SIAM Conference on IMAGING SCIENCE Program

June 5-8, 2018

University of Bologna

Bologna, Italy

HTTPS://SIAM-IS18.DM.UNIBO.IT

This conference is the biennial activity of the SIAM Activity Group on Imaging Science.

The SIAM Activity Group on Imaging Science brings together SIAM members and other scientists and engineers with an interest in the mathematical and computational aspects of imaging. The activity group organizes the biennial SIAM Conference on Imaging Science, awards the SIAG/IS Best Paper Prize every two years to the authors of the best paper on mathematical and computational aspects of imaging, awards the SIAG/IS Early Career Prize to an outstanding early career researcher in the field of imaging science, and maintains a wiki, a member directory, and an electronic mailing list.

Conference Themes

Reconstruction, enhancement, segmentation, analysis, registration, compression, representation, tomography, machine learning and tracking of two and three dimensional images are vital to many areas of science, medicine, and engineering. The increasingly sophisticated mathematical, statistical and computational methods employed in these research areas are referred to as *Imaging Science*.
These techniques include transform and orthogonal series methods, nonlinear optimization, numerical linear algebra, integral equations, partial differential equations, Bayesian and other statistical inverse estimation methods, operator theory, differential geometry, information theory, interpolation and approximation, inverse problems, computer graphics and vision, stochastic processes, and others.

SIAM-IS18 will exchange research results and address open issues in all the aspects of imaging science and will provide a forum for the presentation of work in imaging science.

Committee

General Co-Chairs

Omar Ghattas	(University of Texas at Austin, USA)
Fiorella Sgallari	(University of Bologna)

Scientific Committee

Marcelo Bertalmío	(University Pompeu Fabra, Spain)
Julianne Chung	(Virginia Tech., USA)
Per Christian Hansen	(Technical University of Denmark, Denmark)
Jari Kaipio	(University of Auckland, New Zealand)
Eric Miller	(Tufts University, USA)
Mila Nikolova	(CNRS ENS Cachan, France)
Ronny Ramlau	(Kepler University Linz, Austria and Johann Radon Institute, Austria)
Carola Schönlieb	(University of Cambridge, United Kingdom)
Gabriele Steidl	(Tech.Univ. Kaiserslautern, Germany)
Xue-Cheng Tai	(Hong Kong Baptist University, Hong Kong, China)
Laura Waller	(University of California Berkeley, USA)
Brendt Wohlberg	(Los Alamos National Laboratory, USA)

Organizing Committee

Carolina Beccari	(Dept. Mathematics, University of Bologna)
Giulio Casciola	(Dept. Mathematics, University of Bologna)
Salvatore Cuomo	(Dept. Mathematics and Applications “Renato Caccioppoli”, University of Naples)
Luigi Di Stefano	(Dept. Computer Science and Engineering, University of Bologna)
Giovanni Dore	(Dept. Mathematics, University of Bologna)
Maurizio Falcone	(Dept. Mathematics, University of Rome “La Sapienza”)
Luca Formaggia	(Dept. Mathematics, Politecnico di Milano)
Patrizio Frosini	(Dept. Mathematics, University of Bologna)
Germana Landi	(Dept. Mathematics, University of Bologna)
Alessandro Lanza	(Dept. Mathematics, University of Bologna)
Damiana Lazzaro	(Dept. Mathematics, University of Bologna)
Roberto Mecca	(University of Bologna and University of Cambridge)
Serena Morigi	(Dept. Mathematics, University of Bologna)
Michele Piana	(Dept. Mathematics, University of Genoa)
Elena Loli Piccolomini	(Dept. Computer Science and Engineering, University of Bologna)
Giulia Scalet	(Dept. Civil Engineering and Architecture, University of Pavia)
Federica Sciacchitano	(Dept. Mathematics, University of Genoa)
Valeria Simoncini	(Dept. Mathematics, University of Bologna)
Giulia Spaletta	(Dept. Statistical Science “Paolo Fortunati”, University of Bologna)
Fabiana Zama	(Dept. Mathematics, University of Bologna)

Contents

General Information

Conference location
Registration Desk
Get-togethers
Sponsors and Exhibitors

General Information

Conference location

The Conference will be held in several locations:

- Tuesday 5 morning, opening session in Aula Magna Santa Lucia (via Castiglione, 36)
- from Tuesday 5 afternoon to the end in
  - Building A and Building B - Room A, B, C, D, E, F, G, H, I, L, M, N, O, P, Q (via B. Andreatta, 8)
  - SP.I.S.A - Aula magna (via Belmeloro, 12)
  - Redenti - Room 1 and Room 2 (via B. Andreatta, 6)
  - Matemates

The map below shows the location of these buildings:

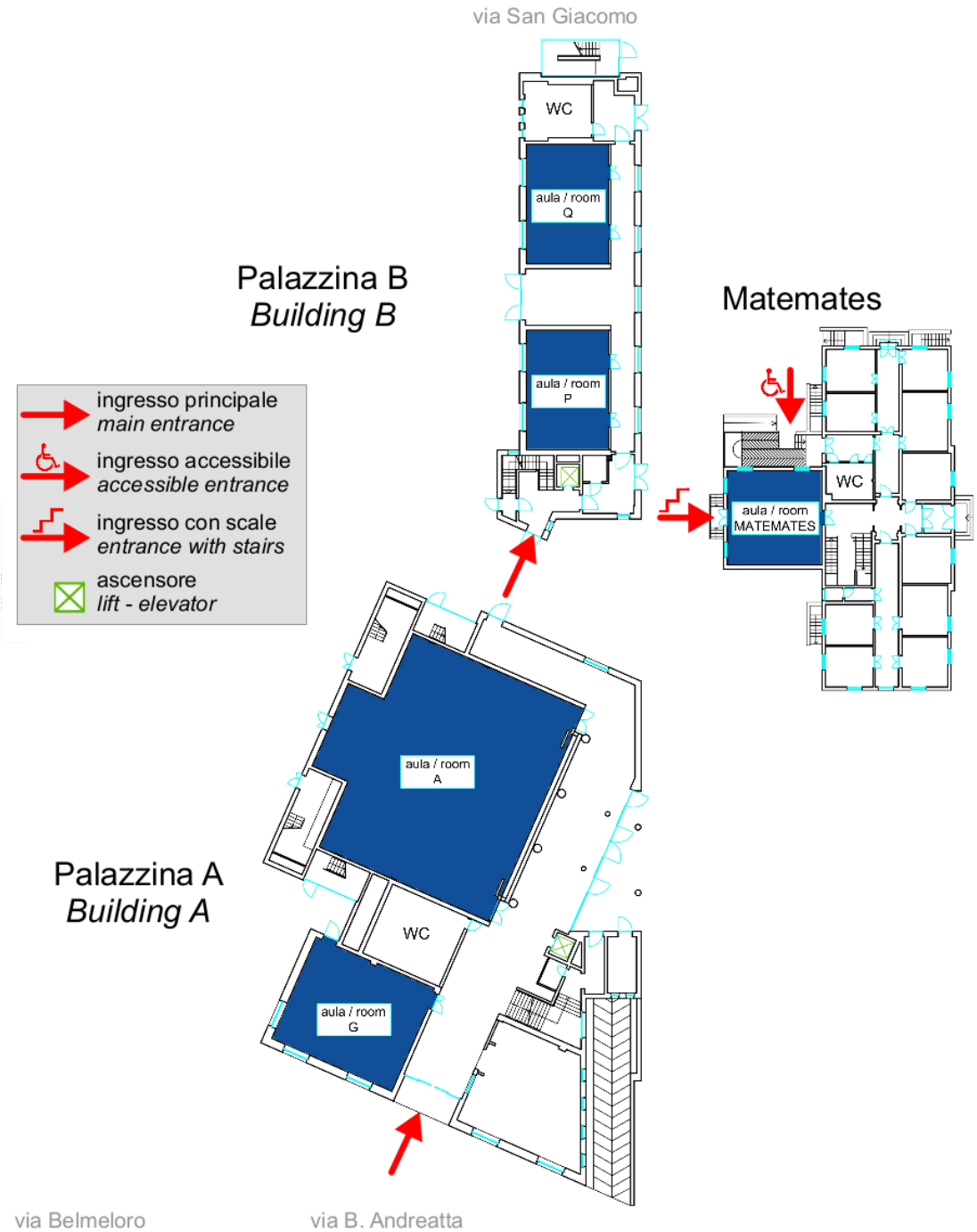
0

GROUND FLOOR – PIANO TERRA

Palazzina A - Building A *(*via B. Andreatta, 8)
Registration desk – Room A – Room G

Palazzina B - Building B *(*via B. Andreatta, 8)
Room Q

Matemates *(*Viale Filopanti, 5)
Room Matemates

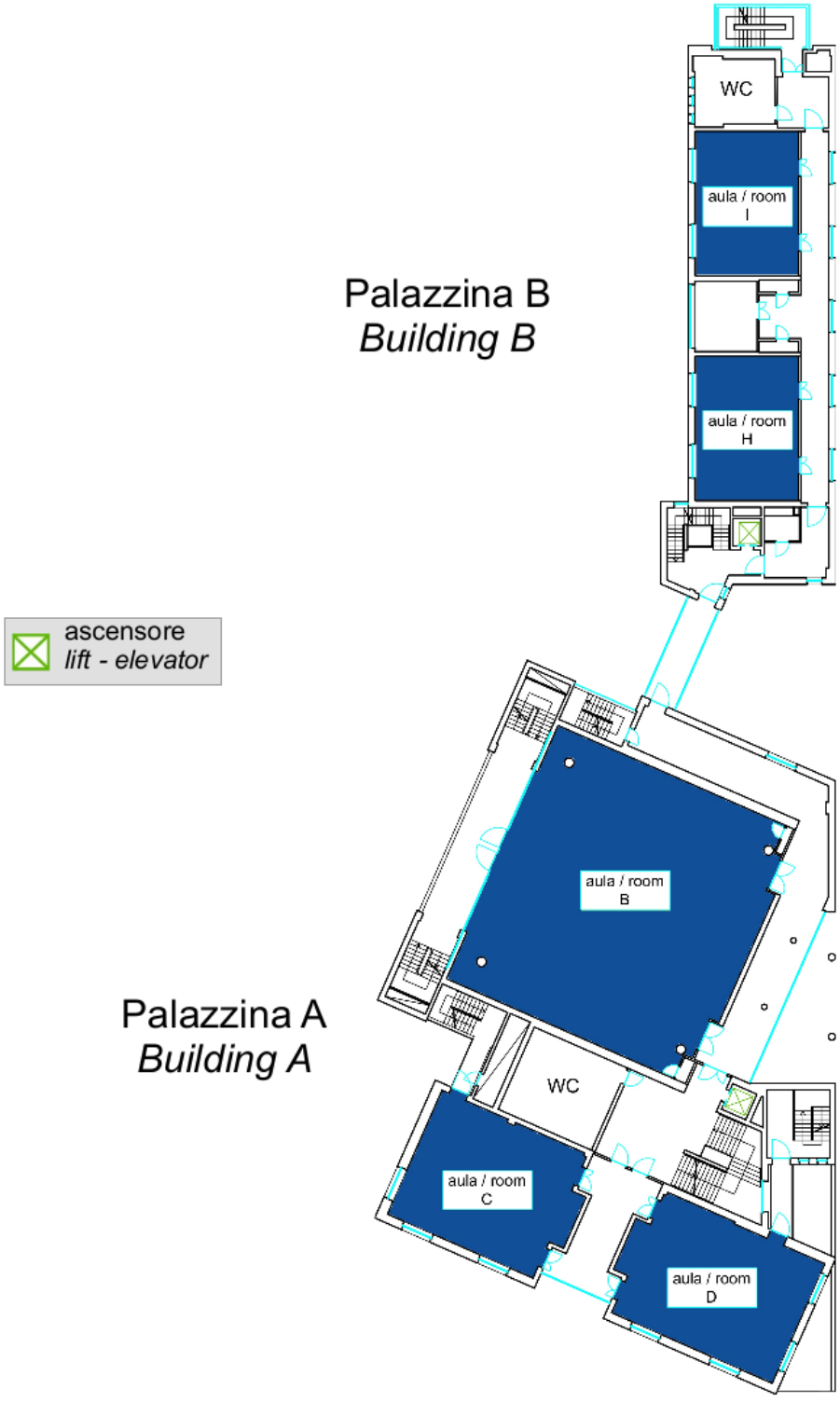


1

FIRST FLOOR – PRIMO PIANO

Palazzina A - Building A (via B. Andreatta, 8)
Room B – Room C – Room D

Palazzina B - Building B (via B. Andreatta, 8)
Room H – Room I

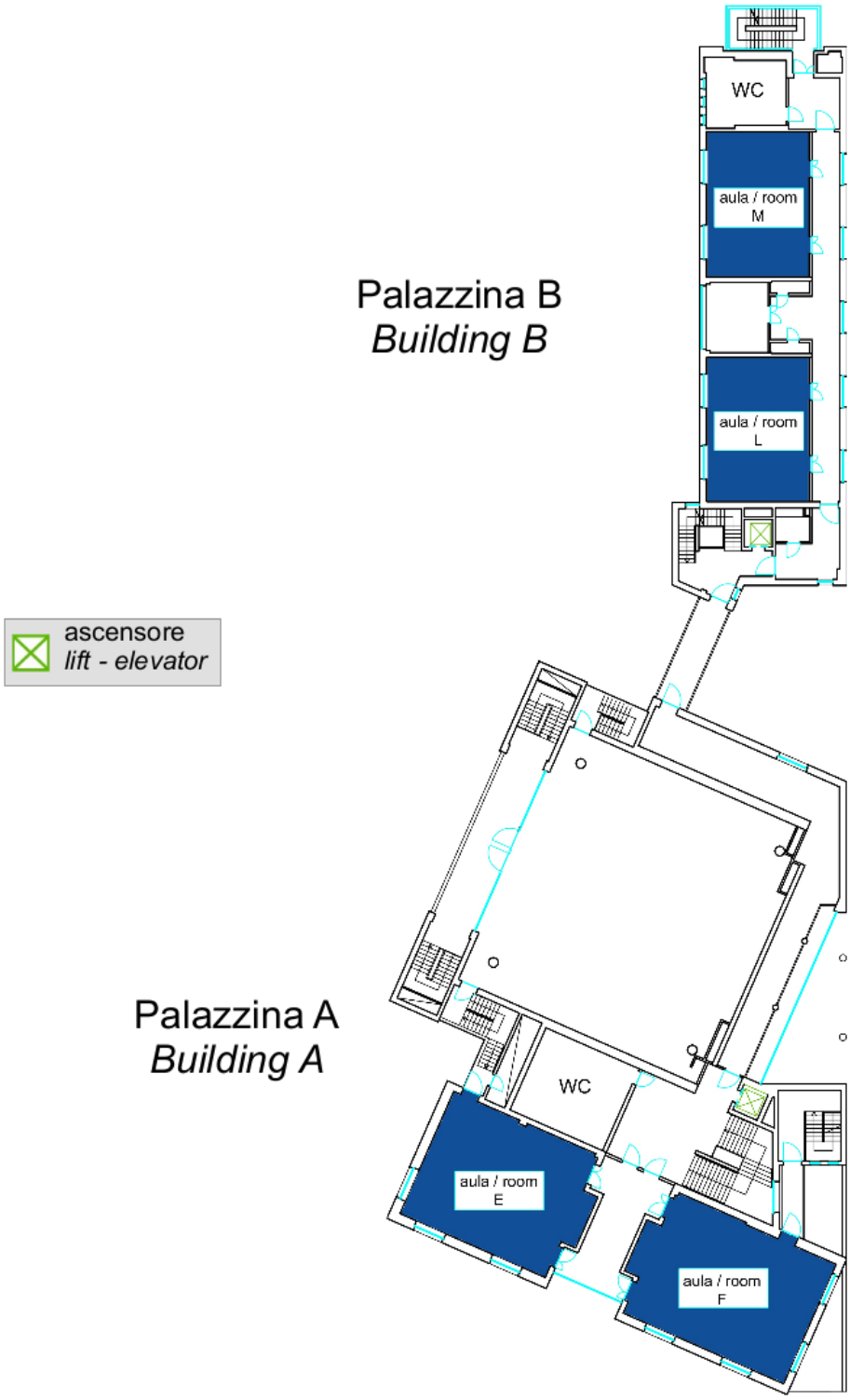


2

SECOND FLOOR – SECONDO PIANO

Palazzina A - Building A *(*via B. Andreatta, 8)
Room E – Room F

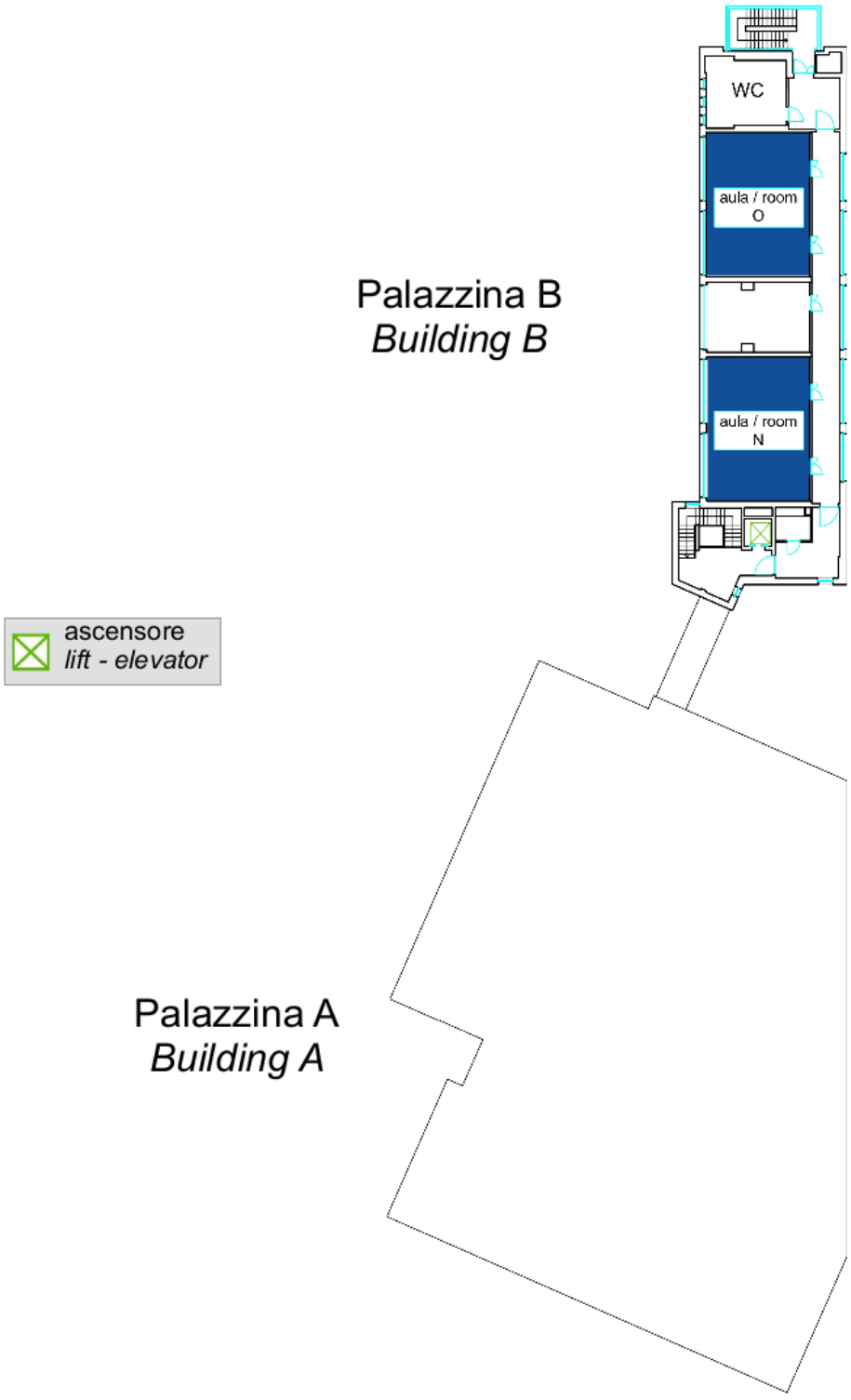
Palazzina B - Building B *(*via B. Andreatta, 8)
Room L – Room M



3

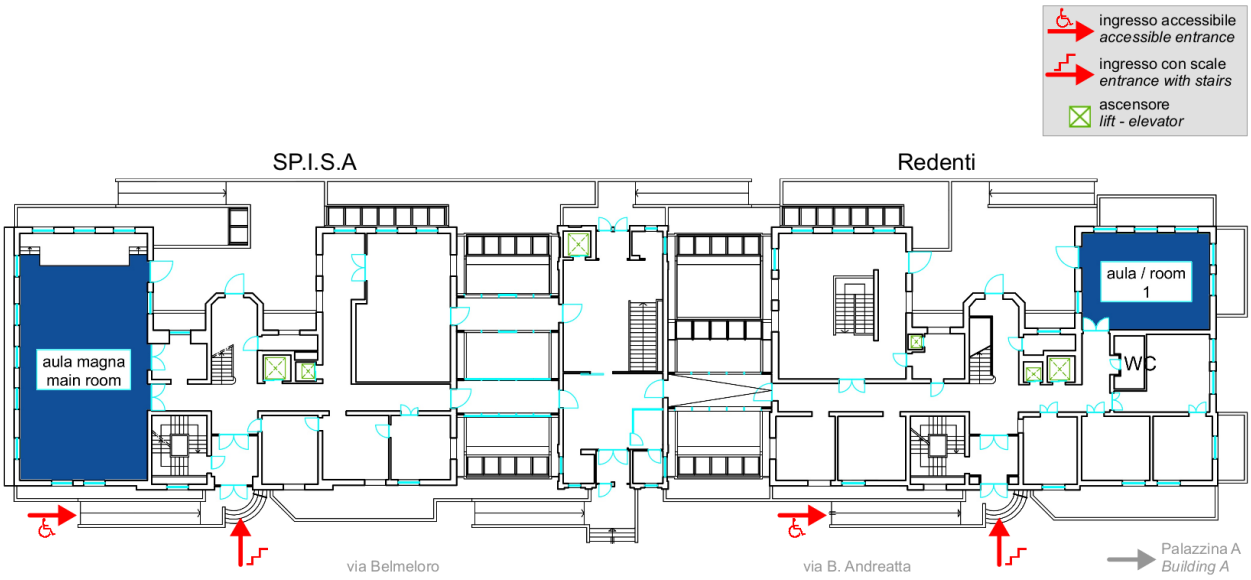
THIRD FLOOR – TERZO PIANO

Palazzina B - Building B (via B. Andreatta, 8)
Room N – Room O



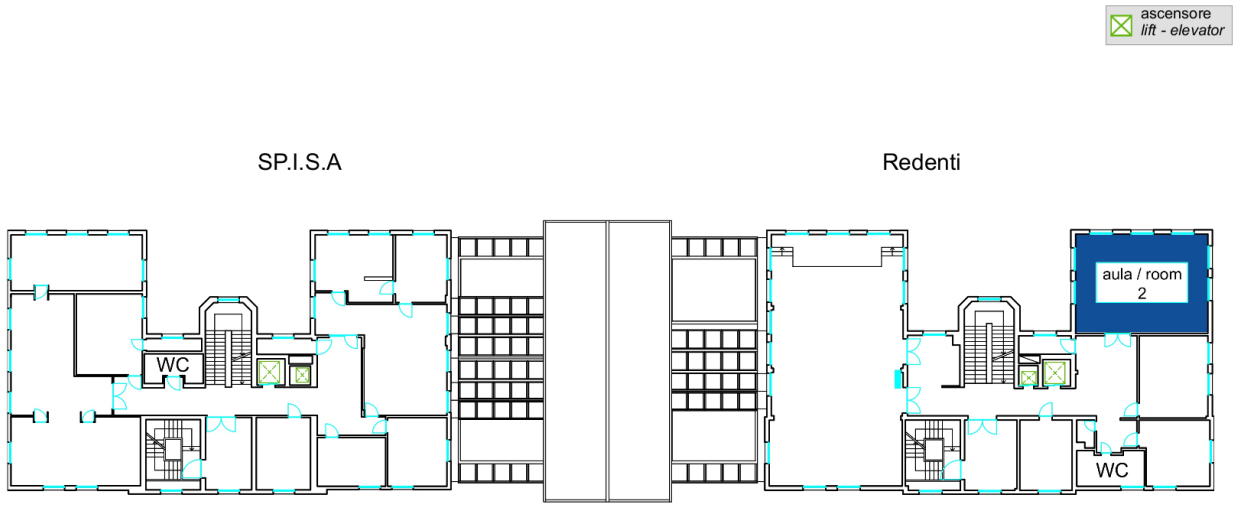
0
GROUND FLOOR – PIANO TERRA

SP.I.S.A. and Redenti *(via B. Andreatta, 6)*
Aula magna SP.I.S.A. – Room 1 - Redenti



1
FIRST FLOOR – PRIMO PIANO

SP.I.S.A. and Redenti *(via B. Andreatta, 6)*
Room 2 - Redenti



Registration Desk

The registration desk is located in the hall of Building A (via B. Andreatta 8) and is open during the following hours:

Monday, June 4:	15:00 – 18:30
Tuesday, June 5:	11:30 – 18:30
Wednesday, June 6:	08:00 – 18:30
Thursday, June 7:	08:00 – 13:30
Friday, June 8:	08:00 – 13:30

Badges

Carry your badge during the conference so that you can be admitted to all technical sessions, coffee breaks, lunches, reception and banquet.
Emergency numbers are provided inside each participant folder.

