

International Workshop on

Regularization Theory of Unstructured Data

Fudan University, Shanghai, China May 15-16, 2015



Fudan University, Shanghai, China

May 15-16, 2015

VENUE:

Room 1801, East Guanghua Main Building, School of Mathematical Sciences
Fudan University, No. 220 Handan Road, Shanghai, China





TABLE OF CONTENTS

SCIENTIFIC PROGRAM.....	1
MAP OF FUDAN.....	4
WIRELESS AND SHUTTLEBUS.....	5
TITLES AND ABSTRACTS.....	6

PLENARY SPEAKERS:

Bernd Hofmann (TU Chemnitz, Germany)
Peter Mathé (WIAS, Germany)
Sergei V Pereverzev (RICAM, Austria)
Zuowei Shen (NUS, Singapore)

INVITED SPEAKERS:

Galyna Kriukova (RICAM, Austria)
Yikan Liu (U. Tokyo, Japan)
Xiliang Lu (Wuhan U., China)
Zhifeng Pang (Henan U., China)
Sergiy Pereverzyev – Jr. (U. Innsbruck, Austria)
Lei Shi (Fudan U., China)
Pavlo Tkachenko (RICAM, Austria)
Wei Wang (Jiaxin U., China)
Haijun Yu (CAS, China)
Jie Zhang (Fudan U., China)
Xiaoqun Zhang (SJTU, China)

LOCAL ORGANIZER:

Jin Cheng (Fudan U., China)
Gang Bao (Zhejiang U., China)
Weiguo Gao (Fudan U., China)
Wenbin Chen (Fudan U., China)
Shuai Lu (Fudan U., China)
Xiang Xu (Zhejiang U., China)

SPONSORED BY:

Major State Basic Research Development Program of China (973 Program)
National Science Foundation of China
National Science Foundation of China (Tianyuan Special Fund)
Science and Tech. Commission of Shanghai Municipality
111 Project



International Workshop on Regularization Theory of Unstructured Data

May 15-16, 2015 Fudan University

Program

	Morning Session	Afternoon Session
May 15 (Friday)	09:30 AM—10:30 AM Zuowei Shen	14:00PM—14:30 PM Xiaoqun Zhang
		14:30PM—15:00 PM Sergiy Pereverzyev – Jr.
	10:30 AM —10:40 AM Break	15:00 PM—15:30 PM Tea break
	10:40 AM—11:40 AM Bernd Hofmann	15:30 PM—16:00 PM Xiliang Lu
		16:00 PM—16:30 PM Haijun Yu
		16:30 PM—17:00 PM Yikan Liu
	Lunch at Danyuan 3 rd floor	Conference dinner at Xingchen restaurant
May 16 (Saturday)	09:30 AM—10:30 AM Sergei V Pereverzev	14:00PM—14:30 PM Lei Shi
		14:30PM—15:00 PM Galyna Kriukova
	10:30 AM —10:40 AM Break	15:00 PM—15:30 PM Tea break
	10:40 AM—11:40 AM Peter Mathé	15:30 PM—16:00 PM Jie Zhang
		16:00 PM—16:30 PM Pavlo Tkachenko
16:30 PM—17:00 PM Wei Wang		
Lunch at Danyuan 3 rd floor	Dinner at Danyuan 3 rd floor	

Friday: May 15th

Morning session: Chairman: Sergei V Pereverzev

- 09:30-10:30 am Zuowei Shen (Singapore)
Image restoration: a data-driven perspective
- 10:30-10:40 am *break*
- 10:40-11:40 am Bernd Hofmann (Germany)
New aspects concerning the capability of variational source conditions in regularization
- 11:40-14:00 pm Lunch at Fudan University, Danyuan Restaurant 3rd floor

Afternoon session: Chairman: Peter Mathé

- 14:00-14:30 pm Xiaoqun Zhang (China)
Fast sparse reconstruction: greedy inverse scale space flows
- 14:30-15:00 pm Sergiy Pereverzyev Jr. (Austria)
On the choice of kernels for a combination of downward continuation and local approximation of harmonic potentials
- 15:00-15:30 pm *Tea break*
- 15:30-16:00 pm Xiliang Lu (China)
ADMM for the inverse problems
- 16:00-16:30 pm Haijun Yu (China)
A phase field model for road structure reconstruction from scattered Taxi GPS trajectory data
- 16:30-17:00 pm Yikan Liu (China)
Inverse source problem for a double hyperbolic equation modeling the three-dimensional time cone model
- 18:00pm Conference dinner at Xingchen Restaurant
(No. 2009, Road Huangxing, Shanghai)
17:30 PM Shuttle bus at East Guanghai Main building entry

