2016 International Workshop on Modern Optimization and Applications

June 27–29, 2016

Beijing, China

http://lsec.cc.ac.cn/~moa2016

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Information for Participants

Conference Site

Conference Site:	Room 204, South Building, Academy of Mathematics and Systems Science (AMSS), Chinese Academy of Sciences (CAS)
Address:	No. 55, Zhong Guan Cun East Road, Hai Dian District, Beijing, CHINA

Registration

Registration will take place **on June 26 from 14:00 to 18:00 at the lobby of South Building** and **on June 27 from 7:30 to 8:30 at the entrance of Room 204 in South Building**.

Internet

The Wi-Fi is available in the conference room. To use it, first search the wireless connection, find "AMSS" and click it; then input the workshop code "E1Z7L1Z5" and your personal information.

Contact Information

If you need any help, please contact the conference secretaries:

- Dr. Ya-Feng Liu: yafliu@lsec.cc.ac.cn;
- Ms. Jiping Wu: wjp@lsec.cc.ac.cn;
- Mr. Weikun Chen: cwk@lsec.cc.ac.cn.

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Local Map


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Workshop Schedule

June 27, 2016, Room 204, South Building of AMSS		
8:30 - 9:10, Session Chair: Yu-Hong Dai		
8:30 - 8:50	Opening Ceremony	
8:50 - 9:10	Photo Taking	
9:10 - 10:00, Session Chair: Ya-xiang Yuan		
9:10 - 10:00	On first-order potential reduction algorithms for linear programming	Yinyu Ye
10:00 - 10:20	Coffee Break	
10:20 - 12:00, Session Chair: Jiming Peng		
10:20 - 11:10	Separation, inverse optimization, and decomposition: Connecting the dots	Ted Ralphs
11:10 - 12:00	Towards higher quality and faster speed in large-scale k-means clustering	Yin Zhang
12:00 - 14:00	Lunch (4th floor of Wuke Restaurant)	
14:00 - 15:40, Session Chair: Thorsten Koch		
14:00 - 14:50	Analysing large biological data: can networks help us?	Tim Conrad
14:50 - 15:40	Dynamic resource allocation for energy efficient transmission in digital subscriber lines	Zhi-Quan Luo
15:40 - 16:00	Coffee Break	
16:00 - 18:00, Session Chair: Zhi-Quan Luo and Anthony Man-Cho So		
16:00 - 18:00	Poster Session	
18:00	Dinner (4th floor of Wuke Restaurant)	

June 28, 2016, Room 204, South Building of AMSS		
8:20 - 10:00, Session Chair: Zhi-Quan Luo		
8:20 - 9:10	Stochastic dual Newton ascent for empirical risk minimization	Peter Richtárik
9:10 - 10:00	Accelerated randomized primal-dual coordinate methods for empirical risk minimization	Lin Xiao
10:00 - 10:20	Coffee Break	
10:20 - 12:00, Session Chair: Peter Richtárik		
10:20 - 11:10	Same, same, but different: a mostly discrete tour through optimization	Thorsten Koch
11:10 - 12:00	Branch-and-Cut for nonlinear chance-constrained problems with applications to hydro scheduling	Giacomo Nannicini
12:00 - 14:00	Lunch (4th floor of Wuke Restaurant)	
14:00 - 15:40, Session Chair: Zhijun Wu		
14:00 - 14:50	Penalty methods for a class of non-Lipschitz optimization problems	Xiaojun Chen
14:50 - 15:40	Barzilai-Borwein step size for stochastic gradient descent	Shiqian Ma
15:40 - 16:00	Coffee Break	
16:00 - 18:00, Session Chair: Xiaojun Chen and Thorsten Koch		
16:00 - 18:00	Poster Session	
18:00	Dinner (4th floor of Wuke Restaurant)	

June 29, 2016, Room 204, South Building of AMSS		
8:20 - 10:00, Session Chair: Xiaojun Chen		
8:20 - 9:10	High-order sparse modeling with applications	Zongben Xu
9:10 - 10:00	Towards understanding the convergence behavior of Newton-type methods for structured convex optimization problems	Anthony Man-Cho So
10:00 - 10:20	Coffee Break	
10:20 - 12:00, Session Chair: Ya-Feng Liu		
10:20 - 11:10	Clique relaxations in network analysis	Sergiy Butenko
11:10 - 12:00	Uncertain linear optimization, asset inequality and vulnerability of financial networks	Jiming Peng
12:00 - 14:00	Lunch (4th floor of Wuke Restaurant)	
14:00 - 15:40, Session Chair: Zaikun Zhang		
14:00 - 14:50	Asymmetric proximal point algorithms with moving proximal centers	Deren Han
14:50 - 15:40	A convergent iterative hard thresholding for sparsity and nonnegativity constrained optimization	Naihua Xiu
15:40 - 16:00	Coffee Break	
16:00 - 17:40, Session Chair: Naihua Xiu		
16:00 - 16:50	On efficiently combining limited-memory and trust-region techniques	Ya-xiang Yuan
16:50 - 17:40	Statistical sampling for big data logistic regression	Tong Zhang
17:40 - 18:00, Session Chair: Yu-Hong Dai		
17:40 - 18:00	Closing Ceremony and "Best Poster Award" Announcement	
18:00	Dinner (4th floor of Wuke Restaurant)	

June 27-28, 2016, Lobby of South Building of AMSS		
Poster Talks		
A1	Quasi-Newton method for computing the US-eigenvalues of a symmetric complex tensor	Minru Bai
A2	Stream selection methods for non-regenerative MIMO relay networks	Cong Sun
A3	Necessary optimality conditions and exact penalization for non-Lipschitz nonlinear programs	Lei Guo
A4	Two-stage convex relaxation approach to least squares loss constrained low-rank plus sparsity optimization problems	Le Han
A5	A practical inexact smoothing Newton method for ordinal embedding	Qingna Li
A6	Discriminatively embedded K-means for multi-view clustering	Kun Song
A7	An new effective hybrid heuristic algorithm for solving undesirable facility location problems	Bailu Yan
A8	Non-orthogonal multiple access meets simultaneous wireless information and power transfer: A new paradigm to improve the data rate	Yanqing Xu
A9	Nonconvex quadratic optimization over the intersection of balls: Complexity, approximation and application	Yong Xia
A10	A new first-order framework for orthogonal constrained optimization problems	Bin Gao
B1	A new parameter value for a modified gradient algorithm	Aiqun Huang
B2	ℓ_p-ball constrained weighted maximin dispersion problem: convex relaxation misleads the approximation algorithm	Shu Wang
B3	A modied proximal gradient method for a class of Nonsmooth convex optimization problems	Yingyi Li
B4	A projection-type algorithm for solving generalized mixed variational inequalities	Kai Tu
B5	Lp-norm regularization algorithms for optimization over permutation matrices	Bo Jiang
B6	Adaptive robust antenna array synthesis for clutter suppression	Wenqiang Pu
B7	A general proximal quasi-Newton method for ℓ_1 penalized optimization problem	Zhilong Dong
B8	A proximal alternating direction method for multi-block coupled convex optimization	Lingling Xu
B9	A proximal point algorithm with asymmetric linear term	Xingju Cai
B10	A novel posture sensing scheme for pump truck-a Euclidean distance matrix based optimization approach	Zhiqiang Yao
B11	Distributed detection fusion via Monte Carlo importance sampling	Xiaojing Shen

Abstracts

Part I

Invited Talks

On first-order potential reduction algorithms for linear programming

Yinyu Ye

Department of Management Science and Engineering

Stanford University

California, U.S.A.