Registration Fee Includes

- Admission to all technical sessions
- Business Meeting (open to SIAG/IS members)
- Social dinner (Wednesday)
- Coffee breaks
- Welcome lunch (Tuesday)
- Welcome cocktail during the evening Poster Session (Tuesday)
- Room set-ups and audio/visual equipment
- Wi-Fi access at the conference

Conference Talk Arrangements

All **plenary talks** will have a slot of 45 minutes (5 minutes reserved for questions and discussion included).

The **minitutorials** will last 2 hours.

All **minisymposia talks** will have a slot of 30 minutes (5 minutes reserved for questions and discussion included).
All **contributed talks** will last 20 minutes (5 minutes reserved for questions and discussion included).

If you need to copy your presentation slides from your USB flash drive to a computer in lecture hall or meeting room, please do it in advance before the session starts.

Important Notice to Poster Presenters

The **poster sessions** are scheduled:

Tuesday, June 5
from 18:30 onwards
in Building A and B
with Welcome cocktail

Wednesday, June 6
from 11:30 to 13:00
in Building A and B

The **Best Poster Award** will be given on Friday, June 8 at 13:00 in Building A, Room A and Room B.

All posters participating to the Best Poster Award are available on the Conference website from June 1.
Poster presenters are requested to set up their material on the provided poster boards (70 cm x 100 cm), following the instructions in the participant folder and be present during both sessions. All materials must be posted by Tuesday, June 5 at 18:00. The conference is not responsible for discarded posters.

Wi-Fi Access

The username and password of your account during the conference period (5-8 June) can be found in your folder.
The users of an institution belonging to Eduroam are able to use the local wireless network using their own credentials (username and password).

Standard Audio/Visual Set-Up in Meeting Rooms

The plenary session room has a PC, two screens and two data projectors.
All other concurrent/breakout rooms have a PC, a screen, a data projector and a whiteboard (overhead projectors are also available).
The data projectors support VGA connection only. Presenters requiring an HDMI or alternate connection must provide their own adaptor.
Cables or adaptors for Apple computers are not supplied, as they vary for each model: please bring your own cable/adaptor if using a Mac computer. The conference is not responsible for the safety and security of speakers' computers.

Presentations Recording

During the conference audio and video recording is prohibited without the written permission of the speaker and the conference organizers.

SIAM Books and Journals

Display copies of selected SIAM books are available on site.

SIAM books are offered at **discounted prices** for all attendees. SIAM members can apply their member discount, and all attendees are entitled to a 20% Conference Discount.

The SIAM **book table** will be staffed from 9:00 through 17:30. The book table will close at 16:00 on Friday. If the SIAM book table is temporarily unattended, please take a copy of the Titles on Display to order online and receive the Conference Discount. *(Note: all prices in the Titles on Display are in Euros.)*

Table Top Displays

- SIAM: Building A, second floor
- IOP: Buiding A, first floor
- Springer Nature: Building A, first floor

Get-togethers

Tuesday, June 5

11:45 – 13:30, Welcome lunch
18:30 – 20:30, Poster Session I and Welcome cocktail

Wednesday, June 6

11:30 – 13:00, Poster Session II
17:45 – 18:30, Business Meeting (open to SIAG/IS members)
19:30 Social dinner

Lunches

There are multiple options for your lunches on Wednesday, Thursday and Friday.

- Two different **lunch boxes** prepared by the catering in the conference location: it can be reserved at the coffee desk the day before (cash payment).

- The John Hopkins University canteen in front of the conference location: Please show your conference badge.
- Elior canteen, Piazza Vittorio Puntoni 1: Special rates for the conference participants.

Several bars and restaurants are available for lunch in the area surrounding via Andreatta and via Belmeloro: The complete list is in your folder.

Conference Banquets

The **Conference banquet** will be served in Palazzo Re Enzo, Piazza del Nettuno 1C. Please carry your badge and ticket with you for admission. For security reasons, only 650 persons are admitted. So a second **special dinner** is organized in the same evening at Cantina Bentivoglio, via Mascarella 4 with Jazz music.

Additional conference banquet **tickets** are available at the price of 65 euros. Please purchase it before Friday, June 1 afternoon

Child Care

Le cicogne

Typical rates: if reserved a few days in advance: €16 / each hour (for a maximum of 4 hours) for a basic baby sitting and €20 / each hour for a baby sitter speaking foreign languages. If requested one day before: €18 + hourly rate. If requested the same day: €28 + hourly rate.

website: http://www.lecicogne.net

Born to life

Typical rates: €25 agency fee + hourly rate €13. After 22:00: €15. Foreign languages available. Reservations: 2 weeks in advance.

website: http://www.bolognababysitter.it

Services and useful informations

- Emergency Phone Number: 118 Medical Emergencies; 112 and 113 Emergency Police Help Number; 115 Fire Department
- Time Zone: CEST (Central European Summer Time); UTC/GMT+2
- Electricity: 220 V, 50Hz; power sockets follow European standards;
- Currency: Euro (EUR)
- Dial Country Code: +39
- Working hours Banks: 8:30 – 13:30; 14:30 – 15:45 (Monday to Friday)
- Buses in Bologna: visit www.tper.it
- Pharmacies: 08:30 – 12:30, 15:30 – 19:30 (Monday to Saturday, some are open 24 hours a day, everyday)
- Shops: 9:30 – 13:00; 15:30 - 19:30 (Monday to Saturday)
- Bologna Touristic Bureau: www.bolognawelcome.com/en

Please note

The conference is not responsible for the safety and security of participants' computers. Do not leave your laptop computers and personal belongings unattended. Please remember to turn off your mobile during all the sessions.

The conference cannot provide photocopying and dollar exchange service. A bank can be found in piazza Aldrovandi 12/A (opening hours: 8:20 – 13:20 and 14:30 – 16:00).

Comments?

Comments about SIAM IS18 are encouraged! Please send it to Cynthia Phillips, SIAM Vice President for Programs (vpp@siam.org).

ORGANIZED BY

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI MATEMATICA

siam
Society for Industrial and Applied Mathematics

IN COOPERATION WITH

IEEE Signal Processing Society

AGM

SIMAI
SOCIETÀ ITALIANA DI MATEMATICA APPLICATA E INDUSTRIALE

SPONSOR

emiliaromagna
terra con l'anima

CINECA

BPER: Banca

DATALOGIC
THE VISION IS YOURS

COMUNICO ITALIANO
ASSOCIAZIONE IMPRESE DI COMUNICAZIONE

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

AZIMUT
CAPITAL MANAGEMENT
Amalia Schiavo – Partner Azimut

INDAM
GNCS

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
ARCES

TENUTA SANTACROCE

Felsineo

Rotary
Distretto 2072

Rotary International Distretto 2072

UNDER THE PATRONAGE OF

RegioneEmilia-Romagna

Comune di Bologna

ORDINE INGEGNERI BOLOGNA
OIBO

II

Plenary Talks and Minitutorials

Plenary Talks and Biographies
Minitutorials and Biographies

Plenary Talks and Biographies

Invited Plenary Presentations **IP1** and **IP2** will take place in Aula Magna Santa Lucia, while the other Invited Presentations will take place in Building A, Room A and Room B in via Andreatta, 8.

Tuesday, 5
10:00 – 10:45

IP1: FLEXIBLE METHODOLOGY FOR IMAGE SEGMENTATION
RAYMOND H. CHAN
Department of Mathematics, The Chinese University of Hong Kong, Hong Kong

Tuesday, 5
11:00 – 11:45

IP2: THE EXPANDING ROLE OF INVERSE PROBLEMS IN INFORMING CLIMATE SCIENCE AND POLICY
ANNA MICHALAK
Department of Global Ecology, Carnegie Institution for Science, Stanford, USA

Wednesday, 6
8:15 – 9:00

IP3: FAKE ID DOCUMENTS AND COUNTERFEITED PRODUCTS: OVERVIEW OF IMAGE ANALYSIS TECHNIQUES TO FIGHT THEM
CLARISSE MANDRIDAKE
Surys Group, France

Thursday, 7
8:15 – 9:00

IP4: FAST ANALOG TO DIGITAL COMPRESSION FOR HIGH RESOLUTION IMAGING
YONINA ELDAR
Department of EE Technion, Israel Institute of Technology, Haifa, Israel

Thursday, 7
13:00 – 13:45

IP5: IMAGE SEGMENTATION AND UNDERSTANDING: A CHALLENGE FOR MATHEMATICIANS
CHRISTOPH SCHNÖRR
Institute of Applied Mathematics, University of Heidelberg, Germany

Friday, 8
8:15 – 9:00

IP6: LINEARLY-CONVERGENT STOCHASTIC GRADIENT ALGORITHMS
FRANCIS BACH
Departement d'Informatique de l'Ecole Normale Superieure Centre de Recherche INRIA de Paris, France

Tuesday, 05 at 10:00

IP1 - Flexible methodology for image segmentation

Raymond H. Chan (Department of Mathematics, The Chinese University of Hong Kong)

Biography:

Raymond Chan obtained his PhD degree from The Courant Institute of Mathematical Sciences in 1985. He is now the Chairman of the Mathematics Department at The Chinese University of Hong Kong. He won a Leslie Fox Prize in 1989; a Feng Kang Prize in 1997; a Morningside Award in 1998; and 2011 Higher Education Outstanding Scientific Research Output Awards from the Ministry of Education in China. He was elected a SIAM Fellow in 2013. He has published 120 journal papers and has been in the ISI Science Citation List of Top 250 Highly-Cited Mathematicians in the world since 2004. Chan has served on the editorial boards of many journals, including: Journal of Mathematical Imaging and Vision, Journal of Scientific Computing, Numerical Linear Algebra with Applications, SIAM Journal on Imaging Sciences, and SIAM Journal on Scientific Computing.

Abstract:

In this talk, we introduce a SaT (Smoothing and Thresholding) method for multiphase segmentation of images corrupted with different degradations: noise, information loss and blur. At the first stage, a convex variant of the Mumford-Shah model is applied to obtain a smooth image. We show that the model has unique solution under different degradations. In the second stage, we apply clustering and thresholding techniques to find the segmentation. The number of phases is only required in the last stage, so users can modify it without the need of repeating the first stage again. The methodology can be applied to various kind of segmentation problems, including color image segmentation, hyper-spectral image classification, and point cloud segmentation. Experiments demonstrate that our SaT method gives excellent results in terms of segmentation quality and CPU time in comparison with other state-of-the-art methods. Joint work with: X.H. Cai (UCL), M. Nikolova (ENS, Cachan) and T.Y. Zeng (CUHK)

Tuesday, 05 at 11:00

IP2 - The expanding role of inverse problems in informing climate science and policy

Anna Michalak (Department of Global Ecology, Carnegie Institution for Science, Stanford)

Biography:

Dr. Anna M. Michalak is a faculty member in the Department of Global Ecology of the Carnegie Institution for Science in Stanford, California, and an Associate Professor in the Department of Earth System Science at Stanford University. Prior to joining Carnegie, she was the Frank and Brooke Transue Faculty Scholar and Associate Professor at the University of Michigan, Ann Arbor. Her research interests primarily lie in two areas. She explores the impacts of climate change and extreme events on freshwater and coastal water quality via influences on nutrient delivery to, and on conditions within, water bodies. She also studies the cycling and emissions of greenhouse gases at the Earth surface at regional to global scales – scales directly relevant to informing climate science and policy – primarily through the use of atmospheric observations that provide the clearest constraints at these critical scales. She is the recipient of numerous awards, including the Presidential Early Career Award for Scientists and Engineers (nominated by NASA), the NSF CAREER award, the Association of Environmental Engineering and Science Professors Outstanding Educator Award, and the Leopold Fellowship in environmental leadership. Dr. Michalak holds a B.Sc. from the University of Guelph, Canada, and M.S. and Ph.D. degrees from Stanford.

Abstract:

Climate change is driven primarily by anthropogenic emissions of greenhouse gases, chief among them carbon dioxide and methane. The two most fundamental challenges in carbon cycle science are to develop approaches (1) to quantify human emissions of greenhouse gases at scales ranging from the individual to the globe and from hours to decades, and (2) to anticipate how the “natural” (e.g. oceans, land) components of the carbon cycle will act to mitigate or to amplify the impact of human emissions. Developing science that addresses decision maker needs lies at the core of both challenges. Spatiotemporal variability in observations of atmospheric concentrations of greenhouse gases can be used to tackle both challenges, because the atmosphere preserves signatures of emissions and uptake (a.k.a. fluxes) of greenhouse gases at the earth’s surface. Information about these fluxes can be recovered through the solution of an inverse problem by coupling atmospheric observations with a model of atmospheric dynamics. This talk will give an overview of the use of inverse problems in carbon cycle science, as well as discuss methodological challenges associated with a shift from focusing on simple quantification of fluxes to mechanistic attribution of inferred spatiotemporal flux variability.

Wednesday, 06 at 08:15

IP3 - Fake ID documents and counterfeited products: Overview of image analysis techniques to fight them

Clarisse Mandridake (Surys group)

Biography:

Mrs. Clarisse Manjary Mandridake received her PhD in Image and Signal Processing from the University of Bordeaux I, France, for her works on bi-dimensional signal decomposition applied to classification of textured images, working in Laboratoire Automatique Productique et Traitement du Signal, and in close connection with ARIANA Project in INRIA Sophia-Antipolis. She joined the research team of Advestigo for her postdoc year in 2002. As a researcher at Advestigo and later at Hologram Industries (now renamed SURYS), she developed technologies for the representation, indexation and search of images and videos in large scale databases. She is now in charge of the coordination of the research project for the SURYS digital labs and animates the scientist partnerships with University labs. Her expertise covers Applied Mathematics, image characterization, fingerprinting and authentication on various physical supports, from ID documents to smartlabels. More recently, her area of interest is to contribute to technological innovation for use by poor countries or developing countries in order to help them put in place what is called "good governance". It is a sine qua non Condition for any future economic development.

Abstract:

TBD

Thursday, 07 at 08:15

IP4 - Fast analog to digital compression for high resolution imaging

Yonina Eldar (Department of EE, Technion, Israel Institute of Technology, Haifa)

Biography:

Yonina C. Eldar is a Professor in the Department of Electrical Engineering at the Technion—Israel Institute of Technology, Haifa, where she holds the Edwards Chair in Engineering. She is also a Research Affiliate with the Research Laboratory of Electronics at MIT and a Visiting Professor at Duke University, and was a Visiting Professor at Stanford University. She received the B.Sc. degree in physics and the B.Sc. degree in electrical engineering both from Tel-Aviv University (TAU), Tel-Aviv, Israel, in 1995 and 1996, respectively, and the Ph.D. degree in electrical engineering and computer science from the Massachusetts Institute of Technology (MIT), Cambridge, in 2002. She has received many awards for excellence in research and teaching, including the IEEE Signal Processing Society Technical Achievement Award (2013), the IEEE/AESS Fred Nathanson Memorial Radar Award (2014) and the IEEE Kiyo Tomiyasu Award (2016). She was a Horev Fellow of the Leaders in Science and Technology program at the Technion and an Alon Fellow. She received the Michael Bruno Memorial Award from the Rothschild Foundation, the Weizmann Prize for Exact Sciences, the Wolf Foundation Krill Prize for Excellence in Scientific Research, the Henry Taub Prize for Excellence in Research (twice), the Hershel Rich Innovation Award (three times), the Award for Women with Distinguished Contributions, the Andre and Bella Meyer Lectureship, the Career Development Chair at the Technion, the Muriel & David Jacknow Award for Excellence in Teaching, and the Technion's Award for Excellence in Teaching (two times). She received several best paper awards and best demo awards together with her research students and colleagues and was selected as one of the 50 most influential women in Israel. She is the Editor in Chief of Foundations and Trends in Signal Processing, a member of several IEEE Technical Committees and Award Committees, an IEEE Fellow, and a EURASIP Fellow. She is also a member of the Young Israel Academy of Science and was a member of the Israel Committee for Higher Education.

Abstract:

The famous Shannon-Nyquist theorem has become a landmark in the development of digital signal processing. However, in many modern applications, the signal bandwidths have increased tremendously, while the acquisition capabilities have not scaled sufficiently fast. Consequently, conversion to digital has become a serious bottleneck. Furthermore, the resulting high rate digital data requires storage, communication and processing at very high rates which is computationally expensive and requires large amounts of power. In the context of medical imaging sampling at high rates often translates to high radiation dosages, increased scanning times, bulky medical devices, and limited resolution. In this talk, we present a framework for sampling and processing a wide class of wideband analog signals at rates far below Nyquist by exploiting signal structure and the processing task and show several demos of real-time sub-Nyquist prototypes. We then consider applications of these ideas to a variety of problems in medical and optical imaging including fast and quantitative MRI, wireless ultrasound, fast Doppler imaging, and correlation based super-resolution in microscopy and ultrasound which combines high spatial resolution with short integration time. We end by discussing several modern methods for structure-based phase retrieval which has applications in several areas of optical imaging.

Thursday, 07 at 13:00

IP5 - Image Segmentation and Understanding: A Challenge for Mathematicians

Christoph Schnörr (Institute of Applied Mathematics, University of Heidelberg)

Biography:

Christoph Schnörr received his degrees from the Technical University of Karlsruhe (today: Karlsruhe Institute of Technology) and the University of Hamburg, respectively. He worked as a researcher at the Fraunhofer Institut of Information and Data Processing in Karlsruhe before moving to the University of Hamburg. In 1998, he became full professor at the University of Mannheim, where he set up and directed the Computer Vision and Pattern Recognition Group. He moved to the Heidelberg University in 2008 where he is heading the Image and Pattern Analysis Group at the Institute of Applied Mathematics, which also is member of the Interdisciplinary Center for Scientific Computing. Christoph Schnörr has been coordinating 2010-2018 a research training group focusing on probabilistic graphical models and its applications to image analysis, funded by the German Science Foundation. He is one of 4 directors of the Heidelberg Collaboratory for Image Processing that implements and explores novel ways of combining basic strategic research in academia and research labs in industry, as part of the excellence initiative of the Heidelberg University. He served 2005-2014 as co-editor in chief of the International Journal of Computer Vision and currently as associate editor for the Journal of Mathematical Imaging and Vision and the SIAM Journal of Imaging Science. His research interests include mathematical models of image analysis and numerical optimisation.

Abstract:

The tremendous need for the analysis of massive image data sets in many application areas has been mainly promoting pragmatic approaches to imaging analysis during the last years: adopt a computational model with adjustable parameters and predictive power. This development poses a challenge to the mathematical imaging community: (i) shift the focus from low-level problems (like denoising) to mid- and high-level problems of image analysis (a.k.a. image understanding); (ii) devise mathematical approaches and algorithms that advance our understanding of structure detection in image data beyond a set of rules for adjusting the parameters of black-box approaches. The purpose of this talk is to stimulate the corresponding discussion by sketching past and current major trends including own recent work.

Friday, 08 at 08:15

IP6 - Linearly-convergent stochastic gradient algorithms

Francis Bach (Departement d'Informatique de l'Ecole Normale Superieure Centre de Recherche INRIA de Paris)

Biography:

Francis Bach is a researcher at INRIA, leading since 2011 the machine learning project-team, which is part of the Computer Science Department at Ecole Normale Supérieure. He graduated from Ecole Polytechnique in 1997 and completed his Ph.D. in Computer Science at U.C. Berkeley in 2005, working with Professor Michael Jordan. He spent two years in the Mathematical Morphology group at Ecole des Mines de Paris, then he was part of the computer vision project-team at INRIA/Ecole Normale Supérieure from 2007 to 2010. Francis Bach is primarily interested in machine learning, especially in graphical models, sparse methods, kernel-based learning, large-scale convex optimization, computer vision and signal processing. He obtained a Starting Grant in 2009 and a Consolidator Grant in 2016 from the European Research Council as well as the INRIA Young Researcher Prize in 2012. In 2015, he was program co-chair of the International Conference in Machine learning (ICML).

Abstract:

Many machine learning and signal processing problems are traditionally cast as convex optimization problems where the objective function is a sum of many simple terms. In this situation, batch algorithms compute gradients of the objective function by summing all individual gradients at every iteration and exhibit a linear convergence rate for strongly-convex problems. Stochastic methods, rather, select a single function at random at every iteration, classically leading to cheaper iterations but with a convergence rate which decays only as the inverse of the number of iterations. In this talk, I will present the stochastic averaged gradient (SAG) algorithm which is dedicated to minimizing finite sums of smooth functions; it has a linear convergence rate for strongly-convex problems, but with an iteration cost similar to stochastic gradient descent, thus leading to faster convergence for machine learning and signal processing problems. I will also mention several extensions, in particular to saddle-point problems, showing that this new class of incremental algorithms applies more generally.

Minitutorials and Biographies

All minitutorials will take place in Building A, Room B in via Andreatta, 8.

Wednesday, 6
9:30 – 11:30

MT1: COMPUTATIONAL UNCERTAINTY QUANTIFICATION FOR INVERSE PROBLEMS

JOHN BARDSLEY

Department of Mathematical Sciences, The University of Montana, USA

Thursday, 7
9:30 – 11:30

MT2: REGULARIZATION OF INVERSE PROBLEM

OTMAR SCHERZER

Computational Science Center, University of Vienna, Austria

Friday, 8
9:30 – 11:30

MT3: AUTOMATED 3D RECONSTRUCTION FROM SATELLITE IMAGES

GABRIELE FACCIOLO

Centre de mathématiques et de leurs applications [CMLA] - École Normale Supérieure Paris-Saclay, France

with Carlo de Franchis and Enric Meinhardt-Llopis (École Normale Supérieure Paris-Saclay, France)

Wednesday, 06 at 09:30

MT1 - Computational Uncertainty Quantification for Inverse Problems

John Bardsley (Department of Mathematical Sciences, The University of Montana)

Biography:

Dr. Johnathan M. Bardsley is Professor of Mathematics at the University of Montana (UM) in Missoula, Montana, USA. He received his PhD from Montana State University in 2002 under the direction of Professor Curtis R. Vogel, with a dissertation focused on computational inverse problems. He then spent one year as a post-doc at the Statistical and Applied Mathematical Sciences Institute, under the direction of Professor H. Thomas Banks. He began his current job at UM in 2003, and since then has spent two years abroad as a visiting Professor: first at the University of Helsinki in Finland in 2006-07; and then at the University of Otago in New Zealand in 2010-11. Dr. Bardsley has published over 45 refereed journal articles and has given many presentations on his research around the world. He also organized Montana Uncertainty Quantification, a conference/workshop that took place at UM in June 2015. Dr. Bardsley's current research is focused, broadly, on uncertainty quantification for inverse problems, and more specifically, on the development of Markov chain Monte Carlo methods for sampling from posterior distributions that arise in both linear and nonlinear inverse problems. He has a forthcoming book, titled Computational Methods and Uncertainty Quantification for Inverse Problems, that will be published by SIAM.

Abstract:

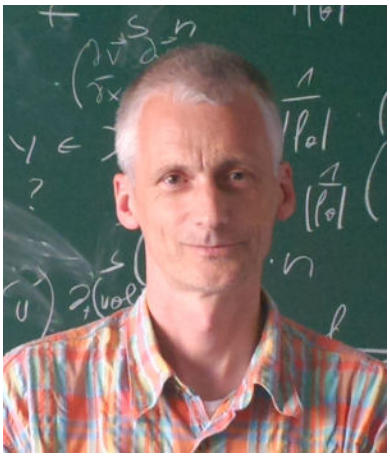
The field of inverse problems is fertile ground for the development of computational uncertainty quantification methods. This is due to the fact that, on the one hand, inverse problems involve noisy measurements, leading naturally to statistical (and hence uncertainty) estimation problems. On the other hand, inverse problems involve physical models that, upon discretization, are known only up to a high-dimensional vector of parameters, making them computationally challenging. Estimating a high-dimensional parameter vector in a discretized physical model from measurements of model output defines computational inverse problems. Such problems are typically unstable in that the estimates don't depend continuously on the measurements. Regularization is a technique that provides stability for inverse problems, and in the Bayesian setting, it is synonymous with the choice of the prior probability density function. Once a prior is chosen, the posterior probability density function results, and it is the solution of the inverse problem in the Bayesian setting. The posterior maximizer – known as the MAP estimator – provides a stable estimate of the unknown parameters. However, uncertainty quantification requires that we extract more information from the posterior, which often requires sampling. The posterior density functions that arise in typical inverse problems are high-dimensional, and are often non-Gaussian, making the corresponding sampling problems challenging. In this mini-tutorial, I will begin with a discussion of inverse problems, move on to Bayesian statistics and prior modeling using Markov random fields, and then end with a discussion of some Markov chain Monte Carlo methods for sampling from posterior density functions that arise in inverse problems.

