2016 PKU Workshop On Mathematics in Imaging Science and Data Analysis (MISDA)

August 4-5, 2016

Beijing, China

http://bicmr.pku.edu.cn/~dongbin/Conferences/MISDA2016/MISDA-2016.html

2016 PKU Workshop On Mathematics in Imaging Science and Data Analysis (MISDA)

August 4-5, 2016

Beijing, China

http://bicmr.pku.edu.cn/~dongbin/Conferences/MISDA2016/MISDA-2016.html

---

Information for Participants

Sponsors and Committee

Conference Schedule

Abstracts

Information for Participants

Conference Hotel For Invited Speakers

Hotel:	"Zhong Guan Xin Yuan" Global Village, Building 1 中关新园1号楼
Address:	No. 216 Zhongguancun North Road, Haidian District 北京市海淀区中关村北大街126号
Dates:	By default, the hotel room is reserved for: August 3rd (check in) and 6th (check-out). Please let us know if you have a different arrival-departure schedule.
Arrival:	By air, please see this link By subway: line 4 to "east gate of Peking University"
Website:	www.pkugv.com
Tel:	+86-10-62752288

Conference Venue

Venue:	Lecture Hall, Jia Yi Bing Building 82 Jing Chun Yuan, BICMR 北京大学镜春园82号甲乙丙楼二层报告厅
Map:	PKU campus map

Meals

- Breakfasts will be complementary at the hotel.
- Lunches and dinners are provided by the workshop. Please let us know if you have any dietary restrictions or preferences.

Registration

- August 3rd, 6pm-9pm, lobby of Global Village, Building 1 (中关新园1号楼大堂).
- August 4th, all day, venue of the workshop.

Currency

Chinese currency is RMB. The current rate is about 1 US (1 Euro) dollar for 6.69 RMB (7.38 RMB). (The exchange rates are from Google, July 2016). The exchange of foreign currency can be done at the airport or at the hotel. Please keep the receipt of the exchange so that you can change back to your own currency if you have RMB left before you leave China. Please be advised that there might be additional service charges when you exchange currency in China.

Parking at PKU Campus

If you plan to drive to PKU, please send us your license plate number; otherwise, your car cannot enter the PKU campus.

Contact Information

If you need any help, please feel free to contact

- Dr. Bin Dong: +86-185-0080-2088
- Ms. Yiwei Li: +86-10-62744134

Sponsors

Beijing International Center For Mathematical Research, Peking University

National Natural Science Foundation of China

Committees

Organizing Committee

Bin Dong, Peking University

Hongkai Zhao, UC Irvine & Peking University

Scientific Committee

Weinan E, Princeton University & Peking University

Stanley Osher, UCLA

Zuowei Shen, National University of Singapore

Pingwen Zhang, Peking University

Conference Schedule

August 4, Thursday

08:00-08:30 Opening Ceremony

- **08:00-08:10 Welcome Address**
- **08:10-08:30 Group Photo**

08:30-10:10 Session T1
Chair: Bin Dong

- **08:30-9:30** **Stanley Osher**, Overcoming the curse of dimensionality for certain Hamilton-Jacobi (HJ)equations arising in control theory and elsewhere
- **09:30-10:10** **Rongjie Lai**, Solve Geometric PDEs on Manifolds Represented as Point Clouds and Applications

10:10-10:30 Coffee Break

10:30-12:00 Session T2
Chair: Bin Dong

- **10:30-11:10** **Yifei Lou**, The Difference of L_1 and L_2 for Compressive Sensing and Image Processing
- **11:10-11:50** **Myung-Joo Kang**, Mathematical Approach for Defect Inspection: Image Processing and Deep Learning

12:00-13:30 Lunch

13:30-15:50 Session T3
Chair: Xiaoqun Zhang

- **13:30-14:30** **Jean-Michel Morel**, Image denoising: a fusion of two theories
- **14:30-15:10** **Hui Ji**, Removing rain streaks from a single image via discriminative sparse coding
- **15:10-15:50** **Xuecheng Tai**, Nonlocal graph TV for variational semi-supervised learning and clustering and fast algorithms

15:50-16:10 Coffee Break

16:10-17:40 Session T4
Chair: Jian-Feng Cai

- **16:10-17:10** **Hongkai Zhao**, Geometric understanding and analysis of unstructured data
- **17:00-17:40** **Xiaoqun Zhang**, Redundancy and sparsity exploiting for Dynamic Image reconstruction and segmentation