Email: yyye@stanford.edu

We describe primal, dual and primal-dual steepest-descent potential reduction methods for linear and convex minimization on the simplex in Rn and present their precise iteration complexity analyses depending on the problem dimension and the Lipschitz parameter of the constraint matrix or the convex objective function. In these methods, no matrix needs to be ever inversed so that they are pure first-order methods. We also propose a reformulation of linear programming where a Gram matrix needs to be only inversed or factorized once, and present its iteration complexity bound that is independent of any Lipschitz constant. We also present preliminary computational results for solving linear programs.

Separation, inverse optimization, and decomposition: Connecting the dots

Ted Ralphs

Department of Industrial and Systems Engineering

Lehigh University

Bethlehem, U.S.A.

Email: ted@lehigh.edu

In this talk, we discuss the connections between a number of fundamental problems that arise in the solution of discrete optimization problems. The separation problem, in its classic form, is known to be polynomially equivalent to optimization by the well-known result of Gröetschel, Lovasz, and Schrijver. We show that, for mixed integer optimization problems, a certain form of inverse optimization problem is equivalent to "forward" optimization and also closely related to a variant of the separation problem known as "primal separation". Finally, we show that the decomposition methods used to obtain improved bounds for discrete optimization problems, also implicitly solve certain inverse optimization and primal separation problems. The connections between these methods can be viewed as resulting from certain "dualities" that underly much of the theory of discrete optimization and are the basic building blocks of solution methodologies.

Towards higher quality and faster speed in large-scale k-means clustering

Yin Zhang

Department of Computational and Applied Mathematics

Rice University

Houston, Texas, U.S.A.

Email: yzhang@rice.edu

K-means clustering is a fundamental but NP-hard problem in machine learning and data analysis. Various pre-processing techniques have been developed to transform datasets into ones more amenable to clustering, but at the final stage the classic Lloyd algorithm is still the method of choice for carrying out the actual clustering. However, as data size increases and particularly as the number of clusters grows, Lloyd algorithm, equipped with state-of-the-art randomized initialization schemes, encounters bottlenecks both in terms of clustering quality and computational speed.

Based on a geometric viewpoint and a partial convexification scheme, we propose a deterministic and parameter-free algorithm, called GeoKM, to attack the K-means clustering problem. GeoKM can be used either as a centroid initialization method that precedes the Lloyd algorithm, or as an independent clustering method without resort to the Lloyd algorithm. We present extensive numerical results demonstrating that, in comparison to the Matlab K-means function (which is based on the Lloyd algorithm), GeoKM is capable of providing not only considerably higher clustering quality, but also significantly faster computational speed.

(Joint work with Feiyu Chen, Liwei Xu, and Taiping Zhang at CQU.)

Analysing large biological data: can networks help us?

Tim Conrad

Department of Mathematics and Computer Science

Freie Universitat Berlin

Berlin, Germany

Email: conrad@math.fu-berlin.de

Generating large biomedical data-sets is becoming cheaper, easier and more trustworthy over time. Yet, interpreting this data and deriving medical knowledge from it is still in its infancies. It is no problem these days to generate datasets containing billions and billions of little "information pieces" that – in principle – reflect the underlying system: for example a human being.

As in other domains, one of the main challenges is to solve inverse problems, for example understanding biological processes such as cancer given the acquired data. However, a somewhat easier tasks seems to be the first stage to this problem: identifying which biological entities are actually involved in a process. If these entities, e.g. molecules or blood values are known, they can be used for more advances analyses such as diagnostics, drug development or simply to develop hypotheses about what is going on.

In this talk I will present two recent methods based on optimization about how to identify key-constituents from large biological datasets using (1) a more traditional sparsity based data-mining approach and (2) an approach, using biological knowledge (interaction networks) as regularization to the first idea. I will show how the regularization can indeed improve the results and give an example using real-world from the TCGA consortium.

Dynamic resource allocation for energy efficient transmission in digital subscriber lines

Zhi-Quan Luo

Department of Electrical and Computer Engineering

University of Minnesota

Minnesota, U.S.A.

Email: luozq@ece.umn.edu

Linear matrix precoding, also known as vectoring, is a well-known technique to mitigate multiuser interference in the downlink Digital Subscriber Line (DSL) transmission. While effective in canceling interference, vectoring does incur major computational overhead in terms of a matrix vector multiplication at each data frame, resulting in significant energy consumption when the number of lines is large. To facilitate energy efficient transmission, it has been recently proposed (in the G.fast standard) that each data frame is divided into a normal operating interval (NOI) and a discontinuous interval (DOI). In the NOI, all lines (or users) are involved in a common vectoring group, which requires a large matrix precoder, while in a DOI, the lines are subdivided into multiple small non-overlapping vectoring subgroups, which are transmitted in a TDMA manner within the data frame. Because of the use of small matrix precoders for the small vectoring subgroups in DOI, the energy efficiency can be significantly improved. In this paper, we consider several key dynamic resource allocation (DRA) problems in DSL: given the instantaneous buffer state, determine the number of transmission opportunities allocated to each line, the optimal NOI and DOI size in each data frame as well as the optimal grouping in DOI. We formulate these optimal DRA problems and propose efficient real-time algorithms for three main tasks: given a data frame, allocate transmission opportunities for all lines, design grouping strategy in DOI, and optimally adjust the durations of the NOI and the vectoring subgroups in the DOI. The simulation results show the efficiency and the effectiveness of our algorithms.

Stochastic dual Newton ascent for empirical risk minimization

Peter Richtárik

The Alan Turing Institute School of Mathematics

University of Edinburgh

Edinburgh, UK

Email: peter.richtarik@ed.ac.uk

We propose a new algorithm for minimizing regularized empirical loss: Stochastic Dual Newton Ascent (SDNA) [1]. Our method is dual in nature: in each iteration we update a random subset of the dual variables. However, unlike existing methods such as stochastic dual coordinate ascent, SDNA is capable of utilizing more or all of curvature information contained in the examples, which leads to striking improvements in both theory and practice - sometimes by orders of magnitude. Time permitting, I will comment on a new primal approach to squeezing more curvature out of the training data [3]–an approach based on a novel randomized BFGS update rule which was shown to be a linearly convergent methods for inverting a matrix [2].

References:

[1] Z. Qu, P.R., O. Fercoq and M. Takac. SDNA: Stochastic dual Newton ascent for empirical risk minimisation, ICML 2016

[2] R. M. Gower and P.R. Randomized quasi-Newton updates are linearly convergent matrix inversion algorithms, arXiv:1602.01768

[3] R. M. Gower, D. Goldfarb and P.R. Stochastic block BFGS: squeezing more curvature out of data, ICML 2016

Accelerated randomized primal-dual coordinate methods for empirical risk minimization

Lin Xiao

Microsoft Research

Redmond, WA, U.S.A.

Email: lin.xiao@microsoft.com

We consider a class of convex optimization problems associated with regularized empirical risk minimization of linear predictors in machine learning (including support vector machines and logistic regression). The finite average structure of such problems allows us to solve their dual problems efficiently using randomized coordinate ascent methods, or we can reformulate them as convex-concave saddle point problems and use primal-dual coordinate algorithms. We present two accelerated randomized coordinate update methods, one works with the dual problem, and the other works with the saddle point formulation. The dual algorithm is a specialization of a more general accelerated coordinate descent method for composite convex optimization. The primal-dual method alternates between maximizing over a randomly chosen dual variable and minimizing over the primal variables. We also develop an extension with weighted sampling probabilities on the dual variables, which has a better complexity than uniform sampling on unnormalized data. We demonstrate both in theory and experiments that these accelerated coordinate gradient methods has comparable or better performance than several state-of-the-art optimization methods.

