors. For a multilinear system with a nonsingular M-tensor and a positive right side vector, we show the sequence generated by the proposed method converges to the unique solution of the multilinear system and the convergence rate is quadratic. Numerical results are reported to show that the proposed method is promising.

A Parallelizable Algorithm for Orthogonally Constrained Optimization Problems

刘　歆
中国科学院数学与系统科学研究院

Abstract: To construct a parallel approach for solving orthogonally constrained optimization problems is usually regarded as an extremely difficult mission, due to the low scalability of orthogonalization procedure. In this talk, we propose an infeasible algorithm for solving optimization problems with orthogonality constraints, in which orthogonalization is no longer needed at each iteration, and hence the algorithm can be parallelized. We also establish a global subsequence convergence and a worst-case complexity for our proposed algorithm. Numerical experiments illustrate that the new algorithm attains a good performance and a high scalability in solving discretized Kohn-Sham total energy minimization problems.

Ranks and decompositions of Hankel tensors

叶　科
中国科学院数学与系统科学研究院

Abstract: Hankel tensors are generalizations of Hankel matrices. In this talk, we will discuss the relation among three types of ranks of Hankel tensors and we will give an algorithm for the minimal rank decomposition of Hankel tensors. We will also discuss the rank of a generic Hankel tensor of order three or 2k for any positive integer k. If time permits, we will also exhibit some concrete examples.

张量优化中 ALS 和 SOR 算法收敛性的一些新认识

杨宇宁
广西大学

摘要：ALS 和 SOR 是求解大规模张量优化问题的常用算法，但关于它们的收敛性质认识还比较局限。我们研究了它们的全局收敛性，得到：1. 若一个极限点对应的各个子问题的海瑟阵是正定的，则该极限点为稳定点，且整个序列收敛到该点；2. 若序列每个点所对应的各个子问题的海瑟阵都不是正定的，则可选择子问题一特殊解，使得算法仍具有全局收敛性。最后将探讨算法的线性收敛性。

Infinite and finite dimensional generalized Hilbert tensors

宋义生
河南师范大学

Abstract: In this paper, we show that H-spectral radius and its Z-spectral radius of finite dimensional generalized Hilbert tensors are smaller than or equal to $M(a)n^{m-1}$ and $M(a)n^{\frac{m}{2}}$, respectively, here $M(a)$ is a constant depending on a. Moreover, both infinite and finite dimensional generalized Hilbert tensors are positive definite for $a \geq 1$. For an m-order infinite dimensional generalized Hilbert tensor with $a > 0$, we prove that it defines a bounded and positively $(m-1)$-homogeneous operator from l^1 into l^p $1 < p < \infty$. Two upper bounds on the norms of corresponding positively homogeneous operators are obtained. The boundedness of Hilbert tensor operator is presented on Bergman spaces A^p $(p > 2(m-1))$. On the base of the boundedness, two positively homogeneous operators are introduced to the spaces of analytic functions, and hence the upper bounds of norm of such two operators are found on Bergman spaces $(p > 2(m-1))$. In particular, the norms of such two operators on Bergman spaces $A^{4(m-1)}$ are smaller than or equal to π and $\pi^{\frac{1}{m-1}}$, respectively.

Facial expression recognition using low rank sparse tensor completion

罗自炎
北京理工大学

Abstract: Multimodal facial expression recognition (FER) has gained increasing attention in recent years. In this paper, a novel approach for 2D+3D facial expression recognition via low-rank tensor completion (FERLrTC) is proposed, in which a 4D tensor model is firstly constructed to explore efficient structure information from multimodal data (both 2D and 3D face data). Based upon the Tucker decomposition of the involved 4D tensor, a low-rank tensor completion model is built up to explore and tackle the issue of missing information in the 4D tensor modeling process. A majorization-minimization based optimization method is designed to effectively solve the relaxation counterpart of the involved optimization problem. Numerical experiments are conducted with a full implementation both on gender-independent and person-independent cases on the BU-3DFE and Bosphorus databases to illustrate the effectiveness of the proposed approach.

The Split Feasibility Problem with Polynomials

赵金玲
北京科技大学

Abstract: This paper discusses the split feasibility problem with polynomials. The sets are semi-algebraic, defined by polynomial inequalities. They can be either convex or nonconvex, either feasible or infeasible. We give semidefinite relaxations for representing the intersection of the sets. Properties of the semidefinite relaxations are studied. Based on that, a semidefinite relaxation algorithm is given for solving the split feasibility problem. Under a general condition, we prove that: if the split feasibility problem is feasible, we can get a feasible point; if it is infeasible, we can obtain a certificate for the infeasibility. Some numerical examples are given.