18:30 Dinner

August 5, Friday

09:00-10:40 Session F1
Chair: Zaiwen Wen

- **09:00-10:00 Zuowei Shen**, Image Restoration: A Data-Driven Perspective
- **10:00-10:40 Yuan Yao**, Linearized Bregman Path Algorithms–Statistical Consistency and New Applications

10:40-11:00 Coffee Break

11:00-12:20 Session F2
Chair: Rongjie Lai

- **11:00-11:40 Zaiwen Wen**, Semi-smooth Second-order methods for composite convex programs
- **11:40-12:20 Wotao Yin**, Coordinate Update Algorithms for Image Processing and Machine Learning

12:20-14:00 Lunch

14:00-16:00 Session F3
Chair: Yifei Lou

- **14:00-14:40 Michael Ng**, Some Regularization Models for Data Classification
- **14:40-15:20 Justin Wan**, Unsupervised Cell Image Segmentation via RPCA and Spectral Clustering
- **15:20-16:00 Jian-Feng Cai**, Fast and Provable Algorithms for Spectrally Sparse Signal Reconstruction via Low-Rank Hankel Matrix Completion

16:00-16:20 Coffee Break

16:20-18:00 Session F4
Chair: Hongkai Zhao

- **16:20-17:00 Bin Dong**, Sparse approximation: from image restoration to high dimensional classification

18:15 Dinner

Abstracts

.
. viii

Overcoming the curse of dimensionality for certain Hamilton-Jacobi (HJ)equations arising in control theory and elsewhere,
Stanley Osher, UCLA, USA ix

Solve Geometric PDEs on Manifolds Represented as Point Clouds and Applications,
Rongjie Lai, RPI, USA x

The Difference of L_1 and L_2 for Compressive Sensing and Image Processing,
Yifei Lou, UT Dallas, USA xi

Mathematical Approach for Defect Inspection : Image Processing and Deep Learning,
Myungjoo Kang, Seoul National University, South Korea xii

Image denoising: a fusion of two theories,
Jean-Michel Morel, École Normale Supérieure de Cachan, France xiii

Linearized Bregman Path Algorithms–Statistical Consistency and New Applications,
Yuan Yao, PKU, China xiv

Nonlocal graph TV for variational semi-supervised learning and clustering and fast algorithms,
Xue-Cheng Tai, University of Bergen, Norway xv

Geometric understanding and analysis of unstructured data,
Hongkai Zhao, UC Irvine, USA xvi

Redundancy and sparsity exploiting for Dynamic Image reconstruction and segmentation,
Xiaoqun Zhang, SJTU, China xvii

Image Restoration: A Data-Driven Perspective,
Zuowei Shen, National University of Singapore, Singapore xviii

Removing rain streaks from a single image via discriminative sparse coding,
Hui Ji, National University of Singapore, Singapore xix

Semi-smooth Second-order methods for composite convex programs,
Zaiwen Wen, PKU, China xx

Coordinate Update Algorithms for Image Processing and Machine Learning,
Wotao Yin, UCLA, USA xxi

Unsupervised Cell Image Segmentation via RPCA and Spectral Clustering,
Justin Wan, University of Waterloo, Canada xxii

Some Regularization Models for Data Classification,
Michael Ng, HKBU, Hong Kong, China xxiii

Fast and Provable Algorithms for Spectrally Sparse Signal Reconstruction via Low-Rank Hankel Matrix Completion,
Jian-Feng Cai, HKUST, Hong Kong, China xxiv

Sparse approximation: from image restoration to high dimensional classification,
Bin Dong, PKU, China xxv

Overcoming the curse of dimensionality for certain Hamilton-Jacobi (HJ)equations arising in control theory and elsewhere

Stanley Osher, UCLA, USA

It is well known that certain HJ PDE's play an important role in analyzing continuous dynamic games and control theory problems. The cost of standard algorithms, and, in fact all PDE grid based approsimations is exponential in the space dimension and time, with huge memory requirements. Here we propose and test methods for solving a large class of HJ PDE relevant to optimal control without the use of grids or numerical approximations. Rather we use rhe classical Hopf formulas for solving initial value problems for HJ PDE. We have noticed that if the Hamiltonian is convex, (this can be relaxed for differential games applications) and positively homogeneous of degree one that very fast methods (related to those used in compressed sensing) exist to solve the resulting optimization problem. We seem to obtain methods which are polynomial in dimension. We can evaluate the solution in very high dimensions in between 10^{-4} and 10^{-8} seconds per evaluation on a laptop. The method requires very limited memory and is almost perfectly parallelizable.