Same, same, but different: a mostly discrete tour through optimization

Thorsten Koch

Zuse Institute Berlin

Berlin, Germany

Email: koch@zib.de

We will make a short, mostly, but not always, linear tour through topics in discrete optimization. From linear programming to mixed-integer non-linear optimization, covering Steiner tree problems and applications in Gas Networks, while making notes on the state of affairs in algorithms, software, modelling and parallel computing.

Branch-and-Cut for nonlinear chance-constrained problems with applications to hydro scheduling

Giacomo Nannicini

Engineering Systems & Design Pillar

Singapore University of Technology and Design

Singapore

Email: nannicini@sutd.edu.sg

We present a Branch-and-Cut algorithm for a class of nonlinear chance-constrained mathematical optimization problems with a finite number of scenarios. This class corresponds to the problems that can be reformulated as deterministic convex mixed-integer nonlinear programming problems, but the size of the reformulation is large and quickly becomes impractical as the number of scenarios grows. The Branch-and-Cut algorithm is based on an implicit Benders decomposition scheme, where we generate cutting planes as outer approximation cuts from the projection of the feasible region on suitable subspaces. The size of the master problem in our scheme is much smaller than the deterministic reformulation of the chance-constrained problem. We apply the Branch-and-Cut algorithm to the mid-term hydro scheduling problem, for which we propose a chance-constrained formulation. A computational study using data from ten hydroplants in Greece shows that the proposed methodology solves instances orders of magnitude faster than applying a general-purpose solver for convex mixed-integer nonlinear programming problems to the deterministic reformulation, and scales much better with the number of scenarios. Our numerical experiments show that introducing a small amount of flexibility in the formulation, allowing constraints to be violated with a joint probability $\leq 5\%$, increases the expected profit by 6.1%.

Penalty methods for a class of non-Lipschitz optimization problems

Xiaojun Chen

Department of Applied Mathematics

The Hong Kong Polytechnic University

Hong Kong, China

Email: maxjchen@polyu.edu.hk

We consider a class of constrained optimization problems with a possibly nonconvex non-Lipschitz objective and a convex feasible set being the intersection of a polyhedron and a possibly degenerate ellipsoid. Such problems have a wide range of applications in data science, where the objective is used for inducing sparsity in the solutions while the constraint set models the noise tolerance and incorporates other prior information for data fitting. To solve this class of constrained optimization problems, a common approach is the penalty method. However, there is little theory on exact penalization for problems with nonconvex and non-Lipschitz objective functions. In this paper, we study the existence of exact penalty parameters regarding local minimizers, stationary points and ϵ-minimizers under suitable assumptions. Moreover, we discuss a penalty method whose subproblems are solved via a nonmonotone proximal gradient method with a suitable update scheme for the penalty parameters, and prove the convergence of the algorithm to a KKT point of the constrained problem. Preliminary numerical results demonstrate the efficiency of the penalty method for finding sparse solutions of underdetermined linear systems.

(Jonit work with Zhaosong Lu and Ting Kei Pong.)

Barzilai-Borwein step size for stochastic gradient descent

Shiqian Ma

Department of Systems Engineering and Engineering Management

The Chinese University of Hong Kong

Hong Kong, China

Email: sqma@se.cuhk.edu.hk

One of the major issues in stochastic gradient descent (SGD) methods is how to choose an appropriate step size while running the algorithm. Since the traditional line search technique does not apply for stochastic optimization algorithms, the common practice in SGD is either to use a diminishing step size, or to tune a fixed step size by hand. Apparently, these two approaches can be time consuming in practice. In this paper, we propose to use the Barzilai-Borwein (BB) method to automatically compute step sizes for SGD and its variants: stochastic variance reduced gradient method (SVRG) and stochastic average gradient method (SAG), which leads to three algorithms: SGD-BB, SVRG-BB and SAG-BB. In particular, we prove that SVRG-BB converges linearly for strongly convex objective function. As a by-product, we prove the linear convergence result of SVRG with Option I proposed in (Johnson and Zhang, 2013), whose convergence result has been missing in the literature. Numerical experiments on standard data sets show that the performance of SGD-BB and SVRG-BB are comparable to and sometimes even better than SGD and SVRG with best-tuned step sizes.

High-order sparse modeling with applications

Zongben Xu

School of Mathematics and Statistics

Xi'an Jiaotong University

Xi'an, China

Email: zbxu@mail.xjtu.edu.cn

Various applications, e.g., video surveillance, hyper-spectral image processing and dynamic MR image reconstruction, can be cost as a high-order compressive sensing ($h_{rd}CS$) problem in which the to-be-processed signals are of high-order tensors with target and background separation form. As highlighted in the 2nd order case (namely, the Low Rank Decomposition of Matrices), Sparsity measure has been central in modeling and solving such $h_{rd}CS$ problems. The existing approaches to measure the sparsity of a tensor are through unfolding the tensor into different matrix forms and then using the matrix sparsity. Such matriacization methodologies fail to exploit the global sparse structure and effectively eliminate the spatio-temporal redundancy of the tensor. In this talk we introduce an rational sparsity measure for any high-order tensors in terms of the number of fundamental Kronecker basis. The introduced measure unifies the sparsity adopted extensively in the 1st order case (namely, the number of nonzero components of a vector) and the 2nd order case (namely, the rank of a matrix) , and also well characterizes the global sparse structure of a high-order tensor. With the new sparsity measure, we define a $h_{rd}CS$ model based on the target and background separation framework. Unlike the existing models, we model the target and background tensors respectively with their essential priors like sparsity, smoothness and similarities. The well known alternating direction method of multipliers (ADMM) is then employed to solve the $h_{rd}CS$ model. To lay the theoretical foundation, we establish an recovery theory of the $h_{rd}CS$ based on tensor RIP, prove a convergence result of ADMM, and provide extensive simulated and real world experiments with video surveillance and hyper-spectral image reconstruction which support the superiority of the $h_{rd}CS$ model over the existing state-of-the-art methods.

Towards understanding the convergence behavior of Newton-type methods for structured convex optimization problems

Anthony Man-Cho So

Department of Systems Engineering and Engineering Management

The Chinese University of Hong Kong

Hong Kong, China

Email: manchoso@se.cuhk.edu.hk

Recently, there has been a growing interest in applying Newton-type methods to solve structured convex optimization problems that arise in machine learning and statistics. A major obstacle to the design and analysis of such methods is that many problems of interest are neither strongly convex nor smooth. In this talk, we will present some design techniques for overcoming such obstacle and report some recent progress on analyzing the convergence rates of the resulting Newton-type methods using error bounds. We will also discuss some directions for further study.

Clique relaxations in network analysis

Sergiy Butenko

Industrial and Systems Engineering

Texas A&M University

College Station, Texas, U.S.A.

Email: butenko@tamu.edu

Increasing interest in studying community structures, or clusters in complex networks arising in various applications has led to a large and diverse body of literature introducing numerous graph-theoretic models relaxing certain characteristics of the classical clique concept. This talk discusses recent progress in studying the clique relaxation models from optimization perspective using a rigorous, systematic framework.

Uncertain linear optimization, asset inequality and vulnerability of financial networks

Jiming Peng

Department of Industrial Engineering

University of Houston

Houston, U.S.A.