Thursday, 07 at 09:30

MT2 - Regularization of Inverse Problem

Otmar Scherzer (Computational Science Center, University of Vienna)

Biography:



Otmar Scherzer received his PhD and Habilitation from the University of Linz (Austria) in 1990, 1995, respectively. He was a postdoc researcher at Texas A&M University and the University of Delaware. He held professorships at the Ludwig Maximilian University Munich, University of Bayreuth, and University of Innsbruck before he became professor at the University of Vienna, where he is now the head of the Computational Science Center. In addition he is research group leader of the "Imaging and Inverse Problems Group" of the Radon Institute of Computational and Applied Mathematics (RICAM) in Linz, which is an institute of the Austrian Academy of Sciences. Otmar Scherzer is an expert in regularization theory and mathematical imaging. He has about 200 publications in leading journals in these fields and is editor of about 10 journals and book series, including SIAM J. imaging Sciences. Moreover, he published two monographs, and edited several books, including the Handbook of Mathematical Imaging in three volumes. In 1991 he received the Theodor Körner Prize, the Prize of the Austrian Mathematical Society, the science prize of Tyrol, and in 1999 the START-prize of the Austrian Science Foundation, which is the highest award for young Austrian scientists in Austria. From 2010 to 2017 he has been Vice-president of the Inverse Problems International Association (IPIA).

Abstract:

Inverse Problems is an interdisciplinary research area with profound applications in many areas of science, engineering, technology, and medicine. Nowadays, a core technique for solving imaging problems are regularization methods. The foundations of these approximation methods were laid by Tikhonov decades ago, when he generalized the classical definition of well-posedness. In the early days of regularization methods, they were analyzed mostly theoretically, while later on numerics, efficient solutions, and applications of regularization methods became important. This Minitutorial gives a survey on theoretical developments in regularization theory: Starting from quadratic regularization methods for linear ill-posed problems, to convex regularization, and to non-convex regularization methods of non-linear problems. The theoretical analysis will be supported by particular imaging examples.

Friday, 08 at 09:30

MT3 - Automated 3D reconstruction from satellite images

Gabriele Facciolo (Centre de mathématiques et de leurs applications [CMLA] - École Normale Supérieure Paris-Saclay)

Biography:

Gabriele Facciolo received his B.Sc. and M.Sc. in computer science from Universidad de la Republica del Uruguay, and his Ph.D. (2011) from Universitat Pompeu Fabra under the supervision of Vicent Caselles. During his thesis he contributed to a pioneering mathematical formalization of the image inpainting problem, and a formulation of temporally consistent video editing robust to illumination changes. He joined Jean-Michel Morel's group at the École Normale Supérieure Paris-Saclay in 2011 where he is currently associate research professor. He has participated in many industrial projects, creating image processing algorithms and transferring technology with the CNES, Schlumberger, DxO Labs, and the foundation BarcelonaMedia. He has more than ten years of experience designing algorithms for remote sensing applications and collaborating with the French Space Agency (CNES) as part of the MISS project (Mathématiques de l'Imagerie Stéréoscopique Spatiale). The 3D reconstruction algorithms and the satellite stereo pipeline (github.com/MISS3D/s2p) he and his team have created within the CMLA have been adopted as the CNES's official stereo pipeline. He and his team also won the 2016 IARPA Multi-View Stereo 3D Mapping Challenge. He is one of the founding Editors of IPOL (www.ipol.im), the first journal publishing articles associated to online executable algorithms.

Abstract:

Commercial spaceborne imaging is experiencing an unprecedented growth both in size of the constellations and resolution of the images. This is driven by applications ranging from geographic mapping to measuring glacier evolution, or rescue assistance for natural disasters. For all these applications it is critical to automatically extract and update elevation data from arbitrary collections of multi-date satellite images. This multi-date satellite stereo problem is a challenging application of 3D computer vision: images are taken at very different dates, from very different points of view, and under different lighting conditions. The case of urban scenes adds further difficulties because of occlusions and reflections. This tutorial is a hands-on introduction to the manipulation of optical satellite images, using complete examples with python code. The objective is to provide all the tools needed to process and exploit the images for 3D reconstruction. We will present the essential modeling elements needed for building a stereo pipeline for satellite images. This includes the specifics of satellite imaging such as pushbroom sensor modeling, coordinate systems, and localization functions. Next we will review the main concepts and algorithms for stereovision and tailor them to the case of satellite images. Finally, we will bring together these elements to build a 3D reconstruction pipeline for multi-date satellite images.

III

Program

Program At-A-Glance

Tuesday, June 05

Wednesday, June 06

Thursday, June 07

Friday, June 08

Program Day By Day

Tuesday, June 05

IP1 FLEXIBLE METHODOLOGY FOR IMAGE SEGMENTATION

Tuesday, 05 at 10:00
Aula Magna (Santa Lucia, floor 0)

In this talk, we introduce a SaT (Smoothing and Thresholding) method for multiphase segmentation of images corrupted with different degradations: noise, information loss and blur. At the first stage, a convex variant of the Mumford-Shah model is applied to obtain a smooth image. We show that the model has unique solution under different degradations. In the second stage, we apply clustering and thresholding techniques to find the segmentation. The number of phases is only required in the last stage, so users can modify it without the need of repeating the first stage again. The methodology can be applied to various kind of segmentation problems, including color image segmentation, hyper-spectral image classification, and point cloud segmentation. Experiments demonstrate that our SaT method gives excellent results in terms of segmentation quality and CPU time in comparison with other state-of-the-art methods. Joint work with: X.H. Cai (UCL), M. Nikolova (ENS, Cachan) and T.Y. Zeng (CUHK)

Chairs:
Omar Ghattas (*The University of Texas at Austin*)

Raymond H. Chan (*Department of Mathematics, The Chinese University of Hong Kong*)

IP2 THE EXPANDING ROLE OF INVERSE PROBLEMS IN INFORMING CLIMATE SCIENCE AND POLICY

Tuesday, 05 at 11:00
Aula Magna (Santa Lucia, floor 0)

Climate change is driven primarily by anthropogenic emissions of greenhouse gases, chief among them carbon dioxide and methane. The two most fundamental challenges in carbon cycle science are to develop approaches (1) to quantify human emissions of greenhouse gases at scales ranging from the individual to the globe and from hours to decades, and (2) to anticipate how the "natural" (e.g. oceans, land) components of the carbon cycle will act to mitigate or to amplify the impact of human emissions. Developing science that addresses decision maker needs lies at the core of both challenges. Spatiotemporal variability in observations of atmospheric concentrations of greenhouse gases can be used to tackle both challenges, because the atmosphere preserves signatures of emissions and uptake (a.k.a. fluxes) of greenhouse gases at the earth's surface. Information about these fluxes can be recovered through the solution of an inverse problem by coupling atmospheric observations with a model of atmospheric dynamics. This talk will give an overview of the use of inverse problems in carbon cycle science, as well as discuss methodological challenges associated with a shift from focusing on simple quantification of fluxes to mechanistic attribution of inferred spatiotemporal flux variability.

Chairs:
Gitta Kutyniok (*Technische Universität Berlin*)

Anna Michalak (*Department of Global Ecology, Carnegie Institution for Science, Stanford*)

MS1-1 INVERSE SCATTERING AND ELECTRICAL IMPEDANCE TOMOGRAPHY

Tuesday, 05 at 13:30
Room P (Palazzina B - Building B, floor 0)

Inverse scattering and electrical impedance tomography have been a very active field of applied mathematics in recent years. New trends have emerged that have allowed to obtain further insights and encouraging results for well established and fascinating inverse problems. The minisymposium focuses on recent developments and innovative contributions in this direction, considering theoretical results and numerical algorithms as well as their application to specific real world problems. The topics of the talks range from scattering by wave guides, over non-iterative reconstruction methods for electrical impedance tomography and their generalizations to inverse scattering, to time-dependent inverse scattering problems.

Organizers:
Nuutti Hyvönen (*Aalto University*)
Roland Griesmaier (*Karlsruhe Institute of Technology*)

13:30 A MUSIC scheme for impedance imaging using multiple AC frequencies

Martin Hanke (*Johannes Gutenberg-Universität Mainz*)

14:00 Detecting indefinite inclusions using the Complete Electrode Model

Henrik Garde (*Aalborg University*)
Stratos Staboulis (*Eniram Oy*)

14:30 Monotonicity-based inverse scattering

Bastian Harrach (*Goethe-Universität Frankfurt am Main*)
Valter Pohjola (*University of Jyväskylä*)
Mikko Salo (*University of Jyväskylä*)

15:00 Multifrequency inverse source problems and a generalization of Prony's method

Roland Griesmaier (*Karlsruhe Institute of Technology*)
Christian Schmiedecke (*Universität Würzburg*)

MS2-1 INTERPOLATION AND APPROXIMATION METHODS IN IMAGING

Tuesday, 05 at 13:30
Room 2 (Redenti, floor 1)

Interpolation and approximation methods are crucial tools needed in image processing, at some or several stages. In fact, as in computer graphics, sometimes images are manually made from physical models of two and three dimensional objects. Since sophisticated approximation and interpolation techniques are building blocks of image restoration, signal recovery, volume data reconstruction, edge detection, object separation as well as prototyping, aim of this mini-symposium is to gather scientists to give notice of new mathematical methods relevant to all this area.

Organizers:
Alessandra De Rossi (*University of Torino*)
Costanza Conti (*University of Firenze*)

Francesco Dell'Accio (*University of Calabria*)

13:30 Patch-based dictionary learning for sparse image approximation

Gerlind Plonka (*University of Goettingen*)

14:00 Adaptive filtering in Magnetic Particle Imaging via Lissajous sampling

Stefano De Marchi (*University of Padova*)
Wolfgang Erb (*University of Hawaii at Manoa*)
Francesco Marchetti (*University of Padova*)

14:30 Performance bounds for co-/sparse box constrained signal recovery

Jan Kuske (*Heidelberg University*)
Stefania Petra (*University of Heidelberg*)

15:00 Near-best quartic C^2 spline quasi-interpolation for volume data reconstruction

Domingo Barrera (*Department of Applied Mathematics, University of Granada*)
Catterina Dagnino (*University of Torino*)
María José Ibáñez (*Department of Applied Mathematics, University of Granada*)
Paola Lamberti (*University of Torino*)
Sara Remogna (*University of Torino*)

MS3-1 APPLICATIONS OF IMAGING MODALITIES BEYOND THE VISIBLE SPECTRUM

Tuesday, 05 at 13:30
Matemates (Matemates, floor 0)

Images are omnipresent in the modern world. We depend on images for progress in medicine, science and technology. Application areas of imaging modalities beyond the visible spectrum include synthetic aperture radar and sonar (SAR and SAS), acoustic imaging, x-ray tomography, and radio astronomy. These imaging modalities provide a platform for a cross fertilization between physical, mathematical, and engineering disciplines related to imaging, image formation, registration, change detection, and automatic feature detection. Because of the breadth involved in imaging modalities beyond the visible spectrum, presentations will highlight the interdisciplinary flavor of imaging methodologies and/or their applications.

Organizers:
Max Gunzburger (*Florida State University*)
G-Michael Tesfaye (*Naval Surface Warfare Center, Panama City*)
Janet Peterson (*Florida State University*)

13:30 Coherence in Synthetic Aperture Sonar Imaging

G-Michael Tesfaye (*Naval Surface Warfare Center, Panama City*)

14:00 Automated repeat-pass processing of synthetic aperture sonar imagery

Oivind Midtgaard (*Norwegian Defence Research Establishment (FFI)*)
Torstein Saebo (*Norwegian Defense Research Establishment (FFI)*)

14:30 Generative Acoustic Imaging Models with Applications

Jason C. Isaacs (*Naval Surface Weapons Center - Panama City*)

15:00 A statistics-based approach to image registration

Katherine Simonson (*Sandia National Laboratories*)
J. Derek Tucker (*Sandia National Laboratories*)

MS4-1 GRAPH TECHNIQUES FOR IMAGE PROCESSING

Tuesday, 05 at 13:30
Room H (Palazzina B - Building B, floor 0)

The explosive growth of data has led to a profound revolution in data science, particularly in the field of image processing. Graph techniques provide flexibility and efficiency in capturing geometric structures of the imaging data. Major challenges in graph-related problems include graph representation of high-dimensional data, regularization on graphs, and fast algorithms. This mini-symposium aims to showcase a broad spectrum of topics in graph techniques for image processing. The presentations will focus on theoretical aspects of graph representation, computational advances, as well as applications in imaging sciences.

Organizers:
Yifei Lou (*University of Texas at Dallas*)
Jing Qin (*Montana State University*)

13:30 Graph Regularized EEG Source Imaging with In-Class Consistency and Out-Class Discrimination

Yifei Lou (*University of Texas at Dallas*)

14:00 A Graph Framework for Manifold-Valued Data

Ronny Bergmann (*Technische Universität Chemnitz*)
Daniel Tenbrinck (*University of Münster*)

14:30 An Auction Dynamics Approach to Data Classification

Ekaterina Rapinchuk (*Michigan State University*)

15:00 Cut Pursuit: A Working Set Strategy to Find Piecewise Constant Functions on Graphs

Loic Landrieu (*Institut géographique national*)

MS5-1 LEARNING AND ADAPTIVE APPROACHES IN IMAGE PROCESSING

Tuesday, 05 at 13:30
Room M (Palazzina B - Building B, floor 0)

Learning and adaptive regularisation approaches have become popular in image processing. The complexity of modern imaging tasks, especially those in medical imaging have given rise to the need for more sophisticated, non-standard regularisations, where learning approaches are used to determine the selection of optimal parameters, forward models, data fitting terms or even the regularisation functionals. This minisymposium will bring together researchers with experience in the fields of parameter learning, non-standard adaptive and/or anisotropic approaches and their analysis - not necessarily in the context of regularisation - while particular emphasis will be given on medical imaging applications, e.g. Magnetic Resonance Imaging.

Organizers:
Kostas Papafitsoros (*Weierstrass Institute Berlin*)

Michael Hintermüller (*Humboldt University and Weierstrass Institute Berlin*)

13:30 A physical-oriented reconstruction method for quantitative magnetic resonance imaging

Guozhi Dong (*Humboldt University Berlin*)
Michael Hintermüller (*Humboldt University and Weierstrass Institute Berlin*)
Kostas Papafitsoros (*Weierstrass Institute Berlin*)

14:00 A Variational Model for Brain Tumor Segmentation: Deep Learning Based Parameter Optimization

Adrián Martín (*Universitat Pompeu Fabra*)
Ivan Ramirez (*Universidad Rey Juan Carlos*)
Emanuele Schiavi (*Universidad Rey Juan Carlos*)

14:30 Analytical solutions of quadratic variational coupling models of arbitrary order

Aaron Wewior (*Saarland University*)

15:00 Bilevel optimization and some "parameter learning" applications in image processing

Michael Hintermüller (*Humboldt University and Weierstrass Institute Berlin*)

MS6-1 TIME-DEPENDENT PROBLEMS IN IMAGING

Tuesday, 05 at 13:30
Room L (Palazzina B - Building B, floor 0)

Time-dependent imaging problems have a broad range of applications and are a lively field of research. Classical tomographic techniques represent inverse problems that are stationary in the sense that neither the searched quantity, nor the data depend on time. So far solution methods for dynamic inverse problems seemed too time-consuming and demanded too much memory capacity to become interesting for real-world applications. However, imaging modalities with data and/or parameters that depend on time attracted much notice over the last years, demanding for innovative inversion and analysis techniques that particularly take into account the physical meaning of the additional temporal variable.

Organizers:
Thomas Schuster (*Saarland University*)
Anne Wald (*Saarland University*)

13:30 On dynamic photoacoustic imaging with optical flow constraints

Simon Arridge (*University College London*)
Marta Betcke (*University College London*)
Ben Cox (*Department of Medical Physics, University College London*)
Nam Huynh (-)
Felix Lucka (*CWI & UCL*)
Bolin Pan (*University College London*)
Beard Paul (*UCL*)
Edward Zhang (*UCL*)

14:00 Dynamic inverse problems for wave equations

Thies Gerken (*University of Bremen*)

14:30 Algorithms for motion compensation

Bernadette Hahn (*University of Würzburg*)

15:00 Reconstruction and Decomposition of Dynamic and Undersampled MR Data

Meike Kinzel (*University of Münster*)

MS7-1 LIMITED DATA PROBLEMS IN IMAGING

Tuesday, 05 at 13:30
Room I (Palazzina B - Building B, floor 0)

Since the breakthrough of CT, many innovative concepts have been developed such as dynamic imaging, photoacoustic tomography, Compton imaging, etc, and studied via associated inverse problems. Each novel technique brings new mathematical challenges and technical constraints. The limited data issue constitutes the most common constraint and one of the main challenges. In this case, a substantial part of the data are unavailable changing deeply the nature of the ill-posed problem and making image reconstruction more complex. This minisymposium will bring together researchers from the inverse problems and imaging communities related to this issue and will promote discussions among participants.

Organizers:
Bernadette Hahn (*University of Würzburg*)
Gaël Rigaud (*Saarland University*)
Jürgen Frikel (*OTH Regensburg*)

13:30 A Complete Characterization of Artifacts in Arbitrary Limited Data Tomography Problems

Leise Borg (*University of Copenhagen*)
Jürgen Frikel (*OTH Regensburg*)
Jakob Jorgensen (*University of Manchester*)
Todd Quinto (*Tufts University*)

14:00 Challenges in learning-based MR image reconstruction

Kerstin Hammernik (*Graz University of Technology*)
Teresa Klatzer (*Graz University of Technology*)
Florian Knoll (*New York University*)
Erich Kobler (*Graz University of Technology*)
Thomas Pock (*Graz University of Technology*)
Michael P Recht (*New York University School of Medicine*)
Daniel Sodickson (*New York University*)

14:30 Iterative image reconstruction for limited angular range scanning in digital breast tomosynthesis

Xiaochuan Pan (*University of Chicago*)
Ingrid Reiser (*University of Chicago*)
Sean Rose (*University of Chicago*)
Emil Sidky (*University of Chicago*)

15:00 Machine learning for imaging problems with limited data

Allard Hendriksen (*CWI*)
Daniel Pelt (*CWI*)

MS8-1 KRYLOV METHODS IN IMAGING: INVERSE PROBLEMS, DATA ASSIMILATION, AND UNCERTAINTY QUANTIFICATION

Tuesday, 05 at 13:30
Room E (Palazzina A - Building A, floor 2)

Krylov methods have played and continue to play a critical role in the development of iterative techniques for solving inverse problems that arise in many important imaging applications such as image deblurring and tomographic reconstruction. This minisymposium will highlight recent developments on Krylov methods for large-scale inverse problems, data assimilation and uncertainty quantification.

Organizers:
Arvind Saibaba (*North Carolina State University*)
Julianne Chung (*Virginia Tech*)
Eric de Sturler (*Virginia Tech*)

13:30 Analysis of bidiagonalization-based regularization methods for inverse problems with general noise setting

Iveta Hnetynkova (*Charles University, Faculty of Mathematics and Physics*)

14:00 Flexible Krylov methods for l_p-regularization

Julianne Chung (*Virginia Tech*)
Silvia Gazzola (*University of Bath*)

14:30 Incorporating Known Information into a Krylov Subspace Iteration

Kirk Soodhalter (*Trinity College Dublin*)

15:00 Krylov Recycling for Sequences of Shifted Systems Arising in Image Restoration

Eric de Sturler (*Virginia Tech*)
Misha Kilmer (*Tufts University*)
Meghan O'Connell (*Mathworks*)

MS9-1 INNOVATIVE MODELS AND ALGORITHMS FOR ASTRONOMICAL IMAGING

Tuesday, 05 at 13:30
Room D (Palazzina A - Building A, floor 1)

The next generation of astronomical imaging instruments provides the chance for an unprecedented step forward in our knowledge of how the universe evolved. It also poses incredible challenges due to the huge amount of data to be processed and the need for a precise and self-consistent analysis of images with widely different depths and resolutions. Defining new approaches to restore, segment and analyse such images is both a fundamental and a challenging task. By combining experiences from two different fields, astrophysics and mathematics, this minisymposium aims at creating an interdisciplinary bridge that can be an enrichment for both research areas.

Organizers:
Silvia Tozza (*INdAM/Dept. Mathematics, University of Rome "La Sapienza"*)
Marco Castellano (*INAF Osservatorio Astronomico di Roma*)
Maurizio Falcone (*Dipartimento di Matematica, Università di Roma "La Sapienza"*)
Adriano Fontana (*INAF Osservatorio Astronomico di Roma*)

13:30 Astronomical imaging in the era of cosmological surveys and giant telescopes: challenges and opportunities

Marco Castellano (*INAF Osservatorio Astronomico di Roma*)

14:00 Blind Deconvolution of galaxy survey images

Samuel Farrens (*CEA*)
Morgan Schmitz (*CEA*)
Jean-Luc Starck (*Service d'Astrophysique, CEA Saclay*)

14:30 Application of machine learning algorithm, based on clustering analysis, to detection and deblending of astronomical sources

Andrea Tramacere (*ISDC Data Center for Astrophysics, University of Geneve*)

15:00 An Inverse diffraction method for de-saturation of Extreme Ultraviolet images of solar eruptive events

Anna Maria Massone (*CNR - SPIN*)

MS10-1 ADVANCED OPTIMIZATION METHODS FOR IMAGE PROCESSING

Tuesday, 05 at 13:30
Room G (Palazzina A - Building A, floor 0)

The development of efficient optimization methods applicable to large scale image processing tasks is an important and current research topic as it leads to improvements in speed and stability or the ability of revealing hidden image properties. The goal of this minisymposium is to discuss and compare image and video processing tasks addressed by means of powerful and efficient optimization algorithms, with particular attention devoted to non-smooth or non convex cost functions. The presentations in this minisymposium discuss both theoretical aspects as well as concrete applications of state-of-the-art optimisation methods relevant to modern mathematical imaging.

Organizers:
Marco Prato (*University of Modena and Reggio Emilia*)
Ignace Loris (*Université Libre de Bruxelles*)

13:30 Inexact forward-backward and primal-dual methods for applied inverse problems

Antonin Chambolle (*Ecole Polytechnique*)
Julian Rasch (*Westfälische Wilhelms-Universität Münster*)

14:00 Non-smooth non-convex Bregman minimization: unification and new algorithms

Jalal Fadili (*Université Caen*)
Peter Ochs (*Saarland University*)

14:30 A block coordinate proximal algorithm for N-th order tensor decomposition

Caroline Chaux (*Aix-Marseille Université*)
Sylvain Maire (*Aix-Marseille Université*)
Nadège Thirion-Moreau (*Aix-Marseille Université*)
Xuan Vu (*Aix-Marseille Université*)

15:00 TV-based Poisson image restoration by IRLS and gradient projection methods

Daniela di Serafino (*University of Campania "L. Vanvitelli"*)
Germana Landi (*University of Bologna*)
Marco Viola (*University of Rome "La Sapienza"*)

MS11-1 COMPUTATIONAL IMAGING FOR MICRO- AND NANO-STRUCTURES IN MATERIALS SCIENCE

Tuesday, 05 at 13:30
Room C (Palazzina A - Building A, floor 1)

In microscopy, the proliferation of digital data resulting from an increasing number of sensors, and automated data capture, has created opportunities for rich characterization of structures in materials. Whereas traditional characterization involved small numbers of 2-D images that were hand analyzed, modern techniques can capture image sequences involving hundreds of individual images, leading to characterization over "large volumes," as compared with traditional approaches. Multiple sensors have allowed for multimodal data collection; robotics has allowed for automated data preparation and collection; and increasing storage capacities have lead to large datasets. The availability of this type of data, which primarily involves imaging modalities, has created an opportunity for modern Computational Imaging (CI) methods to be applied to obtain vast improvements in the quality of micro- and nano-structure analyses as well as their complexity. Traditionally, quantitative analysis of microscope imagery has relied upon forward modeling for testing hypotheses. CI, with its emphasis on inversion methods, represents a largely unexplored methodology in this field. This symposium brings together CI researchers from Imaging Science, Materials Science, and other fields who are applying techniques such as statistical image processing, model-based regularization, sparsity, denoising methods, optics, and the integration of the physics of structure formation towards advancing the science of microscopy.

Organizers:
Brendt Wohlberg (*Los Alamos National Laboratory*)
Jeff Simmons (*Air Force Research Laboratory*)

13:30 3D Computational Phase Microscopy

Laura Waller (*University of California, Berkeley*)

14:00 SLADS: Fast Dynamic Sampling using Machine Learning

Charles Bouman (*Purdue University*)

14:30 Sparse Sampling in Scanning Electron Microscopes

Kurt Larson (*Sandia National Laboratories, US Department of Energy*)

15:00 Denoising of Scanning Transmission Electron Microscopy Images for Materials Structure Characterization

Jie Feng (*University of Wisconsin-Madison*)
Willem Marais (*University of Wisconsin-Madison*)
Paul Voyles (*University of Wisconsin-Madison*)
Rebecca Willett (*University of Wisconsin, Madison*)

MS12-1 NEW DIRECTIONS IN HYBRID DATA TOMOGRAPHY

Tuesday, 05 at 13:30
Room F (Palazzina A - Building A, floor 2)

The reconstruction problems in optical and electrical tomography, such as Optical Diffusion Tomography and Electrical Impedance Tomography, are known to be severely ill-posed. In recent years several modalities have been introduced that circumvents the ill-posedness by introducing another physical modality. This leads to systems of coupled partial differential equations. By using the coupled-physics approach, reconstructions can then be computed with fine resolution and high contrast. To retrieve accurate information from the coupled data one solves the so-called quantitative reconstruction problem. In this mini-symposium we bring together experts working on different quantitative reconstruction problems with hybrid data and discuss future directions.