In addition, as a step often needed in this procedure, we have developed a new and equally fast and efficient method to find, in very high dimensions, the projection of a point exterior to a compact set A onto A. We can also compute the distance to such sets much faster than fast marching or fast sweeping algorithms.

The term "curse of dimensionality" was coined by Richard Bellman in 1957 when he did his pioneering work on dynamic optimization.

This is a joint work with Jerome Darbon and others.

Solve Geometric PDEs on Manifolds Represented as Point Clouds and Applications

Rongjie Lai, RPI, USA

Analyzing and inferring the underlying global intrinsic structures of data from its local information are critical in many fields. In practice, coherent structures of data allow us to model data as low dimensional manifolds, represented as point clouds, in a possible high dimensional space. It is a challenge to extract global geometric information hidden in the point clouds due to the lack of global connectivity. In our recent work, systematical numerical methods are proposed to solving PDEs on manifolds sampled as point clouds. These methods can achieve high order accuracy and enjoy flexibility of solving different type of equations on manifolds with possible high co-dimesion. We use the proposed methods to consider special designed geometric PDEs on point clouds, which provides us a bridge to link local and global information. Based on this method, I will discuss a few applications to geometric understanding for point clouds, including computation of LB eigen-systems for point clouds, extraction of global skeletons structure from point clouds, extraction of conformal structures from point clouds, and intrinsic comparisons among point clouds etc. In addition, our methods can also be extended to solve PDEs on manifolds only represented as incomplete distance information. I will also demonstrate our preliminary results of this method for reconstructing and understanding distance data based on solutions of Laplace-Beltrame equations.

The Difference of L_1 and L_2 for Compressive Sensing and Image Processing

Yifei Lou, UT Dallas, USA

A fundamental problem in compressed sensing (CS) is to reconstruct a sparse signal under a few linear measurements far less than the physical dimension of the signal. Currently, CS favors incoherent systems, in which any two measurements are as little correlated as possible. In reality, however, many problems are coherent, in which case conventional methods, such as L_1 minimization, do not work well. In this talk, I will present a novel non-convex approach, which is to minimize the difference of L_1 and L_2 norms (L_1-L_2) in order to promote sparsity. Some theoretical aspects of L_1-L_2 minimization are discussed and efficient minimization algorithms are constructed and analyzed based on the difference of convex (DC) function methodology. The resulting DC algorithms can be viewed as convergent and stable iterations on top of L_1 minimization. Experiments demonstrate that L_1-L_2 improves L_1 consistently and it outperforms L_p ($0 < p < 1$) for highly coherent matrices. Finally, a recovery problem of point sources in 1D and 2D signal from a set of low-frequency measurements will be present, showing advantages of L_1-L_2 over L_1 when a necessary condition for perfect reconstruction is not satisfied [1]. This talk is in a collaboration with Penghang Yin and Jack Xin at University of California Irvine.

[1]. E. J. Candés and C. Fernandez-Granda, Towards a mathematical theory of super-resolution, *Comm. Pure Appl. Math.* , **67**(6) (2014), 906-956.

Mathematical Approach for Defect Inspection : Image Processing and Deep Learning

Myungjoo Kang, Seoul National University, South Korea

Image processing is one of the mostly increasing areas in computer science. As technology advances, the analog imaging is switched to the digital system now-a-days. Every day, we capture huge amount of images which are very difficult to maintain manually within a certain period of time. So the concept and application of the digital imaging grows rapidly. Digital image processing is used to extract various features from images. This is done by computers automatically without or with little human intervention. One of the most important operations on digital image is to identify and classify various kinds of defects.

Thus to detect the defects from any image some methods are established and placed at three levels. At the lowest level, some techniques are available which deal directly with the raw, possibly noisy pixel values, with denoising and edge detection being good examples. In the middle there are algorithms which utilize low level results, such as segmentation and edge linking. At the highest level are those methods which attempt to extract semantic meaning from the information provided by the lower level.