Email: jopeng@central.uh.edu

Since the financial crisis in 2007-2008, systemic risk in a financial network has become a major concern in financial engineering and economics.In this talk, we study the vulnerability of a financial network based on the linear optimization model introduced by Eisenberg and Noe (2001), where the right hand side of the constraints is subject to market shock and only partial information regarding the liability matrix is revealed. We conduct a new sensitivity analysis to characterize the conditions under which a single bank is solvent, default or bankrupted, and estimate the probability that some financial institute in the network will be bankrupted under mild assumptions on the market shock and the network structure. We also show that the asset inequalities among the banks have a negative impact on the efficiency and stability of the network, and that the so-called monopoly network is the most vulnerable.

Asymmetric proximal point algorithms with moving proximal centers

Deren Han

School of Mathematical Sciences

Nanjing Normal University

Nanjing, China

Email: handeren@njnu.edu.cn

Abstract: We discuss the classical proximal point algorithm (PPA) with a metric proximal parameter in the variational inequality context. The metric proximal parameter is usually required to be positive definite and symmetric in the PPA literature, because it plays the role of the measurement matrix of a norm in the convergence proof. Our main goal is to show that the metric proximal parameter can be asymmetric if the proximal center is shifted appropriately. The resulting asymmetric PPA with moving proximal centers maintains the same implementation difficulty and convergence properties as the original PPA; while the asymmetry of the metric proximal parameter allows us to design highly customized algorithms that can effectively take advantage of the structures of the model under consideration. In particular, some efficient structure-exploiting splitting algorithms can be easily developed for some special cases of the variational inequality. We illustrate these algorithmic benefits by a saddle point problem and a convex minimization model with a generic separable objective function, both of which have wide applications in various fields. We present both the exact and inexact versions of the asymmetric PPA with moving proximal centers; and analyze their convergence including the estimate of their worst-case convergence rates measured by the iteration complexity under mild assumptions and their asymptotically linear convergence rates under stronger assumptions.

Keywords: Proximal Point Algorithm, Variational Inequality, Convergence Rate, Splitting Algorithms, Convex Programming

A convergent iterative hard thresholding for sparsity and nonnegativity constrained optimization

Naihua Xiu

Department of Applied Mathematics

Beijing Jiaotong University

Beijing, China

Email: nhxiu@bjtu.edu.cn

The iterative hard thresholding (IHT) algorithm is a popular greedy-type method in (linear and nonlinear) compressed sensing and sparse optimization problems. In this talk, we give an improved iterative hard thresholding algorithm for solving the sparsity and nonnegativity constrained optimization (SNCO) by employing the Armijo-type stepsize rule, which automatically adjusts the stepsize and support set and leads to a sufficient decrease of the objective function each iteration. Consequently, the improved IHT algorithm enjoys several convergence properties under standard assumptions. Those include the convergence to α-stationary point (also known as L-stationary point in literature if the objective function has Lipschitzian gradient) and the finite identification of the true support set. We also characterize when the full sequence converges to a local minimizer of SNCO and establish its linear convergence rate. Extensive numerical experiments are included to demonstrate the good performance of the proposed algorithm.

On efficiently combining limited-memory and trust-region techniques

Ya-xiang Yuan

Academy of Mathematics and System Sciences

Chinese Academy of Sciences

Beijing, China

Email: yyx@lsec.cc.ac.cn

Limited-memory quasi-Newton methods and trust-region methods represent two efficient approaches used for solving unconstrained optimization problems. A straightforward combination of them deteriorates the efficiency of the former approach, especially in the case of large-scale problems. For this reason, the limited-memory methods are usually combined with a line search. We show how to efficiently combine limited-memory and trust-region techniques. One of our approaches is based on the eigenvalue decomposition of the limited-memory quasi-Newton approximation of the Hessian matrix. The decomposition allows for finding a nearly-exact solution to the trust-region subproblem defined by the Euclidean norm with an insignificant computational overhead as compared with the cost of computing the quasi-Newton direction in line-search limited-memory methods. The other approach is based on two new eigenvalue-based norms. The advantage of the new norms is that the trust-region subproblem is separable and each of the smaller subproblems is easy to solve. We show that our eigenvalue-based limited-memory trust-region methods are globally convergent. Moreover, we propose improved versions of the existing limited-memory trust-region algorithms. The presented results of numerical experiments demonstrate the efficiency of our approach which is competitive with line-search versions of the L-BFGS method.

Statistical sampling for big data logistic regression

Tong Zhang

Department of Statistics

Rutgers University

New Jersey, USA

Email: tzhang@stat.rutgers.edu

Many modern big-data machine learning problems encountered in the industry involve optimization problems so large that traditional optimization methods are difficult to handle. In this talk, I will present a novel statistical sampling method for multi-class logistic regression that can be used to select a small number of the most effective data points. Asymptotically we show that the proposed method can achieve variance no more than s times that of the full-data MLE with no more than 1/s of the full data in the worst case; moreover the required sample size can be significantly smaller than 1/s of the full data when the classification accuracy is relatively high. We demonstrate how to use such sampling methods in real applications.

Part II

Contributed Poster Talks

Quasi-Newton method for computing the US-eigenvalues of a symmetric complex tensor

Minru Bai

College of Mathematics and econometrics

Hunan University

Changsha, China

Email: minru-bai@163.com

US-eigenvalues of complex symmetric tensors and U-eigenvalues for non-symmetric complex tensors are very important because of its background of quantum entanglement. US-eigenvalues generalize Z-eigenvalues from the real case to the complex case, which are closely to the best rank-one approximations to higher-order tensors. In this paper, we first show that the largest U-eigenvalue, the largest US-eigenvalue and the largest Z-eigenvalue are equal to each others for a non-negative symmetric tensor. Then, we establish the first order complex Taylor series and Wintinger calculus of complex gradient of real-valued functions with complex variables, their complex conjugate variables and real variables. Based on this theory, we propose a norm descent quasi-Newton method for computing US-eigenpairs of a complex symmetric tensor. The global and superlinear convergence of the proposed method are established. The numerical examples are presented to support the theoretical findings.

Stream selection methods for non-regenerative MIMO relay networks

Cong Sun

Department of Mathematics

Beijing University of Posts and Telecommunications

Beijing, China

Email: suncong86@bupt.edu.cn

For general MIMO relay AF networks, transmitting different number of data streams lead to significantly different performances. Therefore stream selection is an important preprocessing to maximize the sum rate. We first show that the problem to select only one stream for networks with single antenna users is NP-hard. Then based on the Total Signal to Total Interference plus Noise Ratio model, the stream selection problem for the general MIMO relay AF network is simplified as a 0-1 quadratic programming. Two stream selection algorithms are proposed. One is to delete streams from the full set and the other is to add streams to the basic set. Simulations show that the two algorithms are efficient to achieve high sum rate in medium to high SNR and in low SNR scenarios, respectively; the model with the stream selection as preprocess well balances between the achieved sum rate and the computational cost.

Necessary optimality conditions and exact penalization for non-Lipschitz nonlinear programs

Lei Guo

Sino-US Global logistics Institute

Shanghai Jiao Tong University

Shanghai, China

Email: guolayne@sjtu.edu.cn

When the objective function is not locally Lipschitz, constraint qualifications are no longer sufficient for Karush-Kuhn-Tucker (KKT) conditions to hold at a local minimizer, let alone ensuring an exact penalization.In this paper,we extend quasi-normality and relaxed constant positive linear dependence (RCPLD) condition to allow the non-Lipschitzness of the objective function and show that they are sufficient for the KKT conditions to be necessary for optimality. Moreover, we derive exact penalization results for the following two special cases. When the non-Lipschitz term in the objective function is the sum of a composite function of a separable lower semi-continuous function with a locally Lipschitz function and an indicator function of a closed subset, we show that a local minimizer of our problem is also a local minimizer of an exactpenalization problem under a local error bound condition for a restricted constraint region and a suitable assumption on the outer separable function.When the non-Lipschitz term is the sum of a continuousfunction and an indicator function of a closed subset,we also show that our problem admits an exactpenalization under an extended quasi-normality involving the coderivative of the continuous function.