Organizers:
Kim Knudsen (*Technical University of Denmark*)
Cong Shi (*Georg-August-Universität Göttingen*)

Some results on convergence rates for the density matrix reconstruction

Cong Shi (*Georg-August-Universität Göttingen*)

14:00 Acousto-electric tomography based on complete electrode model for isotropic and anisotropic tissues

Changyou Li (*Northwestern Plytechnical University*)

14:30 Dynamical super-resolution with applications to ultrafast ultrasound

Francisco Romero (*ETH Zurich*)

15:00 Lamé Parameters Estimation from Static Displacement Field Measurements in the Framework of Nonlinear Inverse Problems

Simon Hubmer (*Johannes Kepler University Linz*)
Andreas Neubauer (*Johannes Kepler University Linz*)
Otmar Scherzer (*Computational Science Center, University of Vienna*)
Ekaterina Sherina (*Technical University of Denmark*)

MS13-1 OPTIMIZATION FOR IMAGING AND BIG DATA

Tuesday, 05 at 13:30
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

A large number of Imaging and Big Data applications can be modeled as large-scale optimization problems. Numerical methods that both guarantee some theoretical properties and give good performance are needed when dealing with those problems. The aim of this minisyposium is to describe some novel techniques for such data-intensive applications, as well as emerging challenges in the area. The speakers shall particularly talk about recent interesting applications of optimization techniques to solve problems arising from imaging science, signal processing, wireless communications, machine learning, data mining, information theory, and statistics.

Organizers:
Margherita Porcelli (*University of Firenze*)
Francesco Rinaldi (*University of Padova*)

13:30 An Active-Set Approach for Minimization over the Simplex and the l1-Ball

Andrea Cristofari (*University of Rome "La Sapienza"*)
Marianna De Santis (*University of Rome "La Sapienza"*)
Stefano Lucidi (*University of Rome "La Sapienza"*)
Francesco Rinaldi (*University of Padova*)

14:00 Beyond the worst case convergence analysis of the forward-backward algorithm

Guillaume Garrigos (*Ecole Normale Supérieure, CNRS*)
Lorenzo Rosasco (*University of Genoa, Istituto Italiano di Tecnologia; Massachusetts Institute of Technology*)
Silvia Villa (*Politecnico di Milano*)

14:30 Continuous modularity function for detecting leading communities in networks

Francesco Tudisco (*University of Strathclyde*)

15:00 Distributed learning in large scale networks: from GPS-denied localization to MAP inference in a graphical model

João Gomes (*Institute for Systems and Robotics (ISR/IST), LARSyS, Instituto Superior Técnico, Universidade de Lisboa*)
Claudia Soares (*LARSyS, Instituto Superior Técnico*)
João Xavier (*Institute for Systems and Robotics (ISR/IST), LARSyS, Instituto Superior Técnico, Universidade de Lisboa*)

MS14-1 DENOISING IN PHOTOGRAPHY AND VIDEO

Tuesday, 05 at 13:30
Room A (Palazzina A - Building A, floor 0)

The problem of removing noise from images has a long and rich history. Despite the vast amount of literature and the quality of current algorithms, it remains an open challenge. This is especially true when using photo, video and cinema cameras, where the push towards ever increasing resolution and dynamic range implies ever increasing demands on denoising performance. This minisymposium presents state of the art methods that cover representative, but in no way exhaustive, aspects in this field, from noise models to algorithm evaluation, from fast real-time in-camera techniques to powerful and computationally intensive methods for off-line processing.

Organizers:
Stacey Levine (*Duquesne University*)
Marcelo Bertalmío (*University Pompeu Fabra*)

13:30 A Tour of Denoising: Form, Function, and Applications

Peyman Milanfar (*Google Research*)

14:00 Camera Noise and Noise Perception in Motion Pictures

Tamara Seybold (*Technische Universität München*)

14:30 Benchmarking denoising algorithms with real photographs

Stefan Roth (*Technische Universität Darmstadt*)

15:00 How to Improve Your Denoising Result Without Changing Your Denoising Algorithm

Thomas Batard (*Technische Universität Kaiserslautern*)
Marcelo Bertalmío (*University Pompeu Fabra*)
Gabriela Ghimpeteanu (*Universitat Pompeu Fabra*)
Stacey Levine (*Duquesne University*)

MS15-1 NONLINEAR DIFFUSION: MODELS, EXTENSIONS AND ALGORITHMS

Tuesday, 05 at 13:30
Room B (Palazzina A - Building A, floor 1)

Nonlinear diffusion and its various extensions covering a large class of image processing models play important roles in practical tasks such as image restoration, inpainting, segmentation, registration. There are many research groups employing and developing essentially similar and related models and tools. This mini-symposium aims to bring together such researchers together to showcase the state of arts models and the most recent results, and to exchange ideas for further development and collaboration. The invited talks will cover not only the partial differential equations (PDEs) of the second order, but also PDE models of varying orders such as 4th order and fractional orders. Suitable adaptivity in designing nonlinear coefficients, anisotropic weights and feature based differential order or coefficients is a key in improving the more traditional models. This has been done in a number of ways. Effective algorithms are of vital importance in approximating numerical solutions to the concerned models, especially if we intend for such models to find wide and practical use in the diverse fields of imaging sciences. The mini-symposium should be of interest to all researchers in the community. Organised by Joachim Weickert (Saarland University, Germany), Xue-cheng Tai (Hong Kong Baptist University, China) Ke Chen (University of Liverpool, UK)

Organizers:
Ke Chen (*University of Liverpool*)
Joachim Weickert (*Saarland University*)
Xue-Cheng Tai (*Hong Kong Baptist University*)

13:30 Efficient solution of Euler elastica models

Xue-Cheng Tai (*Hong Kong Baptist University*)

14:00 Efficient Methods for Edge-weighted Colorization Models with Sphere Constraints

Sung-ha Kang (*Georgia Institute of Technology*)
Maryam Yashtini (*Gerogetown University*)
Wei Zhu (*University of Alabama*)

14:30 Generalized image osmosis filtering with applications

Luca Calatroni (*CMAP, École Polytechnique CNRS*)
Marco Caliari (*University of Verona*)
Simone Parisotto (*University of Cambridge*)
Carola-Bibiane Schönlieb (*University of Cambridge*)

15:00 An Image Reconstruction Model Regularized by Edge-preserving Diffusion and Smoothing for Limited-angle Computed Tomography

Hongwei Li (*Capital Normal University of Beijing*)
Jinqiu Xu (*Capital Normal University, Beijing*)
Prof Peng Zhang (*Capital Normal University of Beijing*)
Yunsong Zhao (*Capital Normal University, Beijing*)

CP1 CONTRIBUTED SESSION 1

Tuesday, 05 at 13:30
Room 1 (Redenti, floor 0)

Chairs:
Michele Piana (*Dept. Mathematics, University of Genoa*)

13:30 Efficient projection onto the infinity-1 ball using Newton's root-finding method

Gustavo Chau (*Pontificia Universidad Catolica del Peru*)
Paul Rodriguez (*Pontificia Universidad Catolica del Peru*)
Brendt Wohlberg (*Los Alamos National Laboratory*)

13:50 Image Recovery by Block-Iterative Asynchronous Proximal Splitting

Patrick Combettes (*North Carolina State University*)

14:10 Fast l0 sparse approximation problem via a Scaled Alternating Optimization

Paul Rodriguez (*Pontificia Universidad Catolica del Peru*)

14:30 Composite Optimization by Nonconvex Majorization-Minimization

Jonas Geiping (*University of Siegen*)
Michael Moeller (*University of Siegen*)

14:50 A class of primal-dual proximal algorithms for learned optimization

Jonas Adler (*KTH Royal Institute of Technology*)
Sebastian Banert (*KTH - Royal Institute of Technology*)
Johan Karlsson (*KTH - Royal Institute of Technology*)
Ozan Öktem (*KTH - Royal Institute of Technology*)
Axel Ringh (*KTH - Royal Institute of Technology*)

MS1-2 INVERSE SCATTERING AND ELECTRICAL IMPEDANCE TOMOGRAPHY

Tuesday, 05 at 16:00
Room P (Palazzina B - Building B, floor 0)

Inverse scattering and electrical impedance tomography have been a very active field of applied mathematics in recent years. New trends have emerged that have allowed to obtain further insights and encouraging results for well established and fascinating inverse problems. The minisymposium focuses on recent developments and innovative contributions in this direction, considering theoretical results and numerical algorithms as well as their application to specific real world problems. The topics of the talks range from scattering by wave guides, over non-iterative reconstruction methods for electrical impedance tomography and their generalizations to inverse scattering, to time-dependent inverse scattering problems.

Organizers:
Nuutti Hyvönen (*Aalto University*)
Roland Griesmaier (*Karlsruhe Institute of Technology*)

16:00 On identifiable spectra related to shapes and material properties

Houssem Haddar (*INRIA & Ecole Polytechnique*)

16:30 A spectral method to detect perfect invisibility in waveguides

Lucas Chesnel (*Inria/Ecole Polytechnique*)

17:00 Exterior approach for finding defects in the wave equation

Jeremi Darde (*Universite Paul Sabatier*)

17:30 On the separation of potential fields as an inverse source problem in geomagnetism

Christian Gerhards (*University of Vienna*)

MS2-2 INTERPOLATION AND APPROXIMATION METHODS IN IMAGING

Tuesday, 05 at 16:00
Room 2 (Redenti, floor 1)

Interpolation and approximation methods are crucial tools needed in image processing, at some or several stages. In fact, as in computer graphics, sometimes images are manually made from physical models of two and three dimensional objects. Since sophisticated approximation and interpolation techniques are building blocks of image restoration, signal recovery, volume data reconstruction, edge detection, object separation as well as prototyping, aim of this mini-symposium is to gather scientists to give notice of new mathematical methods relevant to all this area.

Organizers:
Alessandra De Rossi (*University of Torino*)
Costanza Conti (*University of Firenze*)
Francesco Dell'Accio (*University of Calabria*)

16:00 Image reconstruction from scattered data by kernel methods

Gabriele Santin (*University of Stuttgart*)

16:30 Landmark-based image registration using radial kernels

Roberto Cavoretto (*University of Torino*)
Alessandra De Rossi (*University of Torino*)
Hanli Qiao (*University of Torino*)

17:00 RBF methods for edge detection

Lucia Romani (*University of Milano-Bicocca*)
Milvia Rossini (*University of Milano-Bicocca*)
Daniela Schenone (*University of Milano-Bicocca*)

17:30 On a regularized approach for the method of fundamental solution

Guido Ala (*University of Palermo*)
Gregory Fasshauer (*Colorado School of Mines*)
Elisa Francomano (*University of Palermo*)
Salvatore Ganci (*Worldenergy SA, Greenconnector*)
Michael McCourt (*SigOPT, San Francisco*)
Marta Paliaga (*University of Palermo*)

MS3-2 APPLICATIONS OF IMAGING MODALITIES BEYOND THE VISIBLE SPECTRUM

Tuesday, 05 at 16:00
Matemates (Matemates, floor 0)

Images are omnipresent in the modern world. We depend on images for progress in medicine, science and technology. Application areas of imaging modalities beyond the visible spectrum include synthetic aperture radar and sonar (SAR and SAS), acoustic imaging, x-ray tomography, and radio astronomy. These imaging modalities provide a platform for a cross fertilization between physical, mathematical, and engineering disciplines related to imaging, image formation,

registration, change detection, and automatic feature detection. Because of the breadth involved in imaging modalities beyond the visible spectrum, presentations will highlight the interdisciplinary flavor of imaging methodologies and/or their applications.

Organizers:
Max Gunzburger (*Florida State University*)
G-Michael Tesfaye (*Naval Surface Warfare Center, Panama City*)
Janet Peterson (*Florida State University*)

16:00 Parallel Regularized k-means Clustering in Image Analysis and Compression

Benjamin McLaughlin (*NSWC-PCD*)

16:30 Autonomous Naval Mine Countermeasures - single vehicle adaptive behaviours

Samantha Dugelay (*NATO STO Centre for Maritime Research and Experimentation (CMRE)*)
Giorgio Urso (*CMRE*)

17:00 A Deep Learning Approach to Modeling Expected Entropy Reduction in Imaging Sonar

Silvia Ferrari (*Cornell University*)

17:30 Clustering approaches to feature change detection

Max Gunzburger (*Florida State University*)
Janet Peterson (*Florida State University*)
G-Michael Tesfaye (*Naval Surface Warfare Center, Panama City*)

MS4-2 GRAPH TECHNIQUES FOR IMAGE PROCESSING

Tuesday, 05 at 16:00
Room H (Palazzina B - Building B, floor 0)

The explosive growth of data has led to a profound revolution in data science, particularly in the field of image processing. Graph techniques provide flexibility and efficiency in capturing geometric structures of the imaging data. Major challenges in graph-related problems include graph representation of high-dimensional data, regularization on graphs, and fast algorithms. This mini-symposium aims to showcase a broad spectrum of topics in graph techniques for image processing. The presentations will focus on theoretical aspects of graph representation, computational advances, as well as applications in imaging sciences.

Organizers:
Yifei Lou (*University of Texas at Dallas*)
Jing Qin (*Montana State University*)

16:00 EEG Source Imaging based on Spatial and Temporal Graph Structures

Jing Qin (*Montana State University*)

16:30 Interpolation on High Dimensional Point Cloud

Zuoqiang Shi (*Tsinghua University*)

17:00 On the Front Propagation on Weighted Graphs With Applications in Image Processing and High-Dimensional Data

Xavier Desquesnes (*Université d'Orléans*)
Abderrahim Elmoataz (*University of Caen Normandie, CNRS*)

17:30 Learning Binary Neural Networks

Ju Sun (*Stanford University*)
Xiaoxia Sun (*Johns Hopkins*)

MS5-2 LEARNING AND ADAPTIVE APPROACHES IN IMAGE PROCESSING

Tuesday, 05 at 16:00
Room M (Palazzina B - Building B, floor 0)

Learning and adaptive regularisation approaches have become popular in image processing. The complexity of modern imaging tasks, especially those in medical imaging have given rise to the need for more sophisticated, non-standard regularisations, where learning approaches are used to determine the selection of optimal parameters, forward models, data fitting terms or even the regularisation functionals. This minisymposium will bring together researchers with experience in the fields of parameter learning, non-standard adaptive and/or anisotropic approaches and their analysis - not necessarily in the context of regularisation - while particular emphasis will be given on medical imaging applications, e.g. Magnetic Resonance Imaging.

Organizers:
Kostas Papafitsoros (*Weierstrass Institute Berlin*)
Michael Hintermüller (*Humboldt University and Weierstrass Institute Berlin*)

16:00 Deep regularization for medical image analysis

Kerstin Hammernik (*Graz University of Technology*)
Teresa Klatzer (*Graz University of Technology*)
Erich Kobler (*Graz University of Technology*)
Thomas Pock (*Graz University of Technology*)

16:30 Joint reconstruction and segmentation from undersampled MRI data

Veronica Corona (*University of Cambridge*)

17:00 Learning a sampling pattern for MRI

Ferdia Sherry (*University of Cambridge*)

17:30 Structural adaptation for noise reduction in magnetic resonance imaging

Karsten Tabelow (*Weiestrass Institute Berlin*)

MS6-2 TIME-DEPENDENT PROBLEMS IN IMAGING

Tuesday, 05 at 16:00
Room L (Palazzina B - Building B, floor 0)

Time-dependent imaging problems have a broad range of applications and are a lively field of research. Classical tomographic techniques represent inverse problems that are stationary in the sense that neither the searched quantity, nor the data depend on time. So far solution methods for dynamic inverse problems seemed too time-consuming and demanded too much memory capacity to become interesting for real-world applications. However, imaging modalities with data and/or parameters that depend on time attracted much notice over the last years, demanding for innovative inversion and analysis techniques that particularly take into account the physical meaning of the additional temporal variable.

Organizers:
Thomas Schuster (*Saarland University*)

Anne Wald (*Saarland University*)

16:00 A reconstruction method for multi-modal imaging

Leonidas Mindrinos (*Computational Science Center, University of Vienna*)

16:30 Numerical treatment of inverse heat transfer problems

Dimitri Rothermel (*Saarland University*)

17:00 All-at-once versus reduced version of Landweber-Kaczmarz for parameter identification in time dependent problems

Tram Thi Ngoc Nguyen (*Alpen-Adria-Universität Klagenfurt*)

17:30 Regularizing sequential subspace optimization for the identification of the stored energy of a hyperelastic structure

Rebecca Klein (*Saarland University*)

MS7-2 LIMITED DATA PROBLEMS IN IMAGING

Tuesday, 05 at 16:00
Room I (Palazzina B - Building B, floor 0)

Since the breakthrough of CT, many innovative concepts have been developed such as dynamic imaging, photoacoustic tomography, Compton imaging, etc, and studied via associated inverse problems. Each novel technique brings new mathematical challenges and technical constraints. The limited data issue constitutes the most common constraint and one of the main challenges. In this case, a substantial part of the data are unavailable changing deeply the nature of the ill-posed problem and making image reconstruction more complex. This minisymposium will bring together researchers from the inverse problems and imaging communities related to this issue and will promote discussions among participants.

Organizers:
Bernadette Hahn (*University of Würzburg*)
Gaël Rigaud (*Saarland University*)
Jürgen Frikel (*OTH Regensburg*)

16:00 On limited data issues in Compton scattering imaging

Gaël Rigaud (*Saarland University*)

16:30 A new reconstruction strategy for compressed sensing photoacoustic tomography

Thomas Berger (*RECENDT Research Center for Non Destructive Testing GmbH*)
Markus Haltmeier (*University Innsbruck*)
Linh Nguyen (*University of Idaho*)

17:00 Reconstructions from incomplete tomographic data in PAT

Jürgen Frikel (*OTH Regensburg*)

17:30 Algorithms for dynamic tomography with limited data

Samuli Siltanen (*University of Helsinki*)

MS8-2 KRYLOV METHODS IN IMAGING: INVERSE PROBLEMS, DATA ASSIMILATION, AND UNCERTAINTY QUANTIFICATION

Tuesday, 05 at 16:00
Room E (Palazzina A - Building A, floor 2)

Krylov methods have played and continue to play a critical role in the development of iterative techniques for solving inverse problems that arise in many important imaging applications such as image deblurring and tomographic reconstruction. This minisymposium will highlight recent developments on Krylov methods for large-scale inverse problems, data assimilation and uncertainty quantification.

Organizers:
Arvind Saibaba (*North Carolina State University*)
Julianne Chung (*Virginia Tech*)
Eric de Sturler (*Virginia Tech*)

16:00 Krylov, Bayes and L2 magic.

Daniela Calvetti (*Case Western Reserve University*)
Erkki Somersalo (*Case Western Reserve University*)
Alexander Strang (*Case Western Reserve University*)

16:30 Adaptative preconditioning for TV regularization

Silvia Gazzola (*University of Bath*)
Malena Sabate Landman (*University of Bath*)

17:00 Regularization parameter convergence for hybrid RSVD methods

Anthony Helmstetter (*Arizona State University*)
Rosemary Renaut (*Arizona State University*)
Saeed Vatankhah (*University of Tehran*)

17:30 Truncation and Recycling Methods for Lanczos Bidiagonalization and Hybrid Regularization

Julianne Chung (*Virginia Tech*)
Eric de Sturler (*Virginia Tech*)

MS9-2 INNOVATIVE MODELS AND ALGORITHMS FOR ASTRONOMICAL IMAGING

Tuesday, 05 at 16:00
Room D (Palazzina A - Building A, floor 1)

The next generation of astronomical imaging instruments provides the chance for an unprecedented step forward in our knowledge of how the universe evolved. It also poses incredible challenges due to the huge amount of data to be processed and the need for a precise and self-consistent analysis of images with widely different depths and resolutions. Defining new approaches to restore, segment and analyse such images is both a fundamental and a challenging task. By combining experiences from two different fields, astrophysics and mathematics, this minisymposium aims at creating an interdisciplinary bridge that can be an enrichment for both research areas.

Organizers:
Silvia Tozza (*INdAM/Dept. Mathematics, University of Rome "La Sapienza"*)
Marco Castellano (*INAF Osservatorio Astronomico di Roma*)

Maurizio Falcone (*Dipartimento di Matematica, Università di Roma "La Sapienza"*)
Adriano Fontana (*INAF Osservatorio Astronomico di Roma*)

16:00 Separation and Extraction of Structural Components in Astronomical Images

Alexander Menshchikov (*DAp, IRFU, CEA Saclay, Paris*)

16:30 An approximate nonnegative matrix factorization algorithm for astronomical imaging

Carmelo Arcidiacono (*INAF Osservatorio Astronomico di Bologna*)

17:00 Accurate wavefront reconstruction for real-time AO with pyramid wavefront sensors

Victoria Hutterer (*Industrial Mathematics Institute Johannes Kepler University, Linz*)

17:30 Reconstruction of hard X-ray images of solar flares by means of compressed sensing

Miguel Duval Poo (*Dipartimento di matematica, University of Genoa*)
Anna Maria Massone (*CNR - SPIN*)
Michele Piana (*Dept. Mathematics, University of Genoa*)

MS10-2 ADVANCED OPTIMIZATION METHODS FOR IMAGE PROCESSING

Tuesday, 05 at 16:00
Room G (Palazzina A - Building A, floor 0)

The development of efficient optimization methods applicable to large scale image processing tasks is an important and current research topic as it leads to improvements in speed and stability or the ability of revealing hidden image properties. The goal of this minisymposium is to discuss and compare image and video processing tasks addressed by means of powerful and efficient optimization algorithms, with particular attention devoted to non-smooth or non convex cost functions. The presentations in this minisymposium discuss both theoretical aspects as well as concrete applications of state-of-the-art optimisation methods relevant to modern mathematical imaging.

Organizers:
Marco Prato (*University of Modena and Reggio Emilia*)
Ignace Loris (*Université Libre de Bruxelles*)

16:00 A variational Bayesian approach for image restoration with Poisson-Gaussian noise

Emilie Chouzenoux (*Université Paris-Est Marne-la-Vallée*)
Yosra Marnissi (*Université Paris-Est Marne-la-Vallée*)
Jean-Christophe Pesquet (*Université Paris-Saclay*)
Yuling Zheng (*IBM Research China*)

16:30 Proximity operator of a sum of functions: Application to image segmentation

Laurent Condat (*Université Grenoble Alpes*)
Nelly Pustelnik (*CNRS, Laboratoire de Physique de l'ENS de Lyon*)

17:00 Fast algorithms for nonlocal myriad filtering

Friederike Laus (*Technische Universität Kaiserslautern*)
Fabien Pierre (*Université de Lorraine*)
Gabriele Steidl (*University of Kaiserslautern*)

17:30 A fast algorithm for non-convex optimization in highly under-sampled MRI

Damiana Lazzaro (*Dept. Mathematics, University of Bologna*)
Elena Loli Piccolomini (*Dept. Computer Science and Engineering, University of Bologna*)
Fabiana Zama (*Dept. Mathematics, University of Bologna*)

MS11-2 COMPUTATIONAL IMAGING FOR MICRO- AND NANO-STRUCTURES IN MATERIALS SCIENCE

Tuesday, 05 at 16:00
Room C (Palazzina A - Building A, floor 1)

In microscopy, the proliferation of digital data resulting from an increasing number of sensors, and automated data capture, has created opportunities for rich characterization of structures in materials. Whereas traditional characterization involved small numbers of 2-D images that were hand analyzed, modern techniques can capture image sequences involving hundreds of individual images, leading to characterization over "large volumes," as compared with traditional approaches. Multiple sensors have allowed for multimodal data collection; robotics has allowed for automated data preparation and collection; and increasing storage capacities have lead to large datasets. The availability of this type of data, which primarily involves imaging modalities, has created an opportunity for modern Computational Imaging (CI) methods to be applied to obtain vast improvements in the quality of micro- and nano-structure analyses as well as their complexity. Traditionally, quantitative analysis of microscope imagery has relied upon forward modeling for testing hypotheses. CI, with its emphasis on inversion methods, represents a largely unexplored methodology in this field. This symposium brings together CI researchers from Imaging Science, Materials Science, and other fields who are applying techniques such as statistical image processing, model-based regularization, sparsity, denoising methods, optics, and the integration of the physics of structure formation towards advancing the science of microscopy.

Organizers:
Brendt Wohlberg (*Los Alamos National Laboratory*)
Jeff Simmons (*Air Force Research Laboratory*)

16:00 Physics-based Regularization for Denoising Polycrystalline Material Images

Charles Bouman (*Purdue University*)
Jeffrey Rickman (*Materials Science and Engineering/Physics; Lehigh University*)
Jeff Simmons (*Air Force Research Laboratory*)
Amirkoshyar Ziabari (*Electrical and Computer Engineering; Purdue University*)

16:30 Convolutional sparse coding based regularizers for tomographic inverse problems

Singanallur Venkatakrishnan (*Oak Ridge National Laboratory*)
Brendt Wohlberg (*Los Alamos National Laboratory*)

17:00 Incorporating Physical Constraints and Regularization in Min-cut/Max-flow Graph Partitioning for Segmentation and Clustering in Materials Imaging

Alexander Brust (*The Ohio State University*)
Stephen Niezgoda (*The Ohio State University*)
Eric Payton (*Air Force Research Laboratory*)

17:30 Regularized Image Reconstruction for Nonlinear Diffractive Imaging

Ulugbek Kamilov (*Washington University in St. Louis*)
Hassan Mansour (*Mitsubishi Electric Research Laboratories (MERL)*)
Brendt Wohlberg (*Los Alamos National Laboratory*)

MS12-2 NEW DIRECTIONS IN HYBRID DATA TOMOGRAPHY

Tuesday, 05 at 16:00
Room F (Palazzina A - Building A, floor 2)

The reconstruction problems in optical and electrical tomography, such as Optical Diffusion Tomography and Electrical Impedance Tomography, are known to be severely ill-posed. In recent years several modalities have been introduced that circumvents the ill-posedness by introducing another physical modality. This leads to systems of coupled partial differential equations. By using the coupled-physics approach, reconstructions can then be computed with fine resolution and high contrast. To retrieve accurate information from the coupled data one solves the so-called quantitative reconstruction problem. In this mini-symposium we bring together experts working on different quantitative reconstruction problems with hybrid data and discuss future directions.