To get good examples from raw images, denoising methods have been researched various ways. In this paper, we introduce simple denoising methods like Gaussian smoothing and nonlinear denoising method. Then we deal with edge detection and segmentation using Mumford-Shah segmentation method which widely known as Mumford-Shah functional

$$E(f,\Gamma) = \mu^2 \int_{\mathbb{R}} (f-g)^2 + \int_{\mathbb{R}-\Gamma} |\nabla f|^2 + \nu|\Gamma|.$$

After we do segmentation for semiconductor images, we have to find corresponding feature parts for each images. We use fast normalized cross correlation method for matching each feature parts in each images therefore we can decide how to compare each images with resonable image registration.

Image denoising: a fusion of two theories

Jean-Michel Morel, École Normale Supérieure de Cachan, France

In this talk I will explain how the state of the art image denoising algorithms manage an unexpected collaboration of two apparently adverse mathematical approaches: wavelet thresholding and non local Bayesian estimation. This hopefully gives a new insight into the structure of images.

Linearized Bregman Path Algorithms–Statistical Consistency and New Applications

Yuan Yao, PKU, China

Estimate or recovery of sparse parameters from their noisy measurements is a fundamental problem in high dimensional statistics and compressed sensing, etc. In the past two decades, convex regularization approach such as LASSO or BPDN has been made popular for its algorithmic tractability. However, a well-known shortcoming of LASSO and any convex regularizations lies in the bias of estimators, which motivates further investigation of nonconvex regularization yet suffering the computational hurdle. Here we bring an idea based on some dynamics developed in applied mathematics to address this challenge in statistics. Such dynamics can be shown to traverse a path passing through the oracle estimator, an unbiased estimate of the true parameter whose entries have the same signs as those of the true signs, while the LASSO regularization path always deviates from that due to its bias. A discretization of the dynamics leads to the Linearized Bregman iteration algorithm, which is a simple iterative thresholding rule and easy to parallelize in favor of big data analysis. This approach adapts to various sparse regularizations, including logistic regression, fused lasso, matrix regression, and graphical models etc. In particular, equipped with variable splitting for structural sparsity, it leads to improved model selection consistency than generalized LASSO in both theory and applications. New application examples will be demonstrated in statistical ranking, social networks, and computational biology etc., together with a new R package–Libra.

Nonlocal graph TV for variational semi-supervised learning and clustering and fast algorithms

Xue-Cheng Tai, University of Bergen, Norway

In this talk, we first show the essential ideas to use graph cut for data clustering. Then we present some recent developed continuous max-flow model and algorithms. Afterwards, we show the application of these models and algorithms for machine learning and data clustering.

One essential ingradient is to use nonlocal total variation and Laplacian to formulate a the problem as a graph cut. We propose an algorithm for semi-supervised clustering of high-dimensional data. The data points are modeled as vertices of a weighted graph, and the labeling function defined on each vertex takes values from the unit simplex, which can be interpreted as the probability of belonging to each class. The algorithm is proposed as a minimization of a convex functional of the labeling function. There are two versions of the models. The first one combines the Rayleigh quotient for the graph Laplacian and a region-force term, and the second one only replaces the Rayleigh quotient with the total variation of the labeling function. The region-force term is calculated by the affinity between each vertex and the training samples, characterizing the conditional probability of each vertex belonging to each class. The numerical methods for solving these two versions of the proposed algorithm are presented, and both are tested on several benchmark data sets such as handwritten digits (MNIST) and moons data. Experiments indicate that the correction rates and the computational speed are competitive with the state-of-the-art in multi-class semi-supervised clustering algorithms. Especially, the new models produces substantial improvements of the classification accuracy in comparison with the corresponding models without the regional force in cases that the sampling rate is relatively low.

This is joint work with Ke Yin and Stanley Osher.

Geometric understanding and analysis of unstructured data

Hongkai Zhao, UC Irvine, USA

One of the simplest and most natural ways of representing geometry and information in three and higher dimensions is using point clouds, such as scanned 3D points for shape modeling and feature vectors viewed as points embedded in high dimensions for general data analysis. Geometric understanding and analysis of point cloud data poses many challenges since they are unstructured, for which a global mesh or parametrization is difficult if not impossible to obtain in practice. Moreover, the embedding is highly non-unique due to rigid and non-rigid transformations. In this talk, I will present some of our recent work on geometric understanding and analysis of point cloud data. I will first discuss a multi-scale method for non-rigid point cloud registration based on the Laplace-Beltrami eigenmap and optimal transport. The registration is defined in distribution sense which provides both generality and flexibility. If time permits I will also discuss solving geometric partial differential equations directly on point clouds and show how it can be used to "connect the dots" to extract intrinsic geometric information for the underlying manifold.