Saturday: May 16th

Morning session: Chairman: Bernd Hofmann

- 09:30-10:30 am Sergei V Pereverzev (Austria)
Regularized ranking I: Theoretical aspects
- 10:30-10:40 am *break*
- 10:40-11:40 am Peter Mathé (Germany)
Some information-based complexity (IBC) for ill-posed equations
- 11:40-14:00 pm Lunch at Fudan University, Danyuan Restaurant 3rd floor

Afternoon session: Chairman: Sergiy Pereverzyev – Jr.

- 14:00-14:30 pm Lei Shi (China)
Correntropy Induced Loss for Regression
- 14:30-15:00 pm Galyna Kriukova (Austria)
Regularized ranking II: Aggregation by linear functional strategy
- 15:00-15:30 pm *Tea break*
- 15:30-16:00 pm Jie Zhang (China)
Data science and Neuroscience
- 16:00-16:30 pm Pavlo Tkachenko (Austria)
Regularized ranking III: Application in Diabetes Technology
- 16:30-17:00 pm Wei Wang (China)
A global minimization algorithm for Tikhonov functionals with nonlinear operator and non-smooth constraints
- 17:20 pm Dinner at Fudan University, Danyuan Restaurant 3rd floor

2D-Fudan Campus Map



3D-Fudan Campus Map



Detailed information:

A: The conference venue: Room 1801, East Guanghualou

B: Fudan University, Danyuan Restaurant

C: East gate to Fudan Campus

D & Black line: Road Guoding

Wireless service:

Please choose wifi with the name 'fduwireless'

Login Account: ip2015

Login Passwords: ip20151234

Shuttle bus service:

May 15

08:50 AM Ramada Hotel Wujiaochang Lobby ---- Conference Venue

17:30 PM Conference Venue ---- Xingchen Restaurant (Dinner)

May 16

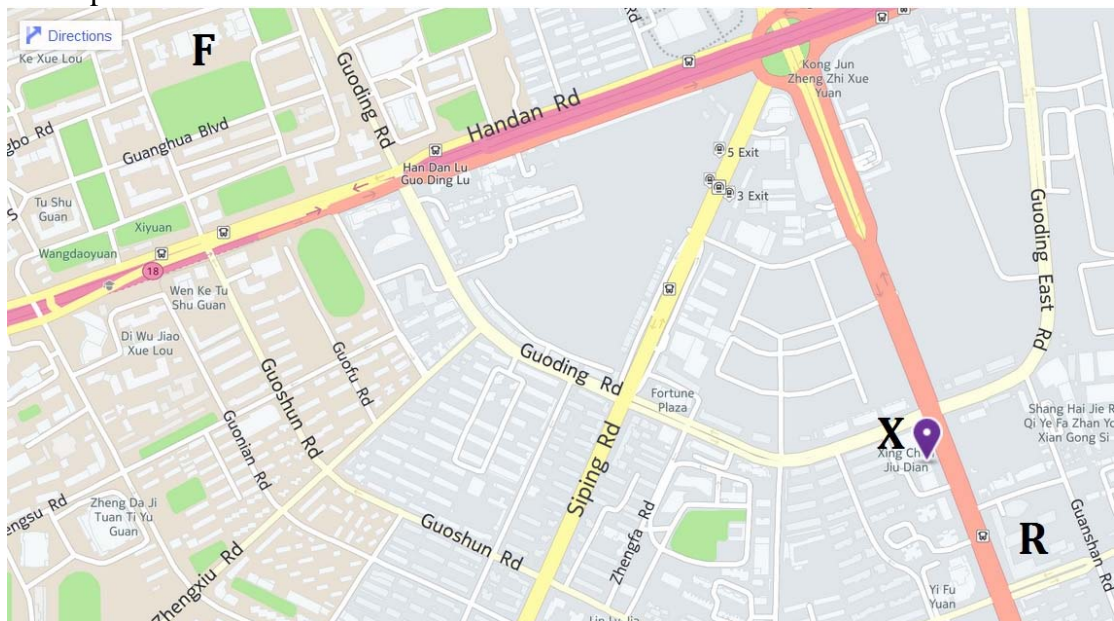
08:50 AM Ramada Hotel Wujiaochang Lobby ---- Conference Venue