Two-stage convex relaxation approach to least squares loss constrained low-rank plus sparsity optimization problems

Le Han

School of Mathematics

South China University of Technology

Guangzhou, China

Email: hanle@scut.edu.cn

This paper is concerned with the least squares loss constrained low-rank plus sparsity optimization problems that seek a low-rank matrix and a sparse matrix by minimizing a positive combination of the rank function and the zero norm over a least squares constraint set describing the observation or prior information on the target matrix pair. For this class of NP-hard optimization problems, we propose a two-stage convex relaxation approach by the majorization for suitable locally Lipschitz continuous surrogates, which has a remarkable advantage in reducing the error yielded by the popular nuclear norm plus ℓ_1-norm convex relaxation method. Also, under a suitable restricted eigenvalue condition, we establish a Frobenius norm error bound for the optimal solution of each stage and show that the error bound of the first stage convex relaxation (i.e. the nuclear norm plus ℓ_1-norm convex relaxation), can be reduced much by the second stage convex relaxation, thereby providing the theoretical guarantee for the two-stage convex relaxation approach. We also verify the efficiency of the proposed approach by applying it to some random test problems and some problems with real data arising from specularity removal from face images, and foreground/background separation from surveillance videos.

A practical inexact smoothing Newton method for ordinal embedding

Qingna Li

School of Mathematics and Statistics

Beijing Institute of Technology

Beijing, China

Email: qnl@bit.edu.cn

We proposed an Euclidean distance matrix based model for ordinal embedding, which is to embed n points into a given lower space while maintaining their distance order. A practical inexact smoothing Newton method was proposed to efficiently deal with the huge amount of inequality constraints, which leads to smaller computational cost and fast speed. Numerical results on practical data confirm the efficiency of the method.

Discriminatively embedded K-means for multi-view clustering

Kun Song

School of Automation

Northwestern Polytechnical University

Xi'an, China

Email: Songkun123000@126.com

In real world applications, more and more data, for example, image/video data, are high dimensional and represented by multiple views which describe different perspectives of the data. Efficiently clustering such data is a challenge. To address this problem, this paper proposes a novel multi-view clustering method called Discriminatively Embedded K-Means (DEKM), which embeds the synchronous learning of multiple discriminative subspaces into multiview K-Means clustering to construct a unified framework, and adaptively control the intercoordinations between these subspaces simultaneously. In this framework, we firstly design a weighted multi-view Linear Discriminant Analysis (LDA), and then develop an unsupervised optimization scheme to alternatively learn the common clustering indicator, multiple discriminative subspaces and weights for heterogeneous features with convergence. Comprehensive evaluations on three benchmark datasets and comparisons with several state-of-the-art multi-view clustering algorithms demonstrate the superiority of the proposed work.

An new effective hybrid heuristic algorithm for solving undesirable facility location problems

Bailu Yan

Beijing University of Chemical Technology

Beijing, China

Email: 18810410523@163.com

1-maximin model and 1-maxisum model are the most representative among the models of undesirable facility location problems. The objective function of the 1-maximin model is piecewise linear and concave. Based on the characteristics of the model, the authors combine the particle swarm optimization algorithm and the golden section algorithm, and proposes a hybrid heuristic algorithm (PSO-GS algorithm) which can solve 1-maximin model. The authors prove that the time complexity of the PSO-GS algorithm is O(mn). Numerical experiments show that the PSO-GS algorithm not only is effective in solving the 1-maximin model, but also has excellent performance in solving the 1-maxisum model.

Non-orthogonal multiple access meets simultaneous wireless information and power transfer: A new paradigm to improve the data rate

Yanqing Xu
Beijing Jiao Tong University
Beijing, China
Email: xuyanqing@bjtu.edu.cn

In this paper, the application of simultaneous wireless information and power transfer (SWIPT) to non-orthogonal multiple access (NOMA) is investigated. A new cooperative SWIPT NOMA protocol is proposed in which the delay-tolerant user act as energy harvesting relay to help delay-aware user. The objective is to maximize the data rate of the delay-tolerant user with the QoS requirement of the delay-aware user satisfied.

Nonconvex quadratic optimization over the intersection of balls: Complexity, approximation and application

Yong Xia

School of Mathematics and Systems Science

Beihang University

Beijing, China

Email: dearyxia@gmail.com

We study the nonconvex quadratic optimization over the intersection of balls (BQ). We prove that (BQ) is in general NP-hard and has a PTAS under some assumptions. Then, bsased on the second-order cone programming (SOCP) relaxation, we propose an approximation algorithm for solving (BQ). As an application, we establish the first approximation bound for the problem of finding the Chebyshev center with respect to the general matrix norm of the intersection of several balls.

A new first-order framework for orthogonal constrained optimization problems

Bin Gao

Academy of Mathematics and Systems Science

Chinese Academy of Sciences

Beijing, China

Email: gaobin@lsec.cc.ac.cn

The orthogonal constrained optimization is widely used in many areas. Once the objective is nonconvex and specially includes linear term, the problem can be very difficult to tackle. In this paper, we propose a first-order framework which consists of two parts and preserves the feasibility of iterates all the time. In the first part, a sufficient reduction of function value can be achieved by two methods. One is gradient reflection with explicit expression realized by gradient descent and Householder transformation. The other is column-wise block coordinate descent. The second part, a symmetrization step is employed to symmetrize the Lagrangian multipliers of orthogonal constraint. Global convergence for this approach and linear convergence rate for the special cases are established. Preliminary experiments illustrate that the new algorithm performs well and is of great potential.

A new parameter value for a modified gradient algorithm

Aiqun Huang

School of Mathematics and Statistics

Huazhong University of Science and Technology

Wuhan, China

Email: aiqunhuang@hust.edu.cn

Yu. Nesterov proposed a gradient method for non-smooth convex minimization problems and this method aroused people's interest. In his method, the values of parameters played an importance role in the theory and practice. But, in this paper, we investigate the properties of these parameters, and obtain a new set of parameters. Numerical tests indicate that the new values of parameters also can achieve the same results as the original values.

ℓ_p-ball constrained weighted maximin dispersion problem: convex relaxation misleads the approximation algorithm

Shu Wang

School of Mathematics and Systems Science

Beihang University

Beijing, China

Email: wangshu.0130@163.com

The ℓ_p-ball constrained weighted maximin dispersion problem (P_{L_p}) is to find a point in an ℓ_p-ball such that the minimum of the weighted Euclidean distance from given points is maximized. Recently, based on the convex relaxation, a randomized approximation algorithm is proposed in [SIAM J. Optim. 23(4), 2264-2294, 2013]. Surprisingly, without the "help" of any convex relaxation, there is a simple randomized approximation algorithm, which not only performs much better but also provides the first data-independent approximation bound of (P_{L_p}) for $2 \leq p < \infty$.

A modied proximal gradient method for a class of Nonsmooth convex optimization problems

Yingyi Li

Beijing University of Technology

Beijing, China

Email: leeandyao@126.com

In this paper, we propose a modified proximal gradient method for solving a class of nonsmooth convex optimization problems, which arise in many contemporary statistical and signal processing applications. The proposed method adopts a new scheme to construct the descent direction based on the proximal gradient method. It is proven that modified proximal gradient method is Q-linearly convergent without the assumption of the strong convexity of the objective function. Some numerical experiments have been conducted to evaluated the proposed method eventually.