Redundancy and sparsity exploiting for Dynamic Image reconstruction and segmentation

Xiaoqun Zhang, SJTU, China

Dynamic medical imaging, such as dynamic PET/MRI/Ultrasound, are useful for the characterization of physiology process and assistance for operation navigation. In this talk, I will illustrate how we make use of data redundancy and sparsity in dynamic images for two medical imaging application : dynamic parallel MRI (pMRI) reconstruction and ultrasound video segmentation. For dynamic pMRI, the problem of the central importance is to acquire less data in k-space domain while maintaining the quality of reconstructed images. By exploiting the between-frame redundancy of dynamic parallel MRI data, we propose a temporal-spatial low rank matrix based model for coil sensibility auto-calibration and then whole data set reconstruction. Numerical experiments on several highly subsampled data demonstrate that the proposed approach outperforms other state-of-the-art methods for cablirationless dynamic pMRI reconstruction. The another application is on ultrasound videos region-of-interest segmentation, which is a challenging task due to low image quality and real-time computation requirement for surgery navigation. We tackle the problem by using wavelet frames and incorporating the noise statistics under a variational framework. The continuity and regularity of the moving boundary is effectively incorporated via weighted sparse regularization, without introducing a heavy computational burden. The overall method can be efficiently solved with recently-developed fast algorithms, making it useful in real-time clinical applications.

Image Restoration: A Data-Driven Perspective

Zuowei Shen, National University of Singapore, Singapore

We are living in the era of big data. The discovery, interpretation and usage of the information, knowledge and resources hidden in all sorts of data to benefit human beings and to improve everyone ' s day to day life is a challenge to all of us. The huge amount of data we collect nowadays is so complicated, and yet what we expect from it is so much. It is hard to imagine that one can characterize these complicated data sets and solve real life problems by solving merely a few mathematical equations. However, generic mathematical models can be used to obtain a coarse level approximation (or low accuracy solution) to the answers we are seeking. The first question is how to use generic prior knowledge of the underlying solutions of the problem in hand and to set up a proper model for a good low level approximation? The second question is whether we are able to use the knowledge and information from the approximate solution derived from the given data to further improve the model itself so that more accurate solutions can be obtained? That is: how to engage an interactive data-driven approach to solve complex problems?

As images are one of the most useful and commonly used types of data, in this talk, we review the development of the wavelet frame (or more general redundant system) based approach for image restoration from a data-driven perspective. We will observe that a good system for approximating any function, including images, should be capable of effectively capturing both global patterns and local features of the function. A wavelet frame is one of the examples of such system. We will show how algorithms of wavelet frame based image restoration are developed via the generic knowledge of images. Then, we will show how specific information of a given image can be used to further improve the models and algorithms. Through this process, we shall reveal some insights and understandings of the wavelet frame based approach for image restoration. We hope that this also leads to new ideas on how to analyze more complex data sets generated from other real life problems.

Removing rain streaks from a single image via discriminative sparse coding

Hui Ji, National University of Singapore, Singapore

Visual distortions on images caused by bad weather conditions can have a negative impact on the visio systems used in surveillance and robotics. One often seen bad weather is rain which causes significant yet complex local intensity fluctuations in images. In this talk, we will present an effective blind source separation algorithm to remove visual effects of rain from a single rainy image, i.e. separate the rain layer and the derained image layer from a rain image. The proposed approach is built on a nonlinear generative model of rain image, namely screen blend model, and the basic idea for blind source separation is to sparsely approximate the patches of two layers by very high discriminative codes over a learned dictionary with strong mutual exclusivity property. Such discriminative sparse codes lead to accurate separation of two layers from their non-linear composite.

Semi-smooth Second-order methods for composite convex programs

Zaiwen Wen, PKU, China

The goal of this paper is to study approaches to bridge the gap between first-order and second-order type methods for composite convex programs. Our key observations are: i) Many well-known operator splitting methods, such as forward-backward splitting (FBS) and Douglas-Rachford splitting (DRS), actually define a fixed-point mapping; ii) The optimal solutions of the composite convex program and the solutions of the system of nonlinear equations derived from the fixed-point mapping are equivalent. Solving the system of nonlinear equations rediscovers a paradigm on developing second-order methods. Although these nonlinear equations may be non-differentiable, they are often semi-smooth and its generalized Jacobian matrix is positive semidefinite due to monotonicity. By combining a regularization approach and a known hyperplane projection technique, we propose an adaptive semi-smooth Newton method and establish its convergence to global optimality. In practice, the second-order methods can be activated until the first-order type methods reach a good neighborhood of the global optimal solution. Preliminary numerical results on ℓ_1-minimization problems demonstrate that our second-order type algorithms are able to achieve quadratic or superlinear convergence as long as the fixed-point residual of the initial point is small enough.