Organizers:
Kim Knudsen (*Technical University of Denmark*)
Cong Shi (*Georg-August-Universität Göttingen*)

16:00 Why does stochastic gradient descent work for inverse problems ?

Bangti Jin (*University College London*)

16:30 Non-zero constraints in quantitative coupled physics imaging

Giovanni S. Alberti (*University of Genoa*)

17:00 Quantitative reconstructions by combining photoacoustic and optical coherence tomography

Peter Elbau (*University of Vienna*)

17:30 Spectral properties of the forward operator in photo-acoustic tomography

Mirza Karamehmedović (*Technical University of Denmark*)

MS13-2 OPTIMIZATION FOR IMAGING AND BIG DATA

Tuesday, 05 at 16:00
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

A large number of Imaging and Big Data applications can be modeled as large-scale optimization problems. Numerical methods that both guarantee some theoretical properties and give good performance are needed when dealing with those problems. The aim of this minisyposium is to describe some novel techniques for such data-intensive applications, as well as emerging challenges in the area. The speakers shall particularly talk about recent interesting applications of optimization techniques to solve problems arising from imaging science, signal processing, wireless communications, machine learning, data mining, information theory, and statistics.

Organizers:
Margherita Porcelli (*University of Firenze*)
Francesco Rinaldi (*University of Padova*)

16:00 Exact spectral-like gradient method for distributed optimization

Nataša Krejić (*University of Novi Sad*)

16:30 Douglas-Rachford iterations for TV - TGV - and constrained TGV - Denoising

Birgit Komander (*Technische Universität Braunschweig*)
Dirk Lorenz (*Technische Universität Braunschweig*)
Lena Vestweber (*Technische Universität Braunschweig*)

17:00 Optimization in inverse problems via iterative regularization

Guillaume Garrigos (*Ecole Normale Supérieure, CNRS*)
Lorenzo Rosasco (*University of Genoa, Istituto Italiano di Tecnologia; Massachusetts Institute of Technology*)
Silvia Villa (*Politecnico di Milano*)

17:30 Stochastic Approximation Method with Second Order Search Direction

Nataša Krejić (*University of Novi Sad*)
Natasa Krklec Jerinkic (*University of Novi Sad*)
Zoran Ovcin (*Faculty of Technical Sciences, University of Novi Sad*)

MS14-2 DENOISING IN PHOTOGRAPHY AND VIDEO

Tuesday, 05 at 16:00
Room A (Palazzina A - Building A, floor 0)

The problem of removing noise from images has a long and rich history. Despite the vast amount of literature and the quality of current algorithms, it remains an open challenge. This is especially true when using photo, video and cinema cameras, where the push towards ever increasing resolution and dynamic range implies ever increasing demands on denoising performance. This minisymposium presents state of the art methods that cover representative, but in no way exhaustive, aspects in this field, from noise models to algorithm evaluation, from fast real-time in-camera techniques to powerful and computationally intensive methods for off-line processing.

Organizers:
Stacey Levine (*Duquesne University*)
Marcelo Bertalmío (*University Pompeu Fabra*)

16:00 Toward efficient and flexible CNN-based solutions for denoising in photography

Pengju Liu (*Harbin Institute of Technology*)
Kai Zhang (*The Hong Kong Polytechnic University*)
Lei Zhang (*Hong Kong Polytechnic University*)

Wangmeng Zuo (*Harbin Institute of Technology*)

16:30 Restoration of noisy and compressed video sequences

Toni Buades (*Universitat de les Illes Balears*)

17:00 Modeling and removal of correlated noise: towards effective approximate models

Lucio Azzari (*Tampere University of Technology*)
Alessandro Foi (*Tampere University of Technology*)
Ymir Mäkinen (*Tampere University of Technology*)

17:30 High-Dimensional Mixture Models For Unsupervised Image Denoising

Julie Delon (*Université Paris Descartes*)

MS15-2 NONLINEAR DIFFUSION: MODELS, EXTENSIONS AND ALGORITHMS

Tuesday, 05 at 16:00
Room B (Palazzina A - Building A, floor 1)

Nonlinear diffusion and its various extensions covering a large class of image processing models play important roles in practical tasks such as image restoration, inpainting, segmentation, registration. There are many research groups employing and developing essentially similar and related models and tools. This mini-symposium aims to bring together such researchers together to showcase the state of arts models and the most recent results, and to exchange ideas for further development and collaboration. The invited talks will cover not only the partial differential equations (PDEs) of the second order, but also PDE models of varying orders such as 4th order and fractional orders. Suitable adaptivity in designing nonlinear coefficients, anisotropic weights and feature based differential order or coefficients is a key in improving the more traditional models. This has been done in a number of ways. Effective algorithms are of vital importance in approximating numerical solutions to the concerned models, especially if we intend for such models to find wide and practical use in the diverse fields of imaging sciences. The mini-symposium should be of interest to all researchers in the community. Organised by Joachim Weickert (Saarland University, Germany), Xue-cheng Tai (Hong Kong Baptist University, China) Ke Chen (University of Liverpool, UK)

Organizers:
Ke Chen (*University of Liverpool*)
Joachim Weickert (*Saarland University*)
Xue-Cheng Tai (*Hong Kong Baptist University*)

16:00 Spectral analysis of nonlinear flows

Gilboa Guy (*Electrical Engineering Department, Technion*)

16:30 Fractional order variational models for image restoration and other problems

Ke Chen (*University of Liverpool*)

17:00 Keeping Backward Diffusion Under Control: Discrete Analysis and Numerics

Martin Welk (*Private University for Health Sciences, Medical Informatics and Technology (UMIT)*)

17:30 Partial Differential Equations and Image Segmentation in Medical Imaging

Luis Alvarez (*Universidad de Las Palmas de Gran Canaria*)
Jesús Ildefonso Díaz (*Departamento de Matemática Aplicada. Universidad Complutense de Madrid*)

CP2 CONTRIBUTED SESSION 2

Tuesday, 05 at 16:00
Room 1 (Redenti, floor 0)

Chairs:
Serena Morigi (*Dept. Mathematics, University of Bologna*)

16:00 Fractional differentiation for image classification

Giovanni Franco Crosta (*University of Milan Bicocca, Dept. Earth- and Environmental Sciences*)

16:20 Hurst Parameter Estimation of Fractional Brownian Surfaces

Olivier Coulon (*Aix-Marseille University, Institut de Neurosciences de La Timone*)
Julien Lefèvre (*Aix-Marseille University*)
Hamed Rabiei (*Aix-Marseille University*)
Frédéric Richard (*Aix-Marseille University*)

16:40 Error Analysis for Filtered Back Projection Reconstructions in Fractional Sobolev Spaces

Matthias Beckmann (*University of Hamburg*)
Armin Iske (*Dept. Mathematics, University of Hamburg*)

17:00 Unsupervised Segmentation of Colonic Polyps in NBI Images based on Wasserstein distances

Isabel Figueiredo (*University of Coimbra*)
Pedro Figueiredo (*Faculty of Medicine, University of Coimbra and Department of Gastroenterology, CHUC, Coimbra*)
Luís Pinto (*Department of Mathematics, University of Coimbra*)
Richard Tsai (*Department of Mathematics, University of Texas at Austin, and KTH Royal Institute of Technology, Sweden.*)

17:20 PDE based Segmentation of Vector-valued Texture Images using Sobolev Gradients

Noor Badshah (*University of Engineering and Technology Peshawar*)
Hassan Shah (*University of Engineering and Technology Peshawar*)
Fahim Ullah (*University of Engineering and Technology Peshawar*)

17:40 Variational Shape Prior Segmentation With an Initial Curve Based on Image Registration Technique

Chang-Ock Lee (*KAIST*)
Doyeob Yeo (*Electronics and Telecommunications Research Institute*)

Wednesday, June 06

IP3 FAKE ID DOCUMENTS AND COUNTERFEITED PRODUCTS: OVERVIEW OF IMAGE ANALYSIS TECHNIQUES TO FIGHT THEM

Wednesday, 06 at 08:15
Room A (Palazzina A - Building A, floor 0)

TBD

Chairs:
Stacey Levine (*Duquesne University*)

Clarisse Mandridake (*Surys group*)

MS16-1 TOPOLOGICAL IMAGE ANALYSIS: METHODS, ALGORITHMS, APPLICATIONS

Wednesday, 06 at 09:30
Room P (Palazzina B - Building B, floor 0)

Topological data analysis is having a relevant impact on imaging science, since it supplies an efficient way of extracting qualitative information and making it available for quantitative comparison. This minisymposium will provide a forum for discussion and dissemination of recent developments in topological analysis of images and visual data. The presentations will address the exposition of new theoretical results and techniques based on topology, algebraic topology and geometry for interpreting and understanding the information contained in images.

Organizers:
Patrizio Frosini (*University of Bologna*)
Massimo Ferri (*University of Bologna*)
Claudia Landi (*University of Modena and Reggio Emilia*)

09:30 Methods, Algorithms and Applications in Topological Image Analysis

Claudia Landi (*University of Modena and Reggio Emilia*)

10:00 Functional data analysis using a topological summary statistic: an application to brain cancer imaging

Andrew X. Chen (*Department of Systems Biology at Columbia University*)
Anthea Monod (*Columbia University*)

10:30 Discrete Morse theory for image analysis

Tamal Krishna Dey (*The Ohio State University*)

11:00 Spectral geometry of shapes under topological alterations and its application to shape matching

Luca Cosmo (*Ca' Foscari University of Venice*)
Emanuele Rodolà (*University of Rome "La Sapienza", Dip. di Informatica*)

MS17 DISCRETE-TO-CONTINUUM GRAPHICAL METHODS FOR LARGE-DATA CLUSTERING, CLASSIFICATION AND SEGMENTATION

Wednesday, 06 at 09:30
Room M (Palazzina B - Building B, floor 0)

Graph methods for machine learning have been found to be extraordinarily successful in several imaging and data analysis applications. They aim to build a graph from the data by encoding similarities between elements and use possible non-local similarity measures for comparison, clustering and classification. The study of large-data limits of state-of-the-art graph models such as Ginzburg-Landau functionals, Cheeger cuts etc. is fundamental for the design of efficient optimisation strategies. In this mini-symposium we gather experts in the field of mathematical graph modelling and large-data convergence to highlight analogies and differences between continuum and discrete variational models for data analysis.

Organizers:
Matthew Thorpe (*University of Cambridge*)
Luca Calatroni (*CMAP, École Polytechnique CNRS*)
Daniel Tenbrinck (*University of Münster*)

Scaling Results in Lp Regularised Semi-Supervised Learning

Matthew Thorpe (*University of Cambridge*)

10:00 Discrete to continuum limit of the graph Ginzburg-Landau functional

Yves van Gennip (*University of Nottingham*)

10:30 Gromov-Hausdorff limit of Wasserstein spaces on point clouds

Garcia Trillos Nicolas (*Brown University*)

11:00 Large data and zero noise limits of graph-based semi-supervised learning algorithms

Matt Dunlop (*Caltech*)

MS18 FUNCTIONAL NEUROIMAGING METHODS FOR EXPERIMENTAL DATA

Wednesday, 06 at 09:30
Room 2 (Redenti, floor 1)

Computation is crucial for information extraction in functional neuroimaging. Indeed, functional images provide representations of complex conditions whose interpretation requires the use of sophisticated computational techniques. This mini-symposium provides an overview of up-to-date methods and applications concerning a wide spectrum of functional neuroimaging problems. As for applications, imaging modalities will range from neurophysiology, through PET to fMRI. As for methodologies, the mathematics considered will involve inverse and forward modeling, pattern recognition, image integration, connectivity analysis. Common trait of these contributions will be the use of experimental measurements, acquired in health and disease, under lab and clinical conditions.

Organizers:
Anna Maria Massone (*CNR - SPIN*)

09:30 Image processing for the investigation of glucose metabolism in patients of ALS

Cristina Campi (*University of Padoa*)
Anna Maria Massone (*CNR - SPIN*)

10:00 Predicting brain atrophy progression from the healthy brain connectome

Sara Garbarino (*Universite de la Cote d'Azur and INRIA Sophia Antipolis*)

10:30 Conductivity models for functional neuroimaging

Maureen Clerc (*INRIA Sophia Antipolis-Méditerranée*)

11:00 Brain imaging from MEG data: an unsupervised clustering approach for source space reduction

Lauri Parkkonen (*Aalto University*)
Narayan Puthanmadam Subramaniyam (*Aalto University*)
Sara Sommariva (*Aalto University*)

MS19 BRAIN IMAGING: FROM NEUROSIGNALS TO FUNCTIONAL BRAIN MAPPING

Wednesday, 06 at 09:30
Matemates (Matemates, floor 0)

Our understanding of the functioning of the brain relies on minimally invasive imaging modalities, requiring advanced computational methods. New questions about brain functions pose computational challenges that need to be addressed by the imaging algorithms and by the data acquisition systems. The aim of the MS is to bring together mathematicians, computational scientists, and neuroscientists to discuss the most relevant advances in brain imaging. The main topics that will be addressed are brain modeling, signal and image processing, inversion methods, brain networks. The goal is to provide an interdisciplinary forum where scholars from different area will exchange ideas and discuss open.

Organizers:
Erkki Somersalo (*Case Western Reserve University*)
Francesca Pitolli (*Dept. of Basic and Applied Sciences for Engineering, University of Rome "La Sapienza"*)

09:30 Novel instrumentation and analysis approaches for brain imaging

Lauri Parkkonen (*Aalto University*)

10:00 Bayesian M/EEG brain mapping in the time and frequency domain

Gianvittorio Luria (*University of Genoa*)
Michele Piana (*Dept. Mathematics, University of Genoa*)
Sara Sommariva (*Aalto University*)
Alberto Sorrentino (*University of Genoa*)

10:30 "Hierarchical Bayesian Uncertainty Quantification for EEG/MEG Source Reconstruction"

Felix Lucka (*CWI & UCL*)

11:00 Phase Synchronization in MEG/EEG: methodological considerations and empirical evidence

Laura Marzetti (*Università degli Studi G. d'Annunzio Chieti e Pescara*)

MS20-1 ADVANCES IN RECONSTRUCTION METHODS FOR ELECTRICAL IMPEDANCE TOMOGRAPHY

Wednesday, 06 at 09:30
Room H (Palazzina B - Building B, floor 0)

Electrical Impedance Tomography (EIT) is an imaging modality wherein electrical current is applied to the surface of an object, surface voltages are measured, and this boundary data is used to reconstruct interior electrical properties. Numerous exciting applications for EIT are being developed by researchers in diverse fields. However, EIT reconstruction is an extremely ill-posed inverse problem, leading to significant challenges in the reconstruction process. Improved reconstruction methods, which seek to stabilize the inversion process, are therefore an active area of research. This minisymposium will bring together researchers from around the world to present the latest advances in EIT reconstruction methods.

Organizers:
Melody Alsaker (*Gonzaga University*)
Samuli Siltanen (*University of Helsinki*)

09:30 Nonlinear D-bar Reconstructions of 2D Human EIT Data with an Optimized Spatial Prior

Melody Alsaker (*Gonzaga University*)
Jennifer Mueller (*Colorado State University*)
Rashmi Murthy (*Colorado State University*)

10:00 Bayesian approximation of continuous boundary data for EIT

Sumanth Reddy Nakkireddy (*Case Western Reserve University*)

10:30 D-bar methods appliedto functionalpulmonary imaging: methods and clinical results

Jennifer Mueller (*Colorado State University*)

11:00 Electrical impedance tomography imaging via the Radon transform

Allan Greenleaf (*University of Rochester*)
Matti Lassas (*University of Helsinki*)
Matteo Santacesaria (*University of Helsinki*)
Samuli Siltanen (*University of Helsinki*)
Gunther Uhlmann (*University of Washington*)

MS21-1 RECENT MATHEMATICAL ADVANCES IN PHASE RETRIEVAL AND COMPUTATIONAL IMAGING

Wednesday, 06 at 09:30
Room I (Palazzina B - Building B, floor 0)

In many areas of science, one has access to magnitude only measurements. Phase retrieval is the problem of recovering a signal from such measurements. Due to its practical significance in imaging science, numerous heuristics have been developed to solve such problems. Novel theoretical developments and exciting new algorithms and applications have led to a renewed interest in phase retrieval. The proposed minisymposium focuses on recent theoretical results showing the success of nonconvex optimization algorithms as well as spectacular recent research efforts in imaging applications. A special emphasis is on theoretical and algorithmic developments that are tightly related to real-world applications.

Organizers:

Mahdi Soltanolkotabi (*University of Southern California*)
Tamir Bendory (*Princeton University*)

09:30 Denoising with spherically uniform neural layers

Dustin Mixon (*Department of Mathematics, Ohio State University*)

10:00 Fast Phase Retrieval from Windowed Fourier Measurements via Wigner Distribution Deconvolution + Angular Synchronization

Mark Iwen (*Department of Mathematics, Michigan State University*)
Sami Merhi (*Michigan State University*)
Michael Perlmutter (*Michigan State University*)

10:30 Nonconvex Sparse Blind Deconvolution: Geometry and Efficient Methods

Han-Wen Kuo (*Columbia University*)
John Wright (*Department of Electrical Engineering, Columbia University*)
Yuqian Zhang (*Columbia University*)

11:00 Invariants for cryo-EM and multireference alignment

Tamir Bendory (*Princeton University*)

MS22-1 MAPPING PROBLEMS IN IMAGING, GRAPHICS AND VISION

Wednesday, 06 at 09:30
Room L (Palazzina B - Building B, floor 0)

Many tasks in imaging, computer graphics and computer vision can be formulated as a mapping problem. The goal is to look for a suitable mapping between two corresponding data. Some examples include finding surface parameterization for texture mapping in computer graphics, warping map for image registration and shape matching for shape analysis. It calls for effective algorithms to compute meaningful mappings with desirable constraints. Recently, there are tremendous developments in the area of mapping problems. This mini-symposium aims at enhancing interaction of scholars working in this field.

Organizers:
Ronald Lui (*Chinese University of Hong Kong*)
Ke Chen (*University of Liverpool*)

09:30 A fast solver for locally rigid image registration

James Herring (*Emory University*)

10:00 A new constrained image registration model to avoid folding

Ke Chen (*University of Liverpool*)
Jin Zhang (*Liao-Cheng University*)

10:30 Medical image analysis based on artificial intelligence and its clinical application

Dexing Kong (*Zhejiang University*)

11:00 Longitudinal MRI brain analysis on image manifold

Shi-hui Ying (*Shanghai University*)

MS23-1 MULTI-MODALITY/MULTI-SPECTRAL IMAGING AND STRUCTURAL PRIORS

Wednesday, 06 at 09:30
Room F (Palazzina A - Building A, floor 2)

Multi-channel (either multi-modality or multi-spectral) has become increasingly interesting in many areas like medical imaging, remote sensing, photography and geophysics to name just a few. A standard approach is to treat the channels separately but as there is an expected correlation between the channels it became popular to treat them jointly. The channels can be coupled by a prior that takes the structure of the scenery / anatomy / geology into account. In this minisymposium we bring together several researchers to present recent theoretical and computational advances in the area of multi-channel imaging and structural priors.

Organizers:
Matthias J. Ehrhardt (*University of Cambridge*)
Simon Arridge (*University College London*)

09:30 Edge Aligning Image Regularizations

Michael Moeller (*University of Siegen*)

10:00 Incorporating feature space classification in multi-spectral image reconstruction

Simon Arridge (*University College London*)

10:30 Coupled regularization with multiple data discrepancies

Martin Holler (*École Polytechnique, Université Paris Saclay*)
Richard Huber (*University of Graz*)
Florian Knoll (*New York University*)

11:00 Magnetic particle imaging using prior information from MRI

Christine Bathke (*Center for Industrial Mathematics (ZeTem), University of Bremen*)

MS24-1 DATA-DRIVEN APPROACHES IN IMAGING SCIENCE

Wednesday, 06 at 09:30
Room G (Palazzina A - Building A, floor 0)

Images are one of the most useful forms of data in our daily lives, and rapid progress in imaging technologies has resulted in an explosion in the number of images captured. Due to the complex structure of images, it is difficult to develop a universal mathematical theory for solving real-world imaging problems. Recently, many data-driven approaches including dictionary learning, edge-driven methods and deep learning methods have demonstrated state-of-the-art performance in various imaging tasks. This mini-symposium aims to share and explore recent progress in these data-driven methods from both theoretical and practical perspectives.

Organizers:
Jae Kyu Choi (*Institute of Natural Sciences, Shanghai Jiao Tong University*)
Chenglong Bao (*Yau Mathematical Sciences Center, Tsinghua University*)

09:30 Algorithmic Self-Calibration in Computational Imaging

Michael Chen (*UC Berkeley*)
Regina Eckert (*UC Berkeley*)
Zachary Phillips (*UC Berkeley*)
Laura Waller (*University of California, Berkeley*)
Li Hao Yeh (*UC Berkeley*)

10:00 Wafer Defect Detection Algorithm Using Deep Learning Algorithms

Myung Joo Kang (*Department of Mathematical Sciences, Seoul National University*)

10:30 Deep Learning for Inverse Wave Scattering Problems

Jong Chul Ye (*Department of Bio and Brain Engineering, Korea Advanced Institute of Science and Technology*)
Jaejun Yoo (*KAIST*)
Yeo Hun Yoon (*KAIST*)

11:00 Computational models for Coherence retrieval

Chenglong Bao (*Yau Mathematical Sciences Center, Tsinghua University*)

MS26 NEW TRENDS IN INPAINTING

Wednesday, 06 at 09:30
Room E (Palazzina A - Building A, floor 2)

Inpainting, which refers to the process of inferring unknown parts of visual content, such as images, videos or surfaces, has witnessed spectacular progresses over the last 20 years, and has been a very fruitful stimulation for the mathematical modeling of such visual content. In this symposium, we aim at bringing together new models and new application fields, as well as stimulating exchanges between different scientific communities. Specifically, the symposium will address sparse inpainting for compression, convolutional neural networks for semantic inpainting, motion-consistent video inpainting, and surfaces interpolation.

Organizers:
Yann Gousseau (*Telecom ParisTech*)
Simon Masnou (*Université Lyon 1*)

09:30 Sparse Inpainting with Anisotropic Integrodifferential Operators

Joachim Weickert (*Saarland University*)

10:00 Image Completion by CNN with Global and Local Consistency

Hiroshi Ishikawa (*Waseda University*)

10:30 Higher-order total directional variation with imaging applications

Simon Masnou (*Université Lyon 1*)
Simone Parisotto (*University of Cambridge*)
Carola-Bibiane Schönlieb (*University of Cambridge*)

11:00 Motion Consistent Video Inpainting

Le Thuc Trinh (*Telecom ParisTech and University Lyon 2*)

MS27 COLOR IMAGING MEETS GEOMETRY

Wednesday, 06 at 09:30
Room C (Palazzina A - Building A, floor 1)

Color perception is a fascinating field of research which has inspired variational models for color correction. Recently, geometric approaches were added to the models to fit better with the human visual system, to treat various color spaces and to transport colors between images. The minisymposium will address recent developments in the field of geometrical color image processing reaching from the perception of brightness in color images, color enhancement and restoration in different color spaces to the colorization of images based on their geometry.

Organizers:
Gabriele Steidl (*University of Kaiserslautern*)
Edoardo Provenzi (*Université de Bordeaux*)

09:30 Resnikoff's geometrical framework for the space of perceived colors and locality of vision

Edoardo Provenzi (*Université de Bordeaux*)

10:00 Colorisation of LiDAR point cloud

Mathieu Bredif (*IGN*)
Aurélie Bugeau (*LaBRI / University of Bordeaux*)
Aujol Jean-Francois (*University of Bordeaux*)
Biasutti Pierre (*LaBRI / IMB / University of Bordeaux*)

10:30 Exemplar-based face colorization using image morphing

Fabien Pierre (*Université de Lorraine*)

11:00 A geometric model of brightness perception and its application to color images correction

Thomas Batard (*Technische Universität Kaiserslautern*)
Marcelo Bertalmío (*University Pompeu Fabra*)

MS28-1 DIFFEOMORPHIC IMAGE REGISTRATION: NUMERICS, APPLICATIONS, AND THEORY

Wednesday, 06 at 09:30
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

We discuss recent advances in diffeomorphic image registration and related correspondence and shape matching problems. Diffeomorphic image registration is a classical, ill-posed, non-linear, non-convex, inverse problem with numerous applications in imaging sciences. It typically involves an infinite number of unknowns, which, upon discretization, results in high-dimensional, ill-conditioned systems. Image registration poses significant numerical challenges. We will showcase state-of-the-art techniques in scientific computing to tackle these challenges, highlight new theoretical developments, and discuss challenging application scenarios that require tailored formulations to obtain plausible solutions.