LP and SDP relaxations for linear semi-infinite polynomial programming problems

郭　峰
大连理工大学

Abstract: In this talk, we will consider a class of so-called linear semi-infinite polynomial programming (LSIPP) problems. It is a subclass of linear semi-infinite programming problems whose constraint functions are polynomials in parameters and index sets are basic semialgebraic sets. By means of Positivstellensatz for positive polynomials, we construct a linear programming (LP) relaxation method and a semidefinite programming (SDP) relaxation method for LSIPP problems.

Completely positive separable matrices

周安娃
上海大学

Abstract: A symmetric matrix A is completely positive (CP) if there exists an entrywise nonnegative matrix V such that A = VV ^T. A real symmetric matrix is called completely positive separable (CPS) if it can be written as a sum of rank-1 Kronecker products of completely positive matrices. In this talk, we study the CPS problem. A criterion is given to determine whether a given matrix is CPS, and a specific CPS decomposition is constructed if the matrix is CPS.

袁氏引理的推广和应用

杨庆之
南开大学

摘要：在这个报告中，我将介绍张树中教授等关于半正定矩阵的秩一分解定理，并给出了这个结果的进一步推广。然后介绍了袁亚湘院士关于齐次二次函数系统的一个引理，在推广的秩一分解结果基础上，提出了一般二次函数系统的袁氏引理及带区间约束的二次函数系统的袁氏引理，由此导出了一般二次不等式系统的 S-lemma，区间二次系统的 S-lemma。还提出了一类二次矩阵不等式系统的袁氏引理及 S-lemma。作为进一步的发展，还介绍了四阶张量系统的一个袁氏引理，并由此说明在一定条件下，一类四阶张量优化问题可以通过半定松弛技术得到问题的整体最优(近似)解。

Calculating entanglement eigenvalues for non-symmetric quantum pure states based on the Jacobian SDP relaxation method

倪谷炎
国防科学技术大学

Abstract: Quantum entanglement has attracted much attention in the last decades. The geometric measure of entanglement is a widely used entanglement measure for quantum pure states. The key problem of computation of the geometric measure is to calculate the entanglement eigenvalue, which is equivalent to computing the largest unitary (U-)eigenvalue of a corresponding complex tensor. In this paper, we propose a Jacobian SDP relaxation method to calculate the largest U-eigenvalue of a complex tensor. For an mth order symmetric complex tensor, we convert the problem of computing the largest unitary symmetric US-eigenvalue to a real polynomial optimization problem which can be solved by the Jacobian SDP relaxation method. Its objective function is the real part of the inner product of the symmetric complex tensor and an mth order symmetric rank-one complex tensor. Similarly, for an mth order non-symmetric tensor, we also convert the problem of computing the largest U-eigenvalue to a polynomial optimization problem. But the objective function is changed as a norm of inner product of the non-symmetric tensor and an (m-1)th order rank-one complex tensor. This method can reduce the number of variables in the optimization problem. Numerical examples are presented to show the availability of this approach.

An SOS Tensor-based Optimization Approach for Computing the Minimal H-eigenvalue of Tensors

陈海滨
曲阜师范大学

Abstract: Sum-of-squares (SOS) tensor plays an important role in tensor positive definiteness and polynomial optimization. In this paper, we first show that several types of even order symmetric tensors are SOS tensors, which contains GSDD tensors, circuit diagonally dominant tensors, LLK tensors and WZC tensors. GSDD tensors and circuit diagonally dominant tensors are originally defined from the typical Brauer-type tensor eigenvalue inclusion set and the Brualdi-type tensor eigenvalue inclusion set respectively. Then, a new conclusion about those two typical inclusion sets is proved without sparsity conditions, which improved the corresponding results in [13]. Finally, an SOS tensor-based optimization algorithm is proposed to compute the minimal H-eigenvalue of even order symmetric tensors. Numerical examples are given to show the efficiency of the proposed method, and further discussions about the proposed algorithm are made, as well as future work.

On rank-r decomposition of symmetric tensors and applications

文　杰
南京航空航天大学

Abstract: For a given tensor, by using apolarity, catalecticant matrices and the condition that the mappings matrices are commutative, the rank of the tensor can be obtained by iteration. Then, we can find the generating polynomials under a selected basis set. The decomposition can be constructed by the solutions of generating polynomials under the condition that the solutions are all distinct which can be guaranteed by the commutative property of the matrices. Numerical examples demonstrate the efficiency and accuracy of the proposed method. Finally， apply the algorithm to some Hankel tensor, we can get the rank-r decomposition expression quickly and efficiently.