Coordinate Update Algorithms for Image Processing and Machine Learning

Wotao Yin, UCLA, USA

This talk focuses on a class of algorithms, called coordinate update algorithms, which are useful at solving large-sized problems involving linear and nonlinear mappings, and smooth and nonsmooth functions. They decompose a problem to simple subproblems, where each subproblem updates one, or a small block of, variables each time. They have found applications throughout signal/imaging processing, differential equations, and machine learning. We abstract many problems to the fixed-point problem $x^{k+1} = Tx^k$. This talk discusses the favorable structures of the operator T that enable highly efficient coordinate update iterations. It can be carried out in sequential, parallel, or async-parallel fashions. We introduce new scalable coordinate-update algorithms to many problems involving coupling constraints $Ax = b$, composite nonsmooth functions $f(Ax)$, and large-scale data. We will present a software package and its numerical examples. This is joint work with Brent Edmunds, Zhimin Peng and Tianyu Wu (UCLA), Yangyang Xu (Alabama), and Ming Yan (MSU).

Unsupervised Cell Image Segmentation via RPCA and Spectral Clustering

Justin Wan, University of Waterloo, Canada

Segmentation of cells in time-lapse bright-field microscopic images is crucial in understanding cell behaviors for medical research. However, the complex nature of the cells, together with poor contrast, broken cell boundaries and the halo artifact, pose nontrivial challenges to this problem. In this talk, we present two robust mathematical models to segment bright-field cells automatically. These models treat cell image segmentation as a background subtraction problem, which can be formulated as a Principal Component Pursuit (PCP) problem. Our first segmentation model is formulated as a PCP with nonnegative constraints. In this approach, we exploit the sparse component of the PCP solution for identifying the cell pixels. However, the sparse component and the nonzero entries can scatter all over the image, resulting in a noisy segmentation. The second model is an improvement of the first model by combining PCP with spectral clustering. Seemingly unrelated approaches, we combine the two techniques by incorporating normalized-cut in the PCP as a measure for the quality of the segmentation. Experimental results demonstrate that the proposed models are effective in segmenting cells obtained from bright-field images.

Some Regularization Models for Data Classification

Michael Ng, HKBU, Hong Kong, China

In this talk, we discuss some regularization models for data classification. They include singular value decomposition and graph. Experimental results are reported to illustrate the effectiveness of the proposed methods.

Fast and Provable Algorithms for Spectrally Sparse Signal Reconstruction via Low-Rank Hankel Matrix Completion

Jian-Feng Cai, HKUST, Hong Kong, China

A spectrally sparse signal of order r is a mixture of r damped or undamped complex sinusoids. In this talk, we consider the problem of reconstructing spectrally sparse signals from a random subset of n regular time domain samples, which can be reformulated as a low rank Hankel matrix completion problem. We introduce a fast iterative hard thresholding (FIHT) algorithm for efficient reconstruction of spectrally sparse signals via low rank Hankel matrix completion. Theoretical recovery guarantees have been established for FIHT, showing that $O(r^2 \log^2(n))$ number of samples are sufficient for exact recovery with high probability. Empirical performance comparisons establish significant computational advantages for FIHT. In particular, numerical simulations on 3D arrays demonstrate the capability of FIHT on handling large and high-dimensional real data. This is a joint work with Tianming Wang and Ke Wei.

Sparse approximation: from image restoration to high dimensional classification

Bin Dong, PKU, China

The first half of my talk reviews some of our work on sparse approximation in image restoration. In a series of four papers, we established rigorous connections between wavelet frame transforms and differential operators in variational framework, as well as for nonlinear evolution PDEs. Such connections not only provide us with new and fascinating insights on both wavelet frame and differential operator based approaches for image restoration, but also enable us to introduce new models and algorithms that combine the merits of both approaches. In the second half of my talk, I will discuss how these findings from image restoration can further guide us in the process and analysis of more general data sets in high dimensional spaces, such as graph data.

The organizing committee wishes you a wonderful stay in BICMR!