Organizers:
Andreas Mang (*Department of Mathematics, University of Houston*)
George Biros (*Institute for Computational Engineering and Sciences, University of Texas at Austin*)

09:30 Modelling and complexity issues on large deformations for shape ensembles

Alain Trouvé (*Centre de Mathématiques et Leurs Applications*)

10:00 Optimal transport for diffeomorphic registration

François-Xavier Vialard (*University Paris-Dauphine*)

10:30 A Lagrangian Framework for Fast and Flexible Diffeomorphic Image Registration

Lars Ruthotto (*Department of Mathematics and Computer Science, Emory University*)

11:00 Statistically-constrained Robust Diffeomorphic Registration

Christos Davatzikos (*University of Pennsylvania*)
Aristeidis Sotiras (*University of Pennsylvania*)
Ke Zeng (*University of Pennsylvania*)

MS29 GEOMETRY AND LEARNING IN 3D SHAPE ANALYSIS

Wednesday, 06 at 09:30
Room A (Palazzina A - Building A, floor 0)

With the advance of modern technology and computer power, processing and analysis of 3D shapes becomes a ubiquitous task due to fast acquisition and frequent use of 3D data. Recent developments of machine learning bring many state-of-the-art results in image processing. However, extension of deep learning methods in 3D shape analysis is still in an early state due to the challenge of non-Euclidean structures of 3D shapes. The mini symposium aims at enhancing interaction of scholars working on learning methods for 3D shape analysis.

Organizers:
Ronald Lui (*Chinese University of Hong Kong*)
Rongjie Lai (*Rensselaer Polytechnic Institute*)

09:30 Learning Geometry

Ron Kimmel (*Technion - Israel Institute of Technology*)

10:00 Geometric Interpretation to GAN model

Xianfeng Gu (*State University of New York at Stony Brook*)

10:30 Tradeoffs between speed and accuracy in inverse problems

Alexander Bronstein (*Technion - Israel Institute of Technology*)

11:00 The Geometry of Synchronization Problems and Learning Group Actions

Tingrao Gao (*The University of Chicago*)

MS72-1 INVERSE PROBLEMS WITH IMPERFECT FORWARD MODELS

Wednesday, 06 at 09:30
Room D (Palazzina A - Building A, floor 1)

Inverse problems are typically concerned with the interpretation of indirectly measured data that are related to the quantities of interest (images) through models that describe the data acquisition. In practice, one has to deal not only with noisy or incomplete data, but also with simplified or imperfect models that cannot capture the mechanisms of data acquisition in full complexity. Correctly accounting for these imperfections is crucial for the development of stable numerical algorithms. The aim of this workshop is bringing together researchers working on different approaches to such problems arising in imaging in order to highlight similarities as well as differences and foster further collaboration.

Organizers:
Yury Korolev (*University of Cambridge*)
Martin Burger (*University of Muenster*)

09:30 A lattice analogue of the residual method for inverse problems with imperfect forward models

Martin Burger (*University of Muenster*)
Yury Korolev (*University of Cambridge*)

10:00 All-at-once formulation and regularization of inverse problems

Barbara Kaltenbacher (*Alpen-Adria-Universität Klagenfurt*)

10:30 Deep learning for trivial inverse problems

Hannes Albers (*University of Bremen*)
Tobias Kluth (*University of Bremen*)
Peter Maass (*University of Bremen*)

11:00 Spatio-temporal imaging by joint motion and image reconstruction and its application to spat-temporal MRI

Angelica I. Aviles-Rivero (*University of Cambridge*)
Carola-Bibiane Schönlieb (*University of Cambridge*)

MT1 COMPUTATIONAL UNCERTAINTY QUANTIFICATION FOR INVERSE PROBLEMS

Wednesday, 06 at 09:30
Room B (Palazzina A - Building A, floor 1)

The field of inverse problems is fertile ground for the development of computational uncertainty quantification methods. This is due to the fact that, on the one hand, inverse problems involve noisy measurements, leading naturally to statistical (and hence uncertainty) estimation problems. On the other hand, inverse problems involve physical models that, upon discretization, are known only up to a high-dimensional vector of parameters, making them computationally challenging. Estimating a high-dimensional parameter vector in a discretized physical model from measurements of model output defines computational inverse problems. Such problems are typically unstable in that the estimates don't depend continuously on the measurements. Regularization is a technique that provides stability for inverse problems, and in the Bayesian setting, it is synonymous with the choice of the prior probability density function. Once a prior is chosen, the posterior probability density function results, and it is the solution of the inverse problem in the Bayesian setting. The posterior maximizer – known as the MAP estimator – provides a stable estimate of the unknown parameters. However, uncertainty quantification requires that we extract more information from the posterior, which often requires sampling. The posterior density functions that arise in typical inverse problems are high-dimensional, and are often non-Gaussian, making the corresponding sampling problems challenging. In this mini-tutorial, I will begin with a discussion of inverse problems, move on to Bayesian statistics and prior modeling using Markov random fields, and then end with a discussion of some Markov chain Monte Carlo methods for sampling from posterior density functions that arise in inverse problems.

Chairs:
Julianne Chung (*Virginia Tech*)

John Bardsley (*Department of Mathematical Sciences, The University of Montana*)

CP3 CONTRIBUTED SESSION 3

Wednesday, 06 at 09:30
Room 1 (Redenti, floor 0)

Chairs:
Elena Loli Piccolomini (*Dept. Computer Science and Engineering, University of Bologna*)

09:30 Chest radiograph Image Enhancement, A Total Variation-Undecimated Wavelets Approach

Anthony Aidoo (*Eastern Connecticut State University*)

09:50 Spatiotemporal PET reconstruction using total variation based priors

Maïtine Bergounioux (*CNRS - Université d'Orléans UMR 7013*)
Evangelos Papoutsellis (*Université Francois Rabelais de Tours*)
Clovis Tauber (*UMRS Inserm U930, Imagerie et Cerveau, Université de Tours*)

10:10 Edge-Adaptive Image Reconstruction

Richard Archibald (*Oak Ridge National Laboratory*)
Victor Churchill (*Dartmouth College*)
Anne Gelb (*Dartmouth College*)

10:30 X-ray tomography in periodic slabs

Joonas Ilmavirta (*University of Jyväskylä*)

10:50 Quantitative Photoacoustic Tomography

Hwan Goh (*University of Auckland*)

11:10 Adaptive Truncated Total Least Squares for an Inverse Scattering Problem from Ultrasound Tomography

Mohamed Almekkaway (*The Pennsylvania State University*)
Jesse Barlow (*The Pennsylvania State University*)
Anita Carevic' (*University of Split*)
Ivan Slapnicar (*University of Split*)
Xingzhao Yun (*The Pennsylvania State University*)

MS2-3 INTERPOLATION AND APPROXIMATION METHODS IN IMAGING

Wednesday, 06 at 13:00
Room 2 (Redenti, floor 1)

Interpolation and approximation methods are crucial tools needed in image processing, at some or several stages. In fact, as in computer graphics, sometimes images are manually made from physical models of two and three dimensional objects. Since sophisticated approximation and interpolation techniques are building blocks of image restoration, signal recovery, volume data reconstruction, edge detection, object separation as well as prototyping, aim of this mini-symposium is to gather scientists to give notice of new mathematical methods relevant to all this area.

Organizers:
Alessandra De Rossi (*University of Torino*)
Costanza Conti (*University of Firenze*)
Francesco Dell'Accio (*University of Calabria*)

13:00 On Shannon sampling operators in Imaging

Gert Tamberg (*Tallinn University of Technology*)

13:30 Numerical methods for Mellin integral equations with applications in Imaging Science

Donatella Occorsio (*University of Basilicata*)
Maria Grazia Russo (*University of Basilicata*)

14:00 Approximation results for prototyping

Gianluca Vinti (*University of Perugia*)

14:30 Hexagonal Shepard method for scattered data interpolation

Francesco Dell'Accio (*University of Calabria*)
Filomena Di Tommaso (*University of Calabria*)

MS16-2 TOPOLOGICAL IMAGE ANALYSIS: METHODS, ALGORITHMS, APPLICATIONS

Wednesday, 06 at 13:00
Room P (Palazzina B - Building B, floor 0)

Topological data analysis is having a relevant impact on imaging science, since it supplies an efficient way of extracting qualitative information and making it available for quantitative comparison. This minisymposium will provide a forum for discussion and dissemination of recent developments in topological analysis of images and visual data. The presentations will address the exposition of new theoretical results and techniques based on topology, algebraic topology and geometry for interpreting and understanding the information contained in images.

Organizers:
Patrizio Frosini (*University of Bologna*)
Massimo Ferri (*University of Bologna*)
Claudia Landi (*University of Modena and Reggio Emilia*)

13:00 Persistent entropy: a statistical tool for separating topological features from noise

Rocío Gonzalez-Diaz (*Universidad de Sevilla*)

13:30 Local persistent homology of metric-measure spaces in image analysis

Washington Mio (*Florida State University*)

14:00 Computing persistent homology of images with(out) discrete Morse theory

Hubert Wagner (*IST Austria*)

14:30 Efficient computation of multipersistent homology and applications to data analysis and visualization

Leila De Floriani (*University of Maryland*)
Federico Iuricich (*City University of New York*)

MS20-2 ADVANCES IN RECONSTRUCTION METHODS FOR ELECTRICAL IMPEDANCE TOMOGRAPHY

Wednesday, 06 at 13:00
Room H (Palazzina B - Building B, floor 0)

Electrical Impedance Tomography (EIT) is an imaging modality wherein electrical current is applied to the surface of an object, surface voltages are measured, and this boundary data is used to reconstruct interior electrical properties. Numerous exciting applications for EIT are being developed by researchers in diverse fields. However, EIT reconstruction is an extremely ill-posed inverse problem, leading to significant challenges in the reconstruction process. Improved reconstruction methods, which seek to stabilize the inversion process, are therefore an active area of research. This minisymposium will bring together researchers from around the world to present the latest advances in EIT reconstruction methods.

Organizers:
Melody Alsaker (*Gonzaga University*)
Samuli Siltanen (*University of Helsinki*)

13:00 Acousto-Electric Tomography with limited data
Kim Knudsen (*Technical University of Denmark*)

13:30 Robust Absolute EIT Imaging in 2D
Sarah Hamilton (*Marquette University*)

14:00 Improving direct reconstructions from partial-boundary data in electrical impedance tomography
Andreas Hauptmann (*University College London*)

14:30 Reconstruction of a piecewise constant conductivity on a polygonal partition via shape optimization in EIT
Matteo Santacesaria (*University of Helsinki*)

MS21-2 RECENT MATHEMATICAL ADVANCES IN PHASE RETRIEVAL AND COMPUTATIONAL IMAGING

Wednesday, 06 at 13:00
Room I (Palazzina B - Building B, floor 0)

In many areas of science, one has access to magnitude only measurements. Phase retrieval is the problem of recovering a signal from such measurements. Due to its practical significance in imaging science, numerous heuristics have been developed to solve such problems. Novel theoretical developments and exciting new algorithms and applications have led to a renewed interest in phase retrieval. The proposed minisymposium focuses on recent theoretical results showing the success of nonconvex optimization algorithms as well as spectacular recent research efforts in imaging applications. A special emphasis is on theoretical and algorithmic developments that are tightly related to real-world applications.

Organizers:
Mahdi Soltanolkotabi (*University of Southern California*)
Tamir Bendory (*Princeton University*)

13:00 Phase retrieval by alternating projections for random Gaussian measurements
Irene Waldspurger (*CEREMADE (Université Paris-Dauphine)*)

13:30 Phase retrieval with structured measurements
Yonina Eldar (*Department of EE, Technion, Israel Institute of Technology, Haifa*)

14:00 Phase Retrieval Without Small-Ball Probability Assumptions
Felix Krahmer (*Technical University of Munich, Department of Mathematics*)
Yi-Kai Liu (*National Institute of Standards and Technology*)

14:30 What are heuristic phase retrieval algorithms and why you should care
Veit Elser (*Department of Physics, Cornell University*)

MS22-2 MAPPING PROBLEMS IN IMAGING, GRAPHICS AND VISION

Wednesday, 06 at 13:00
Room L (Palazzina B - Building B, floor 0)

Many tasks in imaging, computer graphics and computer vision can be formulated as a mapping problem. The goal is to look for a suitable mapping between two corresponding data. Some examples include finding surface parameterization for texture mapping in computer graphics, warping map for image registration and shape matching for shape analysis. It calls for effective algorithms to compute meaningful mappings with desirable constraints. Recently, there are tremendous developments in the area of mapping problems. This mini-symposium aims at enhancing interaction of scholars working in this field.

Organizers:
Ronald Lui (*Chinese University of Hong Kong*)
Ke Chen (*University of Liverpool*)

13:00 Non-isometric shape matching via conformal Laplace-Beltrami Basis Pursuit
Rongjie Lai (*Rensselaer Polytechnic Institute*)
Stephan Schonsheck (*Rensselaer Polytechnic Institute (RPI)*)

13:30 On a new multigrid algorithm for image segmentation
Ke Chen (*University of Liverpool*)
Mike Roberts (*University of Liverpool*)

14:00 Parametrising flat-foldable surfaces with incomplete data
Ronald Lui (*Chinese University of Hong Kong*)
Di Qiu (*The Chinese University of Hong Kong*)

14:30 Surface mapping using Teichmuller theory
Xianfeng Gu (*State University of New York at Stony Brook*)

MS23-2 MULTI-MODALITY/MULTI-SPECTRAL IMAGING AND STRUCTURAL PRIORS

Wednesday, 06 at 13:00
Room F (Palazzina A - Building A, floor 2)

Multi-channel (either multi-modality or multi-spectral) has become increasingly interesting in many areas like medical imaging, remote sensing, photography and geophysics to name just a few. A standard approach is to treat the channels separately but as there is an expected correlation between the channels it became popular to treat them jointly. The

channels can be coupled by a prior that takes the structure of the scenery / anatomy / geology into account. In this minisymposium we bring together several researchers to present recent theoretical and computational advances in the area of multi-channel imaging and structural priors.

Organizers:
Matthias J. Ehrhardt (*University of Cambridge*)
Simon Arridge (*University College London*)

13:00 Unbiased joint reconstruction in multi-modal biomedical imaging

Martin Burger (*University of Muenster*)

13:30 Multimodal Sparse Reconstruction Via Learning Cross-Modality Maps

Joao Mota (*Heriot-Watt University*)

14:00 Faster image reconstruction by stochastic optimization

Matthias J. Ehrhardt (*University of Cambridge*)

MS24-2 DATA-DRIVEN APPROACHES IN IMAGING SCIENCE

Wednesday, 06 at 13:00
Room G (Palazzina A - Building A, floor 0)

Images are one of the most useful forms of data in our daily lives, and rapid progress in imaging technologies has resulted in an explosion in the number of images captured. Due to the complex structure of images, it is difficult to develop a universal mathematical theory for solving real-world imaging problems. Recently, many data-driven approaches including dictionary learning, edge-driven methods and deep learning methods have demonstrated state-of-the-art performance in various imaging tasks. This mini-symposium aims to share and explore recent progress in these data-driven methods from both theoretical and practical perspectives.

Organizers:
Jae Kyu Choi (*Institute of Natural Sciences, Shanghai Jiao Tong University*)
Chenglong Bao (*Yau Mathematical Sciences Center, Tsinghua University*)

13:00 Partial Differential Equations in Manifold Learning

Zuoqiang Shi (*Tsinghua University*)

13:30 Machine Learning for Seismic Data Processing

Jianwei Ma (*Department of Mathematics, Center of Geophysics, Harbin Institute of Technology*)

14:00 Operator Norm Optimization for Structural Changes in Cryo-EM Imaging

Yunho Kim (*Department of Mathematical Sciences, Ulsan National Institute of Science and Technology*)

14:30 Exploiting Low-Quality Visual Data using Deep Networks

Zhangyang Wang (*Department of Computer Science and Engineering, Texas A&M University (TAMU)*)

MS31-1 VARIATIONAL APPROACHES FOR REGULARIZING NONLINEAR GEOMETRIC DATA

Wednesday, 06 at 13:00
Room M (Palazzina B - Building B, floor 0)

In various applications in science and engineering, the data do not take values in a vector space but in a nonlinear space such as a manifold. Examples are circle and sphere-valued data as appearing in SAR imaging and the space of positive matrices with the Fisher-Rao metric, which is the underlying data space for Diffusion Tensor Imaging. Many recent, successful methods for processing geometric data rely on variational approaches, i.e., the minimization of an energy functional. In this mini-symposium, we aim at bringing together researches with different areas of expertise, who share interest in variational approaches for geometric data.

Organizers:
Martin Storath (*Universität Heidelberg*)
Martin Holler (*École Polytechnique, Université Paris Saclay*)
Andreas Weinmann (*Hochschule Darmstadt*)

13:00 Metamorphosis and Schild's Ladder for One-Dimensional Shapes with Applications to the Classification of Cardiac Stem Cells

Giann Gorospe (*Johns Hopkins University*)
Rene Vidal (*Johns Hopkins University*)

13:30 Averaging positive-definite matrices

Pierre-Antoine Absil (*University of Louvain*)
Kyle Gallivan (*Florida State University*)
Julien Hendrickx (*UCLouvain*)
Estelle Massart (*UCLouvain*)
Yuan Xinru (*Florida State University*)

14:00 Curvature Regularization on Manifolds

Heeren Behrend (*University of Bonn*)
Martin Rumpf (*University of Bonn*)
Benedikt Wirth (*Universität Münster*)

14:30 Unsupervised Label Learning on Manifolds by Spatially Regularized Geometric Assignment

Artjom Zern (*Universität Heidelberg*)

MS32 NONLINEAR SPECTRAL THEORY AND APPLICATIONS (PART 1)

Wednesday, 06 at 13:00
Room C (Palazzina A - Building A, floor 1)

In recent years there have been advances in the theory of nonlinear eigenvalue problems related to image processing and computer vision. The formulations of nonlinear transforms, related to one-homogeneous functionals, such as total-variation, has opened way to various applications of image decomposition, face fusion, denoising and more. Theory related to 1-Laplacian eigenvectors on graphs has contributed to better understanding of classification, segmentation and clustering methods. In addition, new numerical methods for solving these hard problems have been proposed. In this two-part minisymposium researchers will present their latest results and discuss future trends in this emerging field.

Organizers:
Aujol Jean-Francois (*University of Bordeaux*)
Gilboa Guy (*Electrical Engineering Department, Technion*)

13:00 Introductory words and recent trends in nonlinear spectral processing

Gilboa Guy (*Electrical Engineering Department, Technion*)

13:30 Nonlinear Spectral Image Decomposition and its Application to Segmentation

Zeune Leonie (*University of Twente*)

14:00 Nonlinear spectral methods in machine learning

Matthias Hein (*University of Tuebingen*)

14:30 Spectral total-variation local scale signatures for image manipulation and fusion

Hait Ester (*Technion*)

MS34-1 NUMERICAL LINEAR ALGEBRA TECHNIQUES FOR IMAGE RESTORATION AND RECONSTRUCTION

Wednesday, 06 at 13:00
Room E (Palazzina A - Building A, floor 2)

Image Restoration and Reconstruction are crucial topics that finds application in different fields, such as medicine, engineering, as well as in several scientific fields. Among the different approaches, Numerical Linear Algebra offers various computationally attractive techniques, which can be combined also with sophisticated nonlinear models, exploiting particular matrix structure, working in low dimensional subspaces, estimating efficiently the regularization parameters, and developing iterative methods able to preserve possible constraints on the computed solution.

Organizers:
Caterina Fenu (*University of Cagliari*)
Marco Donatelli (*University of Insubria*)

13:00 IR Tools MATLAB Package for Large-Scale Inverse Problems: Introduction to Basic Capabilities

Silvia Gazzola (*University of Bath*)
Per Christian Hansen (*Technical University of Denmark*)
James Nagy (*Emory University*)

13:30 IR Tools MATLAB Package for Large-Scale Inverse Problems: Constrained Krylov Subspace Solvers

Silvia Gazzola (*University of Bath*)
Per Christian Hansen (*Technical University of Denmark*)
James Nagy (*Emory University*)

14:00 Multigrid iterative regularization for image deblurring

Alessandro Buccini (*Kent State University*)
Marco Donatelli (*University of Insubria*)

14:30 Unmatched Projector/Backprojector Pairs: Perturbation and Convergence Analysis

Tommy Elfving (*Linköping University*)
Per Christian Hansen (*Technical University of Denmark*)

MS35 OPTIMAL TRANSPORT AND PATCH BASED METHODS FOR COLOR IMAGE EDITING

Wednesday, 06 at 13:00
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

Editing consists in modifying image information or statistics. Most of editing approaches rely on patch-based models that are empirically optimized with greedy algorithms. It makes difficult the control of global statistics of the generated images. Optimal Transport (OT) is an alternative to optimize globally complex editing models. OT offers powerful and flexible tools to interpolate between statistics in large scale problems. It is nevertheless required to adapt OT models to define efficient color editing methods. This minisymposium thus focuses on recent works mixing patches and OT to deal with color transfer, style transfer, texture synthesis and image interpolation.

Organizers:
Nicolas Papadakis (*CNRS, Institut de Mathématiques de Bordeaux*)
Rabin Julien (*CNRS, Normandie Univ.*)

13:00 Inverse problems using regularized optimal transport for computer graphics

Nicolas Bonneel (*CNRS/LIRIS*)

13:30 Image and Video Unsupervised Style Transfer by Adaptive Patch Sampling

Neus Sabater (*Technicolor Research & Innovation*)

14:00 Semi-Discrete Optimal Transport in Patch Space for Enriching Gaussian Textures

Arthur Leclaire (*CMLA, ENS Cachan*)

14:30 Generalized Optimal Transport for Manifold-Valued Images.

Friederike Laus (*Technische Universität Kaiserslautern*)

MS36-1 COMPUTATIONAL METHODS FOR LARGE-SCALE MACHINE LEARNING IN IMAGING

Wednesday, 06 at 13:00
Room A (Palazzina A - Building A, floor 0)

Machine learning has become an essential tool for automatically analyzing imaging data and has already outperformed humans in some image classification tasks. Despite recent progress, there remain enormous challenges when processing large data sets such as image sequences, 3D images, and videos. This mini-symposium presents cutting edge imaging applications of machine learning as well as novel computational approaches for solving large-scale learning problems including advances in stochastic optimization, high-performance computing, and the design of deep neural networks.

Organizers:
Matthias Chung (*Virginia Tech*)
Lars Ruthotto (*Department of Mathematics and Computer Science, Emory University*)

13:00 Randomized Newton and quasi-Newton methods for large linear least squares problems

Julianne Chung (*Virginia Tech*)
Matthias Chung (*Virginia Tech*)
David Kozak (*Colorado School of Mines*)
J. Tanner Slagel (*Virginia Tech*)
Luis Tenorio (*Colorado School of Mines*)

13:30 End-to-end learning of CNN features in in discrete optimization models for motion and stereo

Patrick Knöbelreiter (*Graz University of Technology*)
Gottfried Munda (*Graz University of Technology*)
Thomas Pock (*Graz University of Technology*)
Christian Reinbacher (*Amazon*)
Alexander Shekhovtsov (*TU Prague*)

14:00 Memory-Optimal Deep Neural Networks

Helmut Bölcskei (*ETH Zürich*)
Philipp Grohs (*Universität Wien*)
Gitta Kutyniok (*Technische Universität Berlin*)
Philipp Petersen (*Technische Universität Berlin*)

14:30 A Batch-Incremental Video Background Estimation Model Using Weighted Low-Rank Approximation of Matrices

Aritra Dutta (*KAUST*)
Xin Li (*University of Central Florida*)
Peter Richtarik (*KAUST and University of Edinburgh*)

MS37-1 SPARSE-BASED TECHNIQUES IN VARIATIONAL IMAGE PROCESSING

Wednesday, 06 at 13:00
Room B (Palazzina A - Building A, floor 1)

The sparsity principle, which consists of representing some phenomena with as few variables as possible, has been recently exploited with success in variational image processing. Most of the activities in this context have been dedicated to two (overlapping) research areas. The first includes works pursuing the design of new sparsity-promoting priors both in synthesis-based, analysis-based, and hybrid models. The second deals with devising efficient and robust algorithms for solving the typically large scale and possibly non-smooth non-convex optimization problems raised by sparsity-constrained regularization. This mini-symposium addresses theoretical and numerical issues which arise from designing sparsity-promoting techniques in variational image processing.

Organizers:
Serena Morigi (*Dept. Mathematics, University of Bologna*)
Ivan Selesnick (*New York University*)
Alessandro Lanza (*Dept. Mathematics, University of Bologna*)

13:00 Alternating structure-adapted proximal gradient descent (ASAP) for nonconvex nonsmooth regularised problems with smooth coupling terms. Applications in imaging problems

Mila Nikolova (*CMLA - CNRS ENS Cachan, University Paris-Saclay*)
Pauline Tan (*CMLA, École normale supérieure Paris-Saclay*)

13:30 Class-adapted and Scene-Adapted Regularization for Imaging Inverse Problems

Mário Figueiredo (*Instituto de Telecomunicações and IST, University of Lisboa*)

14:00 Nonconvex regularization of numerical differentiation of noisy images

Rick Chartrand (*Descartes Labs*)

14:30 Robust and stable region-of-interest tomographic reconstruction by sparsity-inducing convex optimization

Demetrio Labate (*University of Houston*)

MS56-1 MATHEMATICAL AND COMPUTATIONAL ASPECTS IN MAGNETIC PARTICLE IMAGING

Wednesday, 06 at 13:00
Matemates (Matemates, floor 0)

Magnetic particle imaging (MPI) is a new imaging modality to determine the concentration of nanoparticles from their nonlinear magnetization behavior. Highly dynamic applied magnetic fields allow a rapid data acquisition in 3D. But the image reconstruction still relies on a time-consuming calibration process. The large model uncertainty is a great challenge for achieving reconstructions with higher resolution. In this mini-symposium, we aim at bringing together researchers working on magnetic particle imaging and related fields. We cover theoretical and practical topics in MPI focusing on mathematical and physical as well as algorithmic and computational issues of the reconstruction.