A projection-type algorithm for solving generalized mixed variational inequalities

Kai Tu

Beijing University of Technology

Beijing, China

Email: kaitu_02@163.com

We propose a projection-type algorithm for generalized mixed variational inequality problem in Euclidean space R^n. We establish the convergence theorem for the proposed algorithm, provided the multi-valued mapping is continuous and f-pseudomonotone with nonempty compact convex values on $dom(f)$, where f is a proper function. The presented algorithm generalize and improve some known algorithms in literatures. Preliminary computational experience is also reported.

Lp-norm regularization algorithms for optimization over permutation matrices

Bo Jiang

School of Mathematical Sciences

Nanjing Normal University

Nanjing, China

Email: jiangbo@njnu.edu.cn

Optimization problems over permutation matrices appear widely in facility layout, chip design, scheduling, pattern recognition, computer vision, graph matching, etc. Since this problem is NP-hard due to the combinatorial nature of permutation matrices, we relax the variable to be the more tractable doubly stochastic matrices and add an Lp-norm $(0 < p < 1)$ regularization term to the objective function. The optimal solutions of the Lp-regularized problem are the same as the original problem if the regularization parameter is sufficiently large. A lower bound estimation of the nonzero entries of the stationary points and some connections between the local minimizers and the permutation matrices are further established. Then we propose an Lp regularization algorithm with local refinements. The algorithm approximately solves a sequence of Lp regularization subproblems by the projected gradient method using a nonmontone line search with the Barzilai-Borwein step sizes. Its performance can be further improved if it is combined with certain local search methods, the cutting plane techniques as well as a new negative proximal point scheme. Extensive numerical results on QAPLIB and the bandwidth minimization problem show that our proposed algorithms can often find reasonably high quality solutions within a competitive amount of time.

Adaptive robust antenna array synthesis for clutter suppression

Wenqiang Pu

Xidian University

Xi'an, China

Email: wqpu@stu.xidian.cn

Abstract: Designing a desired antenna array pattern in the presence of an unknown array error is a key problem in radar applications. In this work, we propose a robust antenna array pattern for clutter suppression based on the worst-case criterion. In case of the unknown array error, we further propose an adaptive approach that jointly designs the desired pattern and compensates the array error. Our simulation results show that our proposed adaptive approach can suppress more clutter power.

Key words: robust optimization, antenna array pattern, clutter suppression

A general proximal quasi-Newton method for l_1 penalized optimization problem

Zhilong Dong

Academy of Mathematics and Systems Science

Chinese Academy of Sciences

Beijing, China

Email: zldong@lsec.cc.ac.cn

In this talk, we propose an inexact proximal quasi-Newton method for solving large scale l_1 penalized optimization problem. The object function consists of one smooth convex part as well as a nonsmooth l_1 penalized term. Firstly, we use a quasi-Newton framework to approximate the smooth part with a quadratic function. Then we solve the reformulated subproblem using an interior point method with wide neighborhood. We use Shermon-Morrison-Woodbury technique to reduce the computational complexity in each iteration, and proposed several techniques to overcome the difficulty of generating computation error. Global convergence as well as the local Q-superlinear convergence rate are guaranteed for this algorithm. Numerical experiments show that our LBIPM algorithm runs faster and returns solutions not worse than those from the state-of-the-art algorithms.

A proximal alternating direction method for multi-block coupled convex optimization

Lingling Xu
School of Mathematical Sciences
Nanjing Normal University
Nanjing, China
Email: xulingling@njnu.edu.cn

In this paper, we propose a proximal alternating direction method (PADM) for solving the convex optimization problems with linear constraints whose objective function is the sum of multi-block separable functions and coupled quadratic function. The algorithm generates iterates via a simple correction step, where the decent direction is based on the PADM. We prove the convergence of the generated sequence under some mild assumptions. Finally, some familiar numerical results are reported for the new algorithm.

A proximal point algorithm with asymmetric linear term

Xingju Cai

School of Mathematical Sciences

Nanjing Normal University

Nanjing, China

Email: caixingju@njnu.edu.cn

We propose an asymmetric proximal point algorithm (APPA) for solving variational inequality problems. The algorithm is “asymmetric” in the sense that the matrix in the linear proximal term is not required to be a symmetric matrix, which makes the method more flexible, especially in dealing with problems with separable structures. Under some suitable conditions, we prove the global linear convergence of the algorithm. To make the method more practical, we allow the subproblem to be solved in an approximate manner and an inaccuracy criterion with constant parameter is adopted. Finally, we report some preliminary Numerical results.

A novel posture sensing scheme for pump truck-a Euclidean distance matrix based optimization approach

Zhiqiang Yao

The College of Information Engineering

Xiangtan University

Xiangtan, China

Email: yaozhiqiang@xtu.edu.cn

Accurate sensing of the posture for pump truck is a basic and key guarantee for safe operating and automatic pouring. The traditional ways of sensing posture is to collect the rotation angles of joints through tilting angle sensors, and then calculate recursively the posture of each arm until the tail. It suffers some drawbacks including elastic deformation and error accumulation. In this paper, we try to introduce wireless location technique to directly sensing the posture of arms and the tail. We model it as a multiple source localization problem with special structure. The traditional solvers for sensor network localization including LS/SDP/GTRS suffers large errors, heavy computational cost, consequently, resulting in time delay. Further, they can not take use of the known arm length information. We then propose a low-rank Euclidean distance matrix based scheme, which divided to three steps. Firstly, based on the structure and movement feature of pump trucks, we set up a so-called pump truck coordinate system, transferring the three-dimensional location problem into two-dimensional problem. Secondly, we use the low-rank Euclidean distance embedding model to describe the resulting problem, where the arm length is included as equality constraints. Finally, the two-dimensional coordinate is transferred back to the three-dimensional coordinates, which is the result we want. Simulation results comparing with SDP/GTRS verified the superior accuracy and efficiency of the proposed scheme.

Distributed detection fusion via Monte Carlo importance sampling

Xiaojing Shen

Department of Mathematics

Sichuan University

Chengdu, China

Email: shenxj@scu.edu.cn

Distributed detection fusion with conditionally dependent observations is known to be a challenging problem. When a fusion rule is fixed, this paper attempts to make progress on this problem for the large sensor networks by proposing a new Monte Carlo framework. Through the Monte Carlo importance sampling, the Bayes cost function is approximated by the sample average. Then, we derive a necessary condition for optimal sensor decision rules so that a Gauss-Seidel/person-by-person optimization approach can be obtained to find the optimal sensor decision rules. It is proved that the new algorithm is finitely convergent. The complexity of the new algorithm is order of O(LN) compared with O(LN^L) of the previous algorithm where L is the number of sensors. Thus, the proposed methods allows us to design the large sensor networks with general dependent observations. Furthermore, an interesting result is that, for the fixed AND or OR fusion rules, we can analytically derive the optimal solution in the sense of minimizing the approximated Bayesian cost function. In general, the solution of the Gauss-Seidel algorithm is only local optimal. However, in the new framework, we can prove that the solution of Gauss-Seidel algorithm is same as the analytically optimal solution in the case of the AND fusion rule. The classic example with dependent observations and some new examples with large number of sensors are examined under this new framework. The results of numerical examples demonstrate the efficiency and effectiveness of the new algorithm class.