Conference Dinner

Xingchen Restaurant

Address: No. 2009, Road Huangxing, Shanghai

Telephone: 021-55097877



F: Fudan University (Conference Venue)

X: Xingchen Restaurant

R: Ramada Hotel Wujiaochang

Contact Person:

Shuai Lu: 0086-15021103548

Titles and abstracts (May 15)

Zuowei Shen

Department of Mathematics
National University of Singapore
10 Lower Kent Ridge Road, Singapore, 119076

Email: matzuows@nus.edu.sg

Title:

Image restoration: a data-driven perspective

Abstracts:

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 a system. We will show how algorithms of the 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 analyse more complex data sets generated from other real life problems.

Titles and abstracts (May 15)

Bernd Hofmann

Technische Universität Chemnitz
Fakultät für Mathematik
Reichenhainer Str. 39/41, D-09107 Chemnitz, Germany

Email: hofmannb@mathematik.tu-chemnitz.de

Title:

New aspects concerning the capability of variational source conditions in regularization

Abstracts:

It is well-known for thirty years that specific conditions concerning the smoothness of solutions are required in order to obtain convergence rates in regularization of ill-posed problems formulated as linear or nonlinear operator equations in Hilbert spaces. Originally, rate results for such problems were based on source conditions of range-type, i.e. the solution has to belong to the range of some linear operator closely connected with the forward operator or its linearization. Since ten years range-type source conditions also play a prominent role for convergence rates in Banach space regularization. However, in the case of nonlinear ill-posed equations in Hilbert and Banach spaces additional conditions with respect to the structure of nonlinearity of the forward operator are necessary. It is a substantial advantage of variational source conditions, which have been developed since 2007, that they combine solution smoothness and nonlinearity conditions. Variational source conditions express the interplay of error terms in the preimage space and changes of the forward operator in the image space in form of variational inequalities which have to be satisfied for all regularized solutions under consideration.

In this talk, based on variational source conditions, there are presented new results on Tikhonov-type l^1 -regularization for linear ill-posed problems with injective forward operators under the condition that the sparsity assumption slightly fails, but the solution is still in l^1 . Specifically, new ideas refer to the improvement of recently published convergence rates results and their extension to non-compact linear forward operators. One part of the talk is devoted to the relationships between Nashed's types of illposedness and mapping properties of the forward operator like compactness and strict singularity. The focus of another aspect of the talk is on the applicability of variational source conditions to Lavrentiev-type regularization in a Hilbert space setting when the forward operator is monotone. As in Tikhonov-type regularization also in Lavrentiev-type regularization appropriate variational source conditions have the potential to yield convergence rates.

This is joint work with Barbara Kaltenbacher, Elena Resmerita (Alpen Adria University Klagenfurt) and Jens Flemming, Ivan Veselić (TU Chemnitz). The research is partially supported by the Deutsche Forschungsgemeinschaft (DFG) under grant HO 1454/8-2.

Titles and abstracts (May 15)

Xiaoqun Zhang

Institute of Natural Sciences
Shanghai Jiao Tong University
800, Dongchuan Road, 200240, Shanghai, China

Email: xqzhang@sjtu.edu.cn

Title:

Fast sparse reconstruction: greedy inverse scale space flows

Abstracts:

We analyze the connection between the recently proposed adaptive inverse scale space methods for basis pursuit and the well-known orthogonal matching pursuit method for the recovery of sparse solutions to underdetermined linear systems. Furthermore, we propose a new greedy sparse recovery method, which approximates l^1 minimization more closely. A variant of our new approach can increase the support of the current iterate by many indices at once, resulting in an extremely efficient algorithm. Our new method has the advantage that there is a simple criterion to determine a-posteriori if an l^1 minimizer was found. Numerical comparisons with orthogonal matching pursuit, weak orthogonal matching pursuit, hard thresholding pursuit and compressive sampling matching pursuit underline that our methods indeed inherits some advantageous properties from the inverse scale space flow.

Titles and abstracts (May 15)

Sergiy Pereverzyev Jr.