Organizers:
Tobias Kluth (*University of Bremen*)
Christina Brandt (*University of Hamburg*)

13:00 Mathematical models in magnetic particle imaging (MPI)

Tobias Kluth (*University of Bremen*)

13:30 Modeling the system function in MPI

Anne Wald (*Saarland University*)

14:00 Time-Frequency-Preprocessing of MPI Raw Signals

Florian Lieb (*University of Applied Sciences, Aschaffenburg*)
Hans-Georg Stark (*Hochschule Aschaffenburg*)

14:30 Model-based reconstruction for multivariate MPI

Andreas Weinmann (*Hochschule Darmstadt*)

MS72-2 INVERSE PROBLEMS WITH IMPERFECT FORWARD MODELS

Wednesday, 06 at 13:00
Room D (Palazzina A - Building A, floor 1)

Inverse problems are typically concerned with the interpretation of indirectly measured data that are related to the quantities of interest (images) through models that describe the data acquisition. In practice, one has to deal not only with noisy or incomplete data, but also with simplified or imperfect models that cannot capture the mechanisms of data acquisition in full complexity. Correctly accounting for these imperfections is crucial for the development of stable numerical algorithms. The aim of this workshop is bringing together researchers working on different approaches to such problems arising in imaging in order to highlight similarities as well as differences and foster further collaboration.

Organizers:
Yury Korolev (*University of Cambridge*)
Martin Burger (*University of Muenster*)

13:00 Bayesian imaging inverse problems with partially unknown models

Marcelo Pereyra (*Harriott-Watt University*)

13:30 Improved source estimation in EEG with Bayesian modelling of the unknown skull conductivity

Alexandra Koulouri (*Aristotle University of Thessaloniki*)

14:00 A time-regularized blind deconvolution method via non-convex optimisation

Arwa Dabbech (*Heriot-Watt University*)
Audrey Repetti (*Heriot-Watt University, Edinburgh*)
Pierre-Antoine Thouvenin (*Institut National Polytechnique de Toulouse*)
Yves Wiaux (*Heriot-Watt University*)

14:30 Accounting for model-errors in PDE-constrained optimization

Tristan van Leeuwen (*Utrecht University*)

CP4 CONTRIBUTED SESSION 4

Wednesday, 06 at 13:00
Room 1 (Redenti, floor 0)

Chairs:
Fabiana Zama (*Dept. Mathematics, University of Bologna*)

13:00 CORVO: a software tool for computing volume of complex biological structures in medical images and videos

Anna Baruzzi (*Department of Medicine, University of Verona*)
Sara Caldrer (*Department of Medicine, University of Verona*)
Michela Lecca (*Fondazione Bruno Kessler - Center for Information and Communication Technology*)
Paola Lecca (*Department of Medicine, University of Verona*)
Paola Melotti (*Centro Fibrosi Cistica Azienda Ospedaliera Universitaria Integrata Verona*)
Claudio Sorio (*Department of Medicine, University of Verona*)

13:20 Resampling Strategies in Medical Imaging

Hassan Mohy-ud-Din (*School of Science and Engineering, LUMS*)

13:40 Breast Cancer Classification via Deep Convolutional Neural Networks

Jue Wang (*Union College*)
Yongjian Yu (*Axon Connected LLC*)

14:00 Mathematical analysis of Magnetic Resonance Fingerprinting

Chris Stolk (*University of Amsterdam*)

14:20 Magnetic resonance-based quantitative imaging of the electric properties at radiofrequency without phase information.

Alessandro Arduino (*Istituto Nazionale di Ricerca Metrologica (INRiM)*)
Oriano Bottauscio (*Istituto Nazionale di Ricerca Metrologica (INRiM)*)
Mario Chiampi (*Politecnico di Torino*)
Luca Zilberti (*Istituto Nazionale di Ricerca Metrologica (INRiM)*)

MS2-4 INTERPOLATION AND APPROXIMATION METHODS IN IMAGING

Wednesday, 06 at 15:30
Room 2 (Redenti, floor 1)

Interpolation and approximation methods are crucial tools needed in image processing, at some or several stages. In fact, as in computer graphics, sometimes images are manually made from physical models of two and three dimensional objects. Since sophisticated approximation and interpolation techniques are building blocks of image restoration, signal recovery, volume data reconstruction, edge detection, object separation as well as prototyping, aim of this mini-symposium is to gather scientists to give notice of new mathematical methods relevant to all this area.

Organizers:
Alessandra De Rossi (*University of Torino*)
Costanza Conti (*University of Firenze*)
Francesco Dell'Accio (*University of Calabria*)

15:30 Object separation in videos by means of adaptive PCA

Tomas Sauer (*University of Passau*)

16:00 Subdivision-based deformable models for extracting volumetric structures from biomedical images

Anaïs Badoual (*EPFL, Lausanne*)
Lucia Romani (*University of Milano-Bicocca*)
Daniel Schmitter (*EPFL, Lausanne*)
Michael Unser (*EPFL, Lausanne*)

16:30 Mathematical methods of ptychographical imaging

Frank Filbir (*Helmholtz Center Munich*)
Rayan Saab (*University of California, San Diego*)
Christian Schroer (*DESY*)
Nada Sissouno (*University of Munich & Helmholtz Zentrum München*)

17:00 Multiple MRA and image processing

Mariantonia Cotronei (*University of Reggio Calabria*)

MS16-3 TOPOLOGICAL IMAGE ANALYSIS: METHODS, ALGORITHMS, APPLICATIONS

Wednesday, 06 at 15:30
Room P (Palazzina B - Building B, floor 0)

Topological data analysis is having a relevant impact on imaging science, since it supplies an efficient way of extracting qualitative information and making it available for quantitative comparison. This minisymposium will provide a forum for discussion and dissemination of recent developments in topological analysis of images and visual data. The presentations will address the exposition of new theoretical results and techniques based on topology, algebraic topology and geometry for interpreting and understanding the information contained in images.

Organizers:
Patrizio Frosini (*University of Bologna*)
Massimo Ferri (*University of Bologna*)

Claudia Landi (*University of Modena and Reggio Emilia*)

15:30 Topological Analysis of Biomedical Images

Chao Chen (*City University of New York*)
Federico Iuricich (*City University of New York*)

16:00 Polygonal meshes of superpixels for image over-segmentation based on topological skeletons

Vitaliy Kurlin (*University of Liverpool*)

16:30 Similarity assessment for the analysis and understanding of 3D shapes: from geometry to topology with an eye to semantics

Silvia Biasotti (*IMATI-CNR*)
Bianca Falcidieno (*IMATI-CNR*)
Michela Spagnuolo (*IMATI-CNR*)

17:00 Topological analytics for large-scale scientific data

Valerio Pascucci (*University of Utah*)

MS20-3 ADVANCES IN RECONSTRUCTION METHODS FOR ELECTRICAL IMPEDANCE TOMOGRAPHY

Wednesday, 06 at 15:30
Room H (Palazzina B - Building B, floor 0)

Electrical Impedance Tomography (EIT) is an imaging modality wherein electrical current is applied to the surface of an object, surface voltages are measured, and this boundary data is used to reconstruct interior electrical properties. Numerous exciting applications for EIT are being developed by researchers in diverse fields. However, EIT reconstruction is an extremely ill-posed inverse problem, leading to significant challenges in the reconstruction process. Improved reconstruction methods, which seek to stabilize the inversion process, are therefore an active area of research. This minisymposium will bring together researchers from around the world to present the latest advances in EIT reconstruction methods.

Organizers:
Melody Alsaker (*Gonzaga University*)
Samuli Siltanen (*University of Helsinki*)

15:30 Contrast enhancement in EIT imaging of the brain

Jari Kaipio (*The University of Auckland*)
Ville Kolehmainen (*University of Eastern Finland*)
Antti Nissinen (*University of Eastern Finland*)
Marko Vauhkonen (*University of Eastern Finland*)

16:00 Generalized linearization techniques and smoothened complete electrode model

Nuutti Hyvönen (*Aalto University*)

16:30 Image reconstruction in rotational EIT with limited boundary access

Edite Figueiras (*International Iberian Nanotechnology Laboratory*)
Jari Hyttinen (*Tampere University of Technology*)
Olli Koskela (*Tampere University of Technology*)
Mari Lehti-Polojärvi (*Tampere University of Technology*)
Aku Seppänen (*University of Eastern Finland*)

17:00 The Use of the Approximation Error Method and Bayesian Inference to Introduce Anatomical and Physiological Prior Information into D-bar Algorithms

Talles Santos (*Polytechnic School of University of São Paulo*)

MS22-3 MAPPING PROBLEMS IN IMAGING, GRAPHICS AND VISION

Wednesday, 06 at 15:30
Room L (Palazzina B - Building B, floor 0)

Many tasks in imaging, computer graphics and computer vision can be formulated as a mapping problem. The goal is to look for a suitable mapping between two corresponding data. Some examples include finding surface parameterization for texture mapping in computer graphics, warping map for image registration and shape matching for shape analysis. It calls for effective algorithms to compute meaningful mappings with desirable constraints. Recently, there are tremendous developments in the area of mapping problems. This mini-symposium aims at enhancing interaction of scholars working in this field.

Organizers:
Ronald Lui (*Chinese University of Hong Kong*)
Ke Chen (*University of Liverpool*)

15:30 Variational Diffeomorphic Models for Image Registration

Ke Chen (*University of Liverpool*)
Daoping Zhang (*University of Liverpool*)

16:00 Fuzzy based energy model for Segmentation of images using hybrid image data

Noor Badshah (*University of Engineering and Technology Peshawar*)

16:30 Topology Preserving Image Segmentation by Beltrami Signature of Images

Hei Long Chan (*The Chinese University of Hong Kong*)

17:00 Sobolev Gradient and Segmentation of Vector Valued Texture Images

Fahim Ullah (*University of Engineering and Technology Peshawar*)

MS24-3 DATA-DRIVEN APPROACHES IN IMAGING SCIENCE

Wednesday, 06 at 15:30
Room G (Palazzina A - Building A, floor 0)

Images are one of the most useful forms of data in our daily lives, and rapid progress in imaging technologies has resulted in an explosion in the number of images captured. Due to the complex structure of images, it is difficult to develop a universal mathematical theory for solving real-world imaging problems. Recently, many data-driven approaches including dictionary learning, edge-driven methods and deep learning methods have demonstrated state-of-the-art performance in various imaging tasks. This mini-symposium aims to share and explore recent progress in these data-driven methods from both theoretical and practical perspectives.

Organizers:
Jae Kyu Choi (*Institute of Natural Sciences, Shanghai Jiao Tong University*)
Chenglong Bao (*Yau Mathematical Sciences Center, Tsinghua University*)

15:30 Learned Experts' Assessment-Based Reconstruction Network ("LEARN") for Sparse-Data CT

Hu Chen (*Sichuan University*)
Yunjin Chen (*ULSee Inc.*)
Peixi Liao (*The Sixth People's Hospital of Chengdu*)
Yang Lv (*Shanghai United Imaging Healthcare Co., Ltd*)
Huaiqiang Sun (*West China Hospital of Sichuan University*)
Ge Wang (*Rensselaer Polytechnic Institute*)
Weihua Zhang (*Sichuan University*)
Yi Zhang (*School of Computer Science, Sichuan University*)

16:00 An Edge Driven Wavelet Frame Model for Image Restoration

Jae Kyu Choi (*Institute of Natural Sciences, Shanghai Jiao Tong University*)
Bin Dong (*Peking University*)
Xiaoqun Zhang (*Institute of Natural Sciences, School of Mathematical Sciences, and MOE-LSC, Shanghai Jiao Tong University*)

MS25 BILINEAR AND QUADRATRIC PROBLEMS IN IMAGING

Wednesday, 06 at 15:30
Room D (Palazzina A - Building A, floor 1)

Nonlinearity in inverse problems poses great challenges in terms of analysis and numerical solution. Among those, bilinear and quadratic problems cover important imaging applications such as blind deconvolution, parallel MRI, and de-autoconvolution, while still possessing sufficient structure to allow for a dedicated treatment. Recently, progress has been made in exploiting this structure, using variational methods as well as compressed sensing techniques, to develop new solution strategies for various practical instances of this problem class. The proposed minisymposium will bring together experts on bilinear and quadratic inverse problems in imaging to discuss recent developments and exchange the aforementioned new ideas.

Organizers:
Felix Krahmer (*Technical University of Munich, Department of Mathematics*)
Kristian Bredies (*Universität Graz*)

15:30 Regularization of bilinear and quadratic inverse problems by tensorial lifting

Robert Beinert (*University of Graz*)

15:30 Nonconvex methods for nanoscale, 3D phaseless imaging

Mahdi Soltanolkotabi (*University of Southern California*)

15:30 Calibrationless Reconstruction Methods in Magnetic Resonance Imaging

H. Christian M. Holme (*University Medical Center Göttingen*)
Sebastian Rosenzweig (*University Medical Center Göttingen*)
Martin Uecker (*University Medical Center Göttingen*)

15:30 Blind Demixing and Deconvolution at Near-Optimal Rate

Peter Jung (*Technical University of Berlin*)
Felix Krahmer (*Technical University of Munich, Department of Mathematics*)
Dominik Stoeger (*Technical University of Munich*)

MS28-2 DIFFEOMORPHIC IMAGE REGISTRATION: NUMERICS, APPLICATIONS, AND THEORY

Wednesday, 06 at 15:30
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

We discuss recent advances in diffeomorphic image registration and related correspondence and shape matching problems. Diffeomorphic image registration is a classical, ill-posed, non-linear, non-convex, inverse problem with numerous applications in imaging sciences. It typically involves an infinite number of unknowns, which, upon discretization, results in high-dimensional, ill-conditioned systems. Image registration poses significant numerical challenges. We will showcase state-of-the-art techniques in scientific computing to tackle these challenges, highlight new theoretical developments, and discuss challenging application scenarios that require tailored formulations to obtain plausible solutions.

Organizers:
Andreas Mang (*Department of Mathematics, University of Houston*)
George Biros (*Institute for Computational Engineering and Sciences, University of Texas at Austin*)

15:30 Non-parametric registration of medical image data using Schatten-q-Norms

Kai Brehmer (*Institute of Mathematics and Image Computing, University of Lübeck*)
Jan Modersitzki (*University of Luebeck*)
Benjamin Wacker (*University of Lübeck*)

16:00 Machine Learning Approaches for Deformable Image Registration

Marc Niethammer (*University of North Carolina at Chapel Hill*)

16:30 GPU Based Geodesics of Image Time Series

Benjamin Berkels (*RWTH Aachen University*)
Michael Buchner (*Institute for Numerical Simulation, University of Bonn*)
Alexander Effland (*Universität Bonn*)
Martin Rumpf (*University of Bonn*)

17:00 CLAIRE: A parallel solver for constrained large deformation diffeomorphic image registration

George Biros (*Institute for Computational Engineering and Sciences, University of Texas at Austin*)
Amir Gholami (*UC Berkeley*)
Andreas Mang (*Department of Mathematics, University of Houston*)

MS31-2 VARIATIONAL APPROACHES FOR REGULARIZING NONLINEAR GEOMETRIC DATA

Wednesday, 06 at 15:30
Room M (Palazzina B - Building B, floor 0)

In various applications in science and engineering, the data do not take values in a vector space but in a nonlinear space such as a manifold. Examples are circle and sphere-valued data as appearing in SAR imaging and the space of positive matrices with the Fisher-Rao metric, which is the underlying data space for Diffusion Tensor Imaging. Many recent, successful methods for processing geometric data rely on variational approaches, i.e., the minimization of an energy functional. In this mini-symposium, we aim at bringing together researches with different areas of expertise, who share interest in variational approaches for geometric data.

Organizers:
Martin Storath (*Universität Heidelberg*)
Martin Holler (*École Polytechnique, Université Paris Saclay*)
Andreas Weinmann (*Hochschule Darmstadt*)

15:30 A variational approach for Multi-Angle TIRF Microscopy

Vincent Duval (*INRIA*)

16:00 Variational approximation of data in manifolds using Geometric Finite Elements

Hanne Hardering (*TU Dresden*)

16:30 Edge-Parallel Inference with Graphical Models Using Wasserstein Messages and Geometric Assignment

Ruben Hühnerbein (*Universität Heidelberg*)

17:00 Total generalized variation for manifold-valued data

Kristian Bredies (*Universität Graz*)
Martin Holler (*École Polytechnique, Université Paris Saclay*)
Martin Storath (*Universität Heidelberg*)
Andreas Weinmann (*Hochschule Darmstadt*)

MS34-2 NUMERICAL LINEAR ALGEBRA TECHNIQUES FOR IMAGE RESTORATION AND RECONSTRUCTION

Wednesday, 06 at 15:30
Room E (Palazzina A - Building A, floor 2)

Image Restoration and Reconstruction are crucial topics that finds application in different fields, such as medicine, engineering, as well as in several scientific fields. Among the different approaches, Numerical Linear Algebra offers various computationally attractive techniques, which can be combined also with sophisticated nonlinear models, exploiting particular matrix structure, working in low dimensional subspaces, estimating efficiently the regularization parameters, and developing iterative methods able to preserve possible constraints on the computed solution.

Organizers:
Caterina Fenu (*University of Cagliari*)
Marco Donatelli (*University of Insubria*)

15:30 Point Spread Function Reconstruction and Blind Deconvolution from Adaptive Optics Data of Extremely Large Telescopes

Ronny Ramlau (*Kepler University Linz and Johann Radon Institute*)

16:00 An ℓ^2-ℓ^q regularization method for large discrete ill-posed problems

Alessandro Buccini (*Kent State University*)
Lothar Reichel (*Kent State University*)

16:30 Minimization of the GCV function for Tikhonov Regularization

Caterina Fenu (*University of Cagliari*)
Lothar Reichel (*Kent State University*)
Giuseppe Rodriguez (*University of Cagliari*)
Hassane Sadok (*Université du Littoral Côte d'Opale*)

17:00 Improving sharpness in geophysical imaging by TV-based regularization

Gian Piero Deidda (*University of Cagliari*)
Patricia Diaz De Alba (*University of Cagliari*)
Caterina Fenu (*University of Cagliari*)
Giuseppe Rodriguez (*University of Cagliari*)
Giulio Vignoli (*University of Cagliari*)

MS36-2 COMPUTATIONAL METHODS FOR LARGE-SCALE MACHINE LEARNING IN IMAGING

Wednesday, 06 at 15:30
Room A (Palazzina A - Building A, floor 0)

Machine learning has become an essential tool for automatically analyzing imaging data and has already outperformed humans in some image classification tasks. Despite recent progress, there remain enormous challenges when processing large data sets such as image sequences, 3D images, and videos. This mini-symposium presents cutting edge imaging applications of machine learning as well as novel computational approaches for solving large-scale learning problems including advances in stochastic optimization, high-performance computing, and the design of deep neural networks.

Organizers:
Matthias Chung (*Virginia Tech*)
Lars Ruthotto (*Department of Mathematics and Computer Science, Emory University*)

15:30 Unpacking Image Models from Neural Nets

Tom Goldstein (*University of Maryland*)
Sohil Shah (*University of Maryland*)

16:00 PDE-based Algorithms for Convolution Neural Networks

Eldad Haber (*University of British Columbia*)
Lars Ruthotto (*Department of Mathematics and Computer Science, Emory University*)

16:30 Maximum Principle Based Algorithms for Deep Learning

Qianxiao Li (*Institute of High Performance Computing*)

17:00 Mass effect in glioblastomas

George Biros (*Institute for Computational Engineering and Sciences, University of Texas at Austin*)
Amir Gholami (*UC Berkeley*)
Naveen Himthani (*UT Austin*)
James Levitt (*UT Austin*)
Andreas Mang (*Department of Mathematics, University of Houston*)
Sameer Tharakan (*UT Austin*)

MS37-2 SPARSE-BASED TECHNIQUES IN VARIATIONAL IMAGE PROCESSING

Wednesday, 06 at 15:30
Room B (Palazzina A - Building A, floor 1)

The sparsity principle, which consists of representing some phenomena with as few variables as possible, has been recently exploited with success in variational image processing. Most of the activities in this context have been dedicated to two (overlapping) research areas. The first includes works pursuing the design of new sparsity-promoting priors both in synthesis-based, analysis-based, and hybrid models. The second deals with devising efficient and robust algorithms for solving the typically large scale and possibly non-smooth non-convex optimization problems raised by sparsity-constrained regularization. This mini-symposium addresses theoretical and numerical issues which arise from designing sparsity-promoting techniques in variational image processing.

Organizers:
Serena Morigi (*Dept. Mathematics, University of Bologna*)
Ivan Selesnick (*New York University*)
Alessandro Lanza (*Dept. Mathematics, University of Bologna*)

15:30 Convex Envelopes for Least Squares Low Rank Approximation

Carl Olsson (*Chalmers University of Technology*)

16:00 Exact continuous relaxations for the l0-regularized least-squares criteria

Emmanuel Soubies (*EPFL, Biomedical Imaging Group, Lausanne VD*)

16:30 On regularization/convexification of functionals including an l2-misfit term

Marcus Carlsson (*Lund University*)

17:00 Sparsity-inducing Non-convex Regularization for Convex Image Processing

Alessandro Lanza (*Dept. Mathematics, University of Bologna*)
Serena Morigi (*Dept. Mathematics, University of Bologna*)
Ivan Selesnick (*New York University*)
Fiorella Sgallari (*Dept. Mathematics, University of Bologna*)

MS38 GEOMETRY-DRIVEN ANISOTROPIC APPROACHES FOR IMAGING PROBLEMS

Wednesday, 06 at 15:30
Room I (Palazzina B - Building B, floor 0)

Several vision-inspired mathematical imaging problems such as image inpainting, segmentation and tracking have been modelled in the recent years by means of variational and geometrical tools weighting differently the orientations in the image at hand. Analytical approaches encode anisotropy in the choice of the functional spaces and nonlinear models, while geometrical techniques typically "lift" the ambient space in order to make the orientation one unknown of the problem. The aim of this workshop is to gather experts from both communities to promote discussions and collaborations. The validity of the models will be confirmed by their application to several imaging tasks.

Organizers:
Luca Calatroni (*CMAP, École Polytechnique CNRS*)
Dario Prandi (*CNRS - L2S, CentraleSupélec*)
Valentina Franceschi (*INRIA Paris*)

15:30 Cortical-inspired functional lifting for image inpainting

Dario Prandi (*CNRS - L2S, CentraleSupélec*)

16:00 Computation of Curvature Penalized Shortest Paths via the Fast Marching Algorithm

Jean-Marie Mirebeau (*Université Paris-Sud - CNRS - Université Paris-Saclay*)

16:30 Anisotropic multiphase mean curvature flows with mobilities

Simon Masnou (*Université Lyon 1*)

17:00 A function space framework for structural total variation regularization with applications in inverse problems

Michael Hintermüller (*Humboldt University and Weierstrass Institute Berlin*)
Martin Holler (*École Polytechnique, Université Paris Saclay*)
Kostas Papafitsoros (*Weierstrass Institute Berlin*)

MS39 NONLINEAR SPECTRAL THEORY AND APPLICATIONS (PART 2)

Wednesday, 06 at 15:30
Room C (Palazzina A - Building A, floor 1)

In recent years there have been advances in the theory of nonlinear eigenvalue problems related to image processing and computer vision. The formulations of nonlinear transforms, related to one-homogeneous functionals, such as total-variation, has opened way to various applications of image decomposition, face fusion, denoising and more. Theory related to 1-Laplacian eigenvectors on graphs has contributed to better understanding of classification, segmentation and clustering methods. In addition, new numerical methods for solving these hard problems have been proposed. In this two-part minisymposium researchers will present their latest results and discuss future trends in this emerging field.

Organizers:
Aujol Jean-Francois (*University of Bordeaux*)
Gilboa Guy (*Electrical Engineering Department, Technion*)

15:30 Theoretical analysis of flows estimating eigenfunctions of one-homogeneous functionals

Aujol Jean-Francois (*University of Bordeaux*)

16:00 Continuum limit of total variation defined on geometric graphs

Garcia Trillos Nicolas (*Brown University*)

17:00 Bias reduction in variational regularization

Camille Sutour (*University Paris Descartes*)

MS56-2 MATHEMATICAL AND COMPUTATIONAL ASPECTS IN MAGNETIC PARTICLE IMAGING

Wednesday, 06 at 15:30
Matemates (Matemates, floor 0)

Magnetic particle imaging (MPI) is a new imaging modality to determine the concentration of nanoparticles from their nonlinear magnetization behavior. Highly dynamic applied magnetic fields allow a rapid data acquisition in 3D. But the image reconstruction still relies on a time-consuming calibration process. The large model uncertainty is a great challenge for achieving reconstructions with higher resolution. In this mini-symposium, we aim at bringing together researchers working on magnetic particle imaging and related fields. We cover theoretical and practical topics in MPI focusing on mathematical and physical as well as algorithmic and computational issues of the reconstruction.