List of Participants of MOA 2016

Congpei An (安聪沛)

Jinan University

Email: tancpei@jnu.edu.cn

Minru Bai （白敏茹)

Hunan University

Email: minru-bai@163.com

Wei Bian （边伟)

Harbin Institute of Technology

Email: bianweilvse520@163.com

Sergiy Butenko

Texas A&M University

Email: butenko@tamu.edu

Xingju Cai （蔡邢菊)

Nanjing Normal University

Email: caixingju@njnu.edu.cn

Yang Cao （曹阳)

Hohai University

Email: caoyang1988828@126.com

Bilian Chen （陈碧连)

Xiamen University

Email: blchen@xmu.edu.cn

Cheng Chen （陈诚)

Academy of Mathematics and Systems Science, CAS

Email: cchen@lsec.cc.ac.cn

Liang Chen （陈亮)

Academy of Mathematics and Systems Science, CAS

Email: chenliang15@lsec.cc.ac.cn

Weikun Chen （陈伟坤)

Academy of Mathematics and Systems Science, CAS

Email: cwk@lsec.cc.ac.cn

Xi Chen （陈曦)

Nankai University

Email: happy1631993@126.com

Xiaojun Chen （陈小君)

Hong Kong Polytechnic University

Email: maxjchen@polyu.edu.hk

Xujin Chen （陈旭瑾)

Academy of Mathematics and Systems Science, CAS

Email: xchen@amss.ac.cn

Yongqiang Chen （陈永强)

Henan Normal University

Email: yongxin3388@163.com

Zhiming Chen (陈志明)

Academy of Mathematics and Systems Science, CAS

Email: zmchen@lsec.cc.ac.cn

Zhongwen Chen (陈中文)

Soochow University

Email: zwchen@suda.edu.cn

Wanyou Cheng (程万友)

Dongguan University of Technology

Email: chengwanyou@sina.com

Tim Conrad

ZIB/Freie Universitat Berlin

Email: conrad@math.fu-berlin.de

Chunfeng Cui (崔春风)

Academy of Mathematics and Systems Science, CAS

Email: cuichf@lsec.cc.ac.cn

Yijue Dai (戴一珏)

Xiangtan University

Email: affict0yourself@qq.com

Yu-Hong Dai (戴彧虹)

Academy of Mathematics and Systems Science, CAS

Email: dyh@lsec.cc.ac.cn

Qian Dong （董乾)

Academy of Mathematics and Systems Science, CAS

Email: dongqian@lsec.cc.ac.cn

Zhengshan Dong （董正山)

Fuzhou University

Email: 1030656689@qq.com

Zhilong Dong （董志龙)

Academy of Mathematics and Systems Science, CAS

Email: zldong@lsec.cc.ac.cn

Rongfei Fang （范戎飞)

Beijing Institute of Technology

Email: fanrongfei@bit.edu.cn

Aifen Feng （冯爱芬)

Henan University of Science And Technology

Email: Kdfaif@163.com

Junkai Feng （冯俊锴)

Beijing University of Technology

Email: fengjunkai1989@126.com

Kai Fu （傅凯)

Academy of Mathematics and Systems Science, CAS

Email: fukai@lsec.cc.ac.cn

Bin Gao (高斌)

Academy of Mathematics and Systems Science, CAS

Email: gaobin@lsec.cc.ac.cn

Xiaoshan Gao (高小山)

Academy of Mathematics and Systems Science, CAS

Email: xgao@mmrc.iss.ac.cn

Guoyong Gu (顾国勇)

Nanjing University

Email: ggu@nju.edu.cn

Ran Gu (顾然)

Academy of Mathematics and Systems Science, CAS

Email: guran@lsec.cc.ac.cn

Lei Guo (郭磊)

Shanghai Jiaotong University

Email: guolayne@sjtu.edu.cn

Deren Han (韩德仁)

Nanjing Normal University

Email: handeren@njnu.edu.cn

Le Han (韩乐)

South China University of Technology

Email: hanle@scut.edu.cn

Mingyi Hong （洪明毅）

Iowa State University

Email: mingyi@iastate.edu

Aiqun Huang （黄爱群）

Huazhong University of Science and Technology

Email: aiqunhuang@hust.edu.cn

Nanjing Huang （黄南京）

Sichuan University

Email: nanjinghuang@hotmail.com

Yakui Huang （黄亚魁）

Academy of Mathematics and Systems Science, CAS

Email: hyk@lsec.cc.ac.cn

Yuehui Huang （黄越辉）

Chinese Electric Power Research Institute

Email: huangyh@epri.sgcc.com.cn

Zilin Huang （黄子麟）

Fuzhou University

Email: 1156019152@qq.com

Jingjing Jia （贾晶晶）

Nankai University

Email: jiajingjing1993@sina.com

Bo Jiang （姜波）

Nanjing Normal University

Email: jiangbo@njnu.edu.cn

Bo Jiang （江波）

Shanghai University of Finance and Economics

Email: isyebojiang@163.com

Kaizhong Jiang （江开忠）

Shanghai University of Engineering Science

Email: kzjiang@sues.edu.cn

Jiang Wei （姜维）

North China University of Water Resources and Electric Power

Email: jiangwei@ncwu.edu.cn

Zhe Jin （金哲）

Academy of Mathematics and Systems Science, CAS

Email: jinzhe15@mails.ucas.ac.cn

Dong Kang （康冬）

Academy of Mathematics and Systems Science, CAS

Email: kangdong@lsec.cc.ac.cn

Thorsten Koch

Zuse Institute Berlin

Email: koch@zib.de

Caixia Kou （寇彩霞）

Beijing University of Posts And Telecommunications

Email: Koucx@lsec.cc.ac.cn

Bo Li （李博）

Petro China Pipeline R&D Center

Email: libo19@petrochina.com.cn

Haifeng Li （李海锋）

Henan Normal University

Email: lihaifengxx@126.com

Huiyun Li （李慧云）

Hebei University of Technology

Email: lhyihn@163.com

Min Li （李敏）

Shandong Normal University

Email: liminemily@sdnu.edu.cn

Pai Li （李湃）

Chinese Electric Power Research Institute

Email: 569307336@qq.com

Qingna Li （李庆娜）

Beijing Institute of Technology

Email: qnl@bit.edu.cn

Xingquan Li (李兴权)

Fuzhou University

Email: n130320024@fzu.edu.cn

Yanling Li (李艳玲)

Hebei University of Technology

Email: yanling_li930@126.com

Yingyi Li (李英毅)

Beijing University of Technology

Email: leeandyao@126.com

Daoling Lin (林道玲)

Jinan University

Email: 18907527263@163.com

Changhe Liu (刘长河)

Henan University of Science And Technology

Email: changheliu@163.com

Chun Liu (刘纯)

Chinese Electric Power Research Institute

Email: liuchun@epri.sgcc.com.cn

Chunguang Liu (刘春光)

Jinan University

Email: tcgliu@jnu.edu.cn

Hao Liu （刘浩）

Nanjing Univeersity of Technology

Email: lhmath@njtech.edu.cn

Jianjun Liu （柳建军）

Petro China Pipeline R&D Center

Email: kjliujj@petrochina.com.cn

Xin Liu （刘歆）

Academy of Mathematics and Systems Science, CAS

Email: liuxin@lsec.cc.ac.cn

Xinwei Liu （刘新为）

Hebei University of Technology

Email: optim2008@163.com

Ya-Feng Liu （刘亚锋）

Academy of Mathematics and Systems Science, CAS

Email: yafliu@lsec.cc.ac.cn

Yajun Liu （刘亚君）

Nankai University

Email: 18722414951@163.com

Zexian Liu （刘泽显）

Hezhou University

Email: liuzexian2008@163.com

Zhi-Quan Luo （罗智泉)

University of Minnesota

Email: luozq@ece.umn.edu

Shiqian Ma （马士谦)

The Chinese University of Hong Kong

Email: sqma@se.cuhk.edu.hk

Ting Ma （马婷)