Applied Mathematics Group
Institute of Mathematics
University of Innsbruck
Technikerstraße 13, 7th floor, room 715
6020 Innsbruck, Austria

Email: sergiy.pereverzyev@uibk.ac.at

Title:

On the choice of kernels for a combination of downward continuation and local approximation of harmonic potentials

Abstracts:

Satellite monitoring of Earth's gravity and magnetic fields provides a large amount of data, but in order to obtain high-resolution models of the above mentioned fields, the satellite data should be combined with local (regional) measurements. Recently, a two-step approximation scheme has been proposed with the goal to perform such a combination. This scheme consists in convolving global and local data with scaling and spatially localizing kernels, but the design of these kernels is an issue itself. In this talk, we are going to discuss an adaptive kernel design that in some sense leads to a best overall approximation from local and global data.

The talk is based on the results of the joint research with C. Gerhards (University of Vienna, Austria) and P. Tkachenko (RICAM, Austria).

Titles and abstracts (May 15)

Xiliang Lu

Department of Mathematics
Wuhan University
China

Email: xllv.math@whu.edu.cn

Title:

ADMM for the inverse problems

Abstracts:

Alternative direction method of multiplier (ADMM) have received a lot of attention in last few years due to its efficiency and flexibility. However the most exist convergence studies on ADMM do not cover the ill-posed problem cases. In this work, we prove that ADMM with a proper stopping condition (Morozov's principle) is a regularization method, which explains why ADMM works for the inverse problems. Numerical examples validate our results.

Titles and abstracts (May 15)

Haijun Yu

Institute of Computational Mathematics
Chinese Academy of Sciences (CAS)
P.O. Box 2719, Beijing 100190, China

Email: hjyu@simm.ac.cn

Title:

A phase field model for road structure reconstruction from scattered Taxi GPS trajectory data

Abstracts:

Smart city is one of the most popular big data projects, while Intelligent Transportation System (ITS) is one of the most important part of smart city. In this talk, I will talk about a practical application in ITS, reconstructing urban road structure dynamically using scattered Taxi GPS trajectory data. Several methods will be introduced for this application. We will give special emphasis on a phase field approach, which is used to regularize the scattered and noisy GPS data to get a relatively smooth and meaningful road structure.

Titles and abstracts (May 15)

Yikan Liu

Graduate School of Mathematical Sciences
The University of Tokyo
3-8-1 Komaba, Meguro-ku, Tokyo 153-8914, Japan

Email: ykliu@ms.u-tokyo.ac.jp

Title:

Inverse source problem for a double hyperbolic equation modeling the three-dimensional time cone model

Abstracts:

In this talk, we consider the reconstruction of the nucleation rate in the three-dimensional time cone model, which turns out to be an inverse source problem for a double hyperbolic equation. More precisely, we attempt to recover a spatial component of the nucleation rate by partial interior observation data. After a direct derivation of a hyperbolic-type governing equation from the original model, we prove the global Lipschitz stability for the inverse problem based on a Carleman estimate. Motivated by the iterative thresholding algorithm for the same problem for hyperbolic equations, we develop an iterative thresholding algorithm for the identification. Extensive numerical experiments up to three spatial dimensions demonstrate the efficiency and accuracy of the algorithm.

This is the joint work with Prof. Masahiro Yamamoto (The University of Tokyo) and Dr. Daijun Jiang (Central China Normal University).

Titles and abstracts (May 16)

Sergei V Pereverzev

Johann Radon Institute for Computational and Applied Mathematics,
Austrian Academy and Sciences, Linz A-4040, Austria

Email: sergei.pereverzyev@oeaw.ac.at

Title:

Regularized ranking I: Theoretical aspects.

Abstracts:

We plan to discuss the problem of ranking in its relation to the regularization theory and to other problems of learning theory. We are going to have a look at the state of the art, indicate some open questions and try to provide some answers.

The talk is also a theoretical introduction for the presentations by Galyna Kriukova and Pavlo Tkachenko, both from RICAM, who will present a new ranking strategy and some of possible applications.

Titles and abstracts (May 16)

Peter Mathé

Weierstrass Institute for Applied Analysis and Stochastics
Mohrentstrasse 39, D-10117, Berlin, Germany

Email: mathe@wias-berlin.de

Title:

Some information-based complexity(IBC) for ill-posed equations

Abstracts:

The solution of ill-posed equations $Ax = y$ in Hilbert space often uses noisy data y^δ , i.e., $\|y - y^\delta\| \leq \delta$. This is not a realistic assumption. In both, applications and numerical simulations, discretization of the equation is performed, and it reasonable to ask how much *information* of the data y^δ is required to achieve a given precision for the solution x . This is the subject of *Information-Based Complexity*, and it seems natural to study ill-posed equations within that context.