Sichuan University

Email: majiawan27@163.com

Fanqin Meng （孟凡钦)

Sichuan University

Email: mengfanqin2008@163.com

Giacomo Nannicini

Singapore University of Technology and Design

Email: nannicini@sutd.edu.sg

Lili Pan （潘丽丽)

Beijing Jiaotong University

Email: panlili1979@163.com

Yonggang Pei （裴永刚)

Henan Normal University

Email: peiyg@163.com

Jiming Peng (彭积明)

University of Houston

Email: jopeng@central.uh.edu

Wenqiang Pu (蒲文强)

Xidian University

Email: wqpu@stu.xidian.cn

Ted Ralphs

Lehigh University

Email: ted@lehigh.edu

Peter Richtárik

Ediburgh University

Email: peter.richtarik@ed.ac.uk

Chao Shen (沈超)

Beijing Jiaotong University

Email: chaoshen@bjtu.edu.cn

Peiping Shen (申培萍)

Henan Normal University

Email: shenpeiping@163.com

Xiaojing Shen (沈晓静)

Sichuan University

Email: wangzg315@126.com

Yang Shen （沈阳）

Nankai University

Email: 494662657@qq.com

Zebang Shen （沈泽邦）

Zhejiang University

Email: shenzebang@me.com

Anthony Man-Cho So (苏文藻)

Chinese University of Hong Kong

Email: manchoso@se.cuhk.edu.hk

Enbin Song （宋恩彬）

Sichuan University

Email: e.b.song@163.com

Kun Song （宋坤）

Northwestern Polytechnical University

Email: Songkun123000@126.com

Lili Song （宋立莉）

Shandong Normal University

Email: songlilig@163.com

Minglu Song （宋明璐）

Nankai University

Email: 1762623435@qq.com

Cong Sun (孙聪)

Beijing University of Posts and Telecommunications

Email: suncong86@bupt.edu.cn

Kai Tu (涂凯)

Beijing University of Technology

Email: kaitu_02@163.com

Chunfeng Wang (汪春峰)

Henan Normal University

Email: wangchunfeng09@126.com

Guoqiang Wang (王国强)

Shanghai University of Engineering Science

Email: guoq_wang@hotmail.com

Haijun Wang (王海军)

China University of Mining and Technology

Email: hjwcumt@163.com

Liping Wang (王丽平)

Nanjing University of Aeronautics and Astronautics

Email: wlpmath@nuaa.edu.cn

Shiguo Wang (王仕果)

Xiangtan University

Email: sgking@xtu.edu.cn

Shu Wang （王姝)

Beihang University

Email: wangshu.0130@163.com

Shuxiong Wang （王树雄)

Academy of Mathematics and Systems Science, CAS

Email: wsx@lsec.cc.ac.cn

Weisheng Wang （王伟胜)

Chinese Electric Power Research Institute

Email: wangws@epri.sgcc.com.cn

Xiaoyu Wang （王小玉)

Academy of Mathematics and Systems Science, CAS

Email: wangxiaoyu2821@126.com

Zhiguo Wang （王治国)

Sichuan University

Email: wangzg315@126.com

ZhouHong Wang （王周宏)

Beijing Jiaotong University

Email: wangzhh@bjtu.edu.cn

Zhijun Wu （吴智君)

Iowa State University

Email: zhijun@iastate.edu

Yong Xia (夏勇)

Beihang University

Email: dearyxia@gmail.com

Lin Xiao

Microsoft Research

Email: lin.xiao@microsoft.com

Yibin Xiao (肖义彬)

University of Electronic Science and Technology of China

Email: xiaoyb9999@hotmail.com

Naihua Xiu (修乃华)

Beijing Jiaotong University

Email: nhxiu@bjtu.edu.cn

Xianchao Xiu (修贤超)

Beijing Jiaotong University

Email: xianchaoxiu@163.com

Fengmin Xu (徐凤敏)

Xi'an Jiaotong University

Email: fengminxu@mail.xjtu.edu.cn

Haiwen Xu (徐海文)

Civil Aviation Flight University of China

Email: xuhaiwen_dream@163.com

Lingling Xu (徐玲玲)

Nanjing Normal University

Email: xulingling@njnu.edu.cn

Yanqing Xu (徐彦卿)

Beijing Jiaotong University

Email: xuyanqing@bjtu.edu.cn

Zongben Xu (徐宗本)

Xi'an Jiaotong University

Email: zbxu@mail.xjtu.edu.cn

Bailu Yan (闫白鹭)

Beijing University of Chemical Technology

Email: 18810410523@163.com

Junfeng Yang (杨俊锋)

Nanjing University

Email: jfyang@nju.edu.cn

Muming Yang (杨沐明)

Academy of Mathematics and Systems Science, CAS

Email: 541388450@qq.com

Ximei Yang (杨喜美)

Henan Normal University

Email: yangximeiluoyang@126.com

Chao Yao (姚超)

Northwestern Polytechnical University

Email: yaochao@nwpu.edu.cn

Zhiqiang Yao (姚志强)

Xiangtan University

Email: yaozhiqiang@xtu.edu.cn

Feng Ye (叶峰)

Xidian University

Email: fye@xidian.edu.cn

Yinyu Ye (叶荫宇)

Stanford University

Email: yyye@stanford.edu

Shenbao Yu (余深宝)

Xiamen University

Email: bobo1991817@qq.com

Tengteng Yu (于腾腾)

Hebei University of Technology

Email: yuteng206@163.com

Honglin Yuan (袁宏霖)

Peking University

Email: yhlmath@pku.edu.cn

Ya-xiang Yuan （袁亚湘）

Academy of Mathematics and Systems Science, CAS

Email: yyx@lsec.cc.ac.cn

Liaoyuan Zeng （曾燎原）

Academy of Mathematics and Systems Science, CAS

Email: zengly@lsec.cc.ac.cn

Haibin Zhang （张海斌）

Beijing University of Technology

Email: zhanghaibin@bjut.edu.cn

Kaili Zhang （张凯丽）

Qufu Normal University

Email: zh_kaili@163.com

Linbo Zhang （张林波）

Academy of Mathematics and Systems Science

Email: zlb@lsec.cc.ac.cn

Linxia Zhang （张林霞）

Sichuan University

Email: 969444987@qq.com

Rui Zhang （张瑞）

Academy of Mathematics and Systems Science, CAS

Email: zhangruijiayou@lsec.cc.ac.cn

Su Zhang (张苏)

Nankai University

Email: zhangsu@nankai.edu.cn

Tong Zhang

Rutgers University

Email: tzhang@stat.rutgers.edu

Yin Zhang (张寅)

Rice University

Email: yzhang@rice.edu

Yong Zhang (张永)

Civil Aviation Flight University of China

Email: xuhaiwen_dream@163.com

Zaikun Zhang (张在坤)

Hong Kong Polytechnic University

Email: zaikun.zhang@polyu.edu.hk

Liang Zhao (赵亮)

Academy of Mathematics and Systems Science, CAS

Email: zhaoliang14@lsec.cc.ac.cn

Na Zhao (赵娜)

Nankai University

Email: chlzhn@126.com

Xin Zhao (赵馨)

Shanghai Jiao Tong University

Email: lovezx1990@sjtu.edu.cn

Aihui Zhou (周爱辉)

Academy of Mathematics and Systems Science

Email: azhou@lsec.cc.ac.cn

Shuisheng Zhou (周水生)

Xidian University

Email: sszhou@mail.xidian.edu.cn

Lei Zhu (朱蕾)

Xiangtan University

Email: 822065196@qq.com

The organizing committee wishes you a pleasant stay in Beijing!