We will discuss *projection schemes* and put emphasis on the dependency of the achievable accuracy of the amount of data, both for ill-posed equations as above, and *statistical* inverse problems, when the noise is Gaussian white noise.

Titles and abstracts (May 16)

Lei Shi

School of Mathematical Sciences
Fudan University
Handan Road 220, Shanghai 200433, China

Email: leishi@fudan.edu.cn

Title:

Correntropy Induced Loss for Regression

Abstracts:

Within the statistical learning framework, we study the regression model associated with the correntropy induced losses. The correntropy, as a similarity measure, has been frequently employed in signal processing and pattern recognition. Motivated by its empirical successes, we aim at presenting some theoretical understanding towards the maximum correntropy criterion in regression problems.

Titles and abstracts (May 16)

Galyna Kriukova

Johann Radon Institute for Computational and Applied Mathematics,
Austrian Academy and Sciences, Linz A-4040, Austria

Email: galyna.kriukova@oeaw.ac.at

Title:

Regularized ranking II: Aggregation by linear functional strategy

Abstracts:

The solving of ill-posed ranking problems naturally leads to the necessity of employment of a regularization scheme. This topic has been intensively studied in recent years. However, problems such as a choice of regularization parameters remain open. In the present talk we discuss a rather general approach to the regularization in reproducing kernel Hilbert spaces, which is based on the idea of a linear combination of approximations corresponding to different values of the regularization parameters. The coefficients of the linear combination are taken by means of the linear functional strategy. Convergence analysis for learning a target function is provided. The theoretical analysis is illustrated by numerical experiments.

Titles and abstracts (May 16)

Jie Zhang

Center for Computational Systems Biology, Fudan University
Shanghai, China

Email: jzhang080@gmail.com

Title:

Data science and Neuroscience

Abstracts:

Advanced neuroimaging techniques provide us with unprecedentedly large data and the opportunity to understand how brain works. In this talk I will briefly introduce two piece of works that extract key information from large neuroimaging datasets to identify the most significant changes in the brain of autism and to distinguish psychiatric diseases from healthy subjects. The first work adopted meta-analysis that can integrate results from multicenter dataset and achieve a high statistical power in multiple comparisons. In the 2nd work we use deep neural network to learn the time varying Markov transition matrix in the multi-dimensional time series data, and can achieve 100% accuracy in pattern recognition between 6 different psychiatric diseases from healthy subjects.

Titles and abstracts (May 16)

Pavlo Tkachenko

Johann Radon Institute for Computational and Applied Mathematics,
Austrian Academy and Sciences, Linz A-4040, Austria

Email: pavlo.tkachenko@oeaw.ac.at

Title:

Regularized ranking III: Application in Diabetes Technology

Abstracts:

The ranking algorithms have become a standing topic in learning theory recently because of their importance for the development of new decision making (or recommender) systems. Various applications of ranking algorithms include document retrieval, credit-risk screening, collaborative filtering, recommender systems in electronic commerce and internet applications. However, the ranking problem appears also outside of internet-based technologies. In particular, in diabetes treatment the errors occurring during blood glucose monitoring (BGM) have different risks for patient's health. The problem of estimating the risks from meter errors can be seen as a ranking problem.

In this talk, we illustrate how the regularized ranking algorithm can be applied for this purpose. We also discuss the application of aggregation by linear functional strategy to predict the cases of hypoglycemia for diabetes patients.

Titles and abstracts (May 16)

Wei Wang

College of Mathematics, Physics and Information Engineering
Jiaxing University, Zhejiang, China 314001

Email: weiwang_math@126.com

Title:

A global minimization algorithm for Tikhonov functionals with nonlinear operator and non-smooth constraints

Abstracts:

In this paper we present a globally convergent algorithm for the computation of a minimizer of the Tikhonov functional with 2-convex penalty term for nonlinear forward operators. It is interesting that the 2-convex penalty term could be non-smooth term, including the case of $\|x\|_{L^1}$ or TV constraints. The method uses a conjugate gradient descent iteration at decreasing values of the regularization parameter α_j , where the approximation obtained with α_j serves as the initial point for the conjugate iteration. With the discrepancy principle as a global stopping rule the method further yields an automatic parameter choice. Finally, we present some numerical simulations on parameter identification problems to test the performance of the method.