Organizers:
Tobias Kluth (*University of Bremen*)
Christina Brandt (*University of Hamburg*)

15:30 Fast Image Reconstruction by Exploiting Redundancies and Sparsities in the Magnetic Particle Imaging Operator

Knopp Tobias (*University Medical Center Hamburg-Eppendorf/Hamburg University of Technology*)

16:00 Fast temporal regularized reconstructions for magnetic particle imaging

Christina Brandt (*University of Hamburg*)
Andreas Hauptmann (*University College London*)

16:30 Chebyshev spectral methods for the reconstruction in Magnetic Particle Imaging

Wolfgang Erb (*University of Hawaii at Manoa*)

17:00 Edge preserving and noise reducing reconstruction for magnetic particle imaging

Martin Storath (*Universität Heidelberg*)

MS69 ANISOTROPIC MULTI SCALE METHODS AND BIOMEDICAL IMAGING

Wednesday, 06 at 15:30
Room F (Palazzina A - Building A, floor 2)

Structure-function relations are central to the study of biological systems. This is true, for instance, in the central nervous system where neurons exhibit a remarkable morphological diversity attesting the importance of structural characteristics for brain function. During the last decade, remarkable advances in microscopy, MRI and other probing techniques, as well as the development of more sensitive staining techniques, have revolutionized the field of biomedical imaging by increasing the availability of high-quality images for applications ranging from basic science through drug discovery and medical diagnostics. Yet, such advances have not been matched with algorithmic and analytical tools capable of processing data with sufficient accuracy and computational efficiency to take full advantage of the information available. In response to this need, a significant effort is being made in applied mathematics to develop a new generation of image processing tools to analyze imaging data with high geometrical sensitivity and across multiple scales. The impact of these methods is expected to be very significant as they would enable to quantify a multiplicity of biological features, carry out more accurate statistical analyses and generate more realistic computational models. The scope of the minisymposium is to bring together experts from the area of anisotropic multiscale methods and their applications to biomedical imaging, and discuss emerging directions in this field.

Organizers:
Davide Barbieri (*Universidad Autonoma de Madrid*)
Demetrio Labate (*University of Houston*)

15:30 Shearlet-based compressed sensing for fast 3D cardiac MR imaging

Stephanie Funk (*Charite*)
Christoph Kolbitsch (*Physikalisch-Technische Bundesanstalt*)
Gitta Kutyniok (*Technische Universität Berlin*)
Jackie Ma (*Fraunhofer Institute for Telecommunications–Heinrich Hertz Institute*)
Maximilian März (*Technische Universität Berlin*)
Tobias Schaeffter (*Physikalisch-Technische Bundesanstalt*)
Jeanette Schulz-Menger (*Charite*)

16:00 Geometric multiscale represention and neuroscience imaging

Demetrio Labate (*University of Houston*)

16:30 New reproducing kernel Hilbert spaces for features extraction

Davide Barbieri (*Universidad Autonoma de Madrid*)

17:00 Optimal Paths for Variants of the 2D and 3D Reeds-Shepp Car for Tracking of Blood Vessels and Fibers in Medical Images

Remco Duits (*Technische Universiteit Eindhoven*)
Stephan Meesters (*Eindhoven University of Technology*)
Jean-Marie Mirebeau (*Université Paris-Sud - CNRS - Université Paris-Saclay*)
Jorg Portegies (*Eindhoven University of Technology*)

CP5 CONTRIBUTED SESSION 5

Wednesday, 06 at 15:30
Room 1 (Redenti, floor 0)

Chairs:
Salvatore Cuomo (*Dept. Mathematics and Applications "Renato Caccioppoli", University of Naples*)

15:30 A new wavelet based metric for color image similarity assessment

Maria Grazia Albanesi (*Department of Electrical, Computer and Biomedical Engineering, University of Pavia*)
Riccardo Amadeo (*Department of Electrical, Computer and Biomedical Engineering, University of Pavia*)
Silvia Bertoluzza (*CNR, IMATI "Enrico Magenes"*)

15:50 Multiwavelet Design by Matrix Spectral Factorization

Fritz Keinert (*Iowa State University*)

16:10 Cone-Adapted Shearlets and Radon Transforms

Francesca Bartolucci (*University of Genoa*)
Filippo De Mari (*University of Genoa*)
Ernesto De Vito (*University of Genoa*)
Francesca Odone (*University of Genoa*)

16:30 A variational model for simultaneous video inpainting and motion estimation

Giuseppe Riey (*University of Calabria*)

16:50 Relative Velocity Estimation from a single Uniform Linear motion Blurred Image using The Discrete Cosine Transform

Jimy Alexander Cortes (*Universidad Tecnologica de Pereira*)
Juan Bernardo Gómez (*Universidad Nacional de Colombia*)
Juan Carlos Riaño (*Universidad Nacional de Colombia*)

17:10 Coherent interferometric imaging of sources in fluid flow

Etienne Gay (*ONERA*)

Thursday, June 07

IP4 FAST ANALOG TO DIGITAL COMPRESSION FOR HIGH RESOLUTION IMAGING

Thursday, 07 at 08:15
Room A (Palazzina A - Building A, floor 0)

The famous Shannon-Nyquist theorem has become a landmark in the development of digital signal processing. However, in many modern applications, the signal bandwidths have increased tremendously, while the acquisition capabilities have not scaled sufficiently fast. Consequently, conversion to digital has become a serious bottleneck. Furthermore, the resulting high rate digital data requires storage, communication and processing at very high rates which is computationally expensive and requires large amounts of power. In the context of medical imaging sampling at high rates often translates to high radiation dosages, increased scanning times, bulky medical devices, and limited resolution. In this talk, we present a framework for sampling and processing a wide class of wideband analog signals at rates far below Nyquist by exploiting signal structure and the processing task and show several demos of real-time sub-Nyquist prototypes. We then consider applications of these ideas to a variety of problems in medical and optical imaging including fast and quantitative MRI, wireless ultrasound, fast Doppler imaging, and correlation based super-resolution in microscopy and ultrasound which combines high spatial resolution with short integration time. We end by discussing several modern methods for structure-based phase retrieval which has applications in several areas of optical imaging.

Chairs:
Gabriele Steidl (*University of Kaiserslautern*)

Yonina Eldar (*Department of EE, Technion, Israel Institute of Technology, Haifa*)

MS31-3 VARIATIONAL APPROACHES FOR REGULARIZING NONLINEAR GEOMETRIC DATA

Thursday, 07 at 09:30
Room F (Palazzina A - Building A, floor 2)

In various applications in science and engineering, the data do not take values in a vector space but in a nonlinear space such as a manifold. Examples are circle and sphere-valued data as appearing in SAR imaging and the space of positive matrices with the Fisher-Rao metric, which is the underlying data space for Diffusion Tensor Imaging. Many recent, successful methods for processing geometric data rely on variational approaches, i.e., the minimization of an energy functional. In this mini-symposium, we aim at bringing together researches with different areas of expertise, who share interest in variational approaches for geometric data.

Organizers:
Martin Storath (*Universität Heidelberg*)
Martin Holler (*École Polytechnique, Université Paris Saclay*)
Andreas Weinmann (*Hochschule Darmstadt*)

09:30 Geodesic Interpolation in the Space of Images
Benjamin Berkels (*RWTH Aachen University*)
Alexander Effland (*Universität Bonn*)
Erich Kobler (*Graz University of Technology*)
Thomas Pock (*Graz University of Technology*)
Martin Rumpf (*University of Bonn*)

10:00 Functional-Analytic Questions in Measure-Valued Variational Problems
Thomas Vogt (*Universität Lübeck*)

10:30 Nonlocal inpainting of manifold-valued data on finite weighted graphs
Ronny Bergmann (*Technische Universität Chemnitz*)
Daniel Tenbrinck (*University of Münster*)

11:00 Curvature Regularization with Adaptive Discretization of Measures
Ulrich Hartleif (*Universität Münster*)

MS41-1 FRAMELETS, OPTIMIZATION, AND IMAGE PROCESSING

Thursday, 07 at 09:30
Room I (Palazzina B - Building B, floor 0)

Frame-based methods together with optimization modeling have been shown to be one of the most effective approaches in imaging processing. This minisymposium focuses on solving various image processing problems, e.g., image denoising/inpainting, image restoration, pMRI and CT in medical imaging, etc., based on multiscale representation systems and optimization techniques. We will have speakers coming from mainland China, Hong Kong SAR, Canada, and USA to present their work on mathematical imaging using framelets, affine shear frames, optimization (convex or non-convex) techniques, deep neural networks, or kernel-based approaches. We believe that the audience of this minisymposium would greatly benefit from their perspectives on this area.

Organizers:
Xiaosheng Zhuang (*City University of Hong Kong*)
Lixin Shen (*Syracuse University*)
Bin Han (*University of Alberta*)
Yan-Ran Li (*Shenzhen Univeristy*)

09:30 Moreau Enhanced TV for Image Restoration
Lixin Shen (*Syracuse University*)

10:00 Multiplicative Noise Removal with A Non-Convex Optimization Model
Jian Lu (*Shenzhen University*)

10:30 Noncovex Frame-based Methods for Image Restoration
Yi Shen (*Zhejiang Sci-Tech Univeristy*)

11:00 Digital Affine Shear Filter Banks with 2-Layer Structure and Their Applications in Image/Video Processing
Zhihua Che (*City University of Hong Kong*)

MS42-1 LOW DIMENSIONAL STRUCTURES IN IMAGING SCIENCE

Thursday, 07 at 09:30
Room M (Palazzina B - Building B, floor 0)

Many objects of interest in imaging science exhibit a low-dimensional structure, which could mean, for instance, low

sparsity of a vector, low-rank property of a large matrix, or low-dimensional manifold model for a data set. Many successful methods rely on deep understanding and clever exploitation of such low-dimensional structures. The goal of this mini-symposium is to bring together researchers actively working on imaging techniques based on low-dimensional models, and to explore some recent state-of-the-art work in scientific computation, machine learning and optimization related with imaging science.

Organizers:
Wenjing Liao (*Georgia Institute of Technology*)
Haizhao Yang (*Duke University*)
Zhizhen Zhao (*University of Illinois Urbana-Champaign*)

09:30 Using invariant features for multi-reference alignment and multi-segment reconstruction

Zhizhen Zhao (*University of Illinois Urbana-Champaign*)

10:00 Model stability of low complexity priors

Samuel Vaiter (*IMB, Université de Bourgogne*)

10:30 What's happening in provable dictionary learning?

Qing Qu (*Columbia University*)
Ju Sun (*Stanford University*)
John Wright (*Department of Electrical Engineering, Columbia University*)

11:00 A tale of two bases: local-nonlocal regularization on image patches with convolution framelets

Tingrao Gao (*The University of Chicago*)

MS43 VARIATIONAL IMAGE SEGMENTATION: METHODS AND APPLICATIONS

Thursday, 07 at 09:30
Room H (Palazzina B - Building B, floor 0)

Segmentation is a fundamental aspect of image processing with many important applications, such as contouring in medical imaging. The variational approach has been widely used to partition 2D and 3D data in numerous practical settings, but effectively incorporating specific knowledge of the target object(s) continues to be a significant challenge. This minisymposium will address recent advances in variational methods for segmentation, considering a wide range of techniques. The work is primarily motivated by associated applications; a number of which which will be discussed in detail.

Organizers:
Jack Spencer (*University of Liverpool*)

09:30 Interactive Variational Segmentation in Medical Imaging

Ke Chen (*University of Liverpool*)
Jack Spencer (*University of Liverpool*)

10:00 Joint CT Reconstruction and Segmentation with Discriminative Dictionary Learning

Yiqiu Dong (*Technical University of Denmark*)
Per Christian Hansen (*Technical University of Denmark*)
Hans Martin Kjer (*Technical University of Denmark*)

10:30 Variational Approaches to Medical Image Segmentation

Tammy Riklin Raviv (*Ben-Gurion University*)

11:00 Minimal Paths and Geodesic Metrics for Image Segmentation and Tubular Structure Extraction

Da Chen (*University Paris Dauphine, PSL Research University; Centre Hospitalier National d'Ophtalmologie des Quinze-Vingts, Paris, France*)
Laurent D. Cohen (*University Paris Dauphine, PSL Research University*)

MS44 3D IMAGE DEPTH/TEXTURE/REFLECTIVITY TRACKING, MODELLING AND RECONSTRUCTION

Thursday, 07 at 09:30
Room P (Palazzina B - Building B, floor 0)

3D image reconstruction where the third dimension is time or depth from exotic light sensors or different light treatments (phase contrast) is addressing new and exciting imaging challenges which require non-invasive, eye-safe and/or low cost solutions. However there can be issues with data acquisition in terms of detection, sparsity and background noise. Also, large scale inverse problems generate significant computational challenges for real-time high resolution reconstruction. Here we look at different mathematical imaging methods for a range of physical and medical applications: cell tracking and modelling, imaging/depth prediction in low/obscured visibility conditions. Methods/Tools to be discussed will range from deep learning, ray tracing, circular Hough transform, variational segmentation and tracking methods. The presentations will include illustrations on realistic data sets. The results advance the state of the art in both reconstruction rate and quality.

Organizers:
Catherine Higham (*University of Glasgow*)
Roderick Murray-Smith (*University of Glasgow*)

09:30 Real-time Depth Prediction with Sensor Fusion.

Catherine Higham (*University of Glasgow*)
Roderick Murray-Smith (*University of Glasgow*)

10:00 Mathematical Imaging Methods for Mitosis Analysis in Live-Cell Phase Contrast Microscopy.

Martin Burger (*University of Muenster*)
Joana Grah (*The Alan Turing Institute*)
Jenny Harrington (*Cancer Research UK Cambridge Institute*)
Siang B. Koh (*Massachusetts General Hospital Cancer Center, Boston*)
Jeremy A. Pike (*University of Birmingham*)
Stefanie Reichelt (*Cancer Research UK Cambridge Institute*)
Carola-Bibiane Schönlieb (*University of Cambridge*)
Alexander Schreiner (*PerkinElmer, Hamburg*)

10:30 Imaging Behind Walls.

Alessandro Boccolini (*Heriot Watt University*)
Daniel Buschek (*University of Munich*)
Piergiorgio Caramazza (*University of Glasgow*)
Daniele Faccio (*Heriot Watt University*)
Robert Henderson (*University of Edinburgh*)

Catherine Higham (*University of Glasgow*)
Matthias Hullin (*University of Bonn*)
Roderick Murray-Smith (*University of Glasgow*)

11:00 Photoacoustic Tomography Reconstruction from Sparse Data using Ray Tracing.

Marta Betcke (*University College London*)
Francesc Rullan (*University College London*)

MS45 MATHEMATICAL TECHNIQUES FOR BAD VISIBILITY RESTORATION

Thursday, 07 at 09:30
Room L (Palazzina B - Building B, floor 0)

Images can be affected by weather conditions such as haze, rain, or dust, etc. Also, they can be captured under conditions of bad visibility, such as night-time or underwater. Images obtained under these circumstances usually present faded colors and loss of contrast, among many other problems. Removing the effect of these conditions will be useful not only for aesthetic purposes, but also to improve the performance of computer vision systems that need to operate outdoors under uncontrolled imaging conditions. This minisymposium presents some state-of-the-art algorithms whose purpose is to enhance the visibility of images captured under these scattering conditions.

Organizers:
Javier Vazquez-Corral (*Information and Communication Technologies Department, Universitat Pompeu Fabra*)

09:30 Variational image dehazing

Javier Vazquez-Corral (*Information and Communication Technologies Department, Universitat Pompeu Fabra*)

10:00 Markov Random Field for combined defogging and stereo reconstruction

Laurent Caraffa (*IGN*)
Jean-Philippe Tarel (*Researcher. COSYS/LEPSiS , IFSTTAR*)

10:30 Spectral Edge Image Fusion

Graham Finlayson (*School of Computing Sciences, University of East Anglia, Norwich Research Park*)

11:00 On the use of sparse reconstruction for the restoration of areas obscured by thick clouds in satellite image time series

Daniele Cerra (*German Aerospace Center (DLR), Remote Sensing Technology Institute, Photogrammetry and Image Analysis, Oberpfaffenhofen*)

MS46 RANDOMIZED NUMERICAL LINEAR ALGEBRA FOR IMAGING SCIENCE

Thursday, 07 at 09:30
Matemates (Matemates, floor 0)

Numerical linear algebra plays a vital role in the area of imaging science. Classically, the field of applied linear algebra has focused on deterministic algorithms that produce highly accurate results. However, the emergence of large-scale datasets has severely challenged our ability to analyze data. Over the last decade, the concept of randomness has been demonstrated as an effective strategy to quickly produce approximate answers to familiar problems, such as computing the singular value decomposition. We invite speakers working at the forefront of numerical linear algebra to explore challenges and solutions for applications in imaging science.

Organizers:
N. Benjamin Erichson (*University of Washington*)
Steven L. Brunton (*University of Washington*)
J. Nathan Kutz (*Univeristy of Washington*)

09:30 Random Sampling Strategies for Learning High-Dimensional Time-Dependent Observations

Giang Tran (*University of Waterloo*)

10:00 Subsampling Large Datasets via Random Mixing

Stephen Becker (*University of Colorado Boulder*)

10:30 Randomized Nonnegative Matrix Factorizations

N. Benjamin Erichson (*University of Washington*)

11:00 Recovery of Structured Nonlinear Dynamics from Under-sampled Measurements

Hayden Schaeffer (*Carnegie Mellon University*)

MS47-1 SPLINES IN IMAGING

Thursday, 07 at 09:30
Room G (Palazzina A - Building A, floor 0)

Splines are unifying mathematical objects that allow making the link between the real continuous world of physics and the digital world of computers. In the field of imaging, a whole class of problems are usually formulated in the continuous domain but call for a digital implementation, which can be efficiently achieved relying on splines. Spline models are advantageous not only computationally, but also conceptually as they allow drawing a number of fundamental connections between disciplines. This mini-symposium focuses on research topics that are relevant to image processing including but not limited to the development of novel spline tools for image processing, segmentation, and for the efficient resolution of inverse problems such as computed tomography. It will also explore the deep connection between splines and variational methods, including Bayesian estimation as well as sparsity-promoting schemes.

Organizers:
Carolina Beccari (*Dept. Mathematics, University of Bologna*)
Virginie Uhlmann (*EPFL, Lausanne*)
Michael Unser (*EPFL, Lausanne*)

09:30 Optimality of splines for the resolution of linear inverse problems with Tikhonov or total-variation regularization

Gupta Harshit (*EPFL, Lausanne*)
Fageot Julien (*EPFL, Lausanne*)
Michael Unser (*EPFL, Lausanne*)

10:00 Sparse Approximation for Few View Tomographic Reconstruction

Alireza Entezari (*Department of Computer & Information Science & Engineering, University of Florida, Gainesville*)
Elham Sakhaee (*University of Florida*)
Kai Zhang (*University of Florida*)

10:30 Recovery of piecewise smooth signals on manifolds using structured low-rank methods

Mathews Jacob (*Department of Electrical and Computer Engineering, University of Iowa*)

11:00 Hermite-like representation of images in terms of samples with local tangents

Costanza Conti (*University of Firenze*)
Lucia Romani (*University of Milano-Bicocca*)
Michael Unser (*EPFL, Lausanne*)

MS48 RECENT ADVANCES IN MATHEMATICAL MORPHOLOGY: ALGEBRAIC AND PDE-BASED APPROACHES

Thursday, 07 at 09:30
Room D (Palazzina A - Building A, floor 1)

Mathematical morphology is a theory for the analysis and processing of geometrical structures that provides highly efficient tools for numerous signal and image processing tasks with a wide range of applications. Designed originally for binary and grey-value data, morphological operations have been generalised to process multi-channel and even matrix-valued data on regular grids as well as graphs. Traditional algebraic lattice approaches have been complemented by PDE concepts. The minisymposium will bring together scientists involved in these thriving developments to share ideas, discuss connections, and promote a deeper understanding of the common principles behind different approaches to morphological image processing.

Organizers:
Martin Welk (*Private University for Health Sciences, Medical Informatics and Technology (UMIT)*)
Michael Breuss (*Brandenburg University of Technology*)

09:30 Discretization of Morphology-type PDEs and Active Contours on Graphs

Kimon Drakopoulos (*University of Southern California*)
Nikos Kolotouros (*University of Pennsylvania*)
Petros Maragos (*National Technical University of Athens*)
Christos Sakaridis (*ETH Zürich*)

10:00 Mathematical morphology for multispectral images

Andreas Kleefeld (*Forschungszentrum Jülich GmbH*)

10:30 Morphological operators on ultrametric spaces

Jesús Angulo (*Center for Mathematical Morphology, Départ. de Mathématiques et Systèmes, MINES ParisTech*)

11:00 Operator-algebraic approach to image processing of matrix fields

Bernhard Burgeth (*Saarland University, Saarbrücken*)

MS49-1 IMAGE RESTORATION, ENHANCEMENT AND RELATED ALGORITHMS

Thursday, 07 at 09:30
Room E (Palazzina A - Building A, floor 2)

High quality images are important for both visualization and analysis purpose. Image reconstruction, the process to compute high quality images from raw hardware measurements and image enhancement, the process to obtain higher quality images from different low quality images (e.g., noisy, blurred, low resolution) of the same scene/object are important imaging problems. Appropriate modeling and efficient algorithms are substantial in both problems. This 4-session mini-symposium gathers together the latest theoretical and practical development in this broad topic. Three sessions focus on (depending on titles) while one session focuses on enhancing resolution of multi-spectral and high-spectral images.

Organizers:
Weihong Guo (*Case Western Reserve University*)
Ke Chen (*University of Liverpool*)
Xue-Cheng Tai (*Hong Kong Baptist University*)
Guohui Song (*Clarkson University*)

09:30 Sparse-data Based 3D Surface Reconstruction for Cartoon and Map

Xue-Cheng Tai (*Hong Kong Baptist University*)

10:00 Infimal Convolution of Oscillation Total Generalized Variation for the Recovery of images with structured texture

Kristian Bredies (*Universität Graz*)
Yiming Gao (*Nanjing University of Science and Technology,*)

10:30 A Distributed Dictionary Learning Algorithm and its Applications

Weihong Guo (*Case Western Reserve University*)
Yue Zhang (*Case Western Reserve University*)

11:00 Variational Models for Joint Subsampling and Reconstruction of Turbulence-degraded Images

Chun Pong Lau (*The Chinese University of Hong Kong*)
Ronald Lui (*Chinese University of Hong Kong*)

MS50-1 ANALYSIS, OPTIMIZATION, AND APPLICATIONS OF MACHINE LEARNING IN IMAGING

Thursday, 07 at 09:30
Room C (Palazzina A - Building A, floor 1)

Energy minimization methods have been among the most powerful tools for tackling ill-posed image processing problems. They are extremely versatile, are able to model the data formation process explicitly, and allow a detailed mathematical analysis of the solution properties. An alternative approach is to consider a parameterized function, a network, that directly maps from the input data to the desired solution and try to learn the optimal parameters of this mapping on a set of training data. While such learning based approaches have recently outperformed energy minimization methods on many image processing problems, several challenging mathematical questions regarding their training as well as the analysis and control of the produced outputs are not well-understood yet. The goal of this minisymposium is to bring together experts from the fields of machine learning, image processing, and optimization to discuss novel approaches

to the design of networks, the solution of the nested non-convex and non-smooth optimization problems to be solved for their training, and the analysis of the resulting solutions.

Organizers:
Michael Moeller (*University of Siegen*)
Gitta Kutyniok (*Technische Universität Berlin*)

09:30 Global Optimality in Matrix, Tensor Factorization, and Deep Learning

Benjamin Haeffele (*Johns Hopkins University*)
Rene Vidal (*Johns Hopkins University*)

10:00 Texture modeling with scattering transform

Sixin Zhang (*Ecole Normale Supérieure Paris*)

10:30 Learning for Compressed Sensing CT Reconstruction

Baiyu Chen (*New York University*)
Kerstin Hammernik (*Graz University of Technology*)
Teresa Klatzer (*Graz University of Technology*)
Florian Knoll (*New York University*)
Erich Kobler (*Graz University of Technology*)
Matthew Muckley (*New York University*)
Ricardo Otazo (*New York University*)
Thomas Pock (*Graz University of Technology*)
Daniel Sodickson (*New York University*)

11:00 Deep inversion: convolutional neural networks meet neuroscience

Christoph Brune (*University of Twente*)

MS51-1 ALGORITHMS FOR SINGLE PARTICLE RECONSTRUCTION IN CRYO-ELECTRON MICROSCOPY (CRYO-EM).

Thursday, 07 at 09:30
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

Cryo-electron microscopy (cryo-EM) is a technique for three-dimensional imaging of biological macromolecules. Molecules are frozen in a thin layer of ice and their tomographic projections are recorded in an electron microscope. Recent advances have yielded molecular reconstructions at near-atomic resolution, and in 2017 the Nobel Prize in Chemistry was awarded to three pioneers of the field. The goal of this minisymposium is to bring together the communities of cryo-EM and computational imaging to facilitate the exchange of new ideas and perspectives. It will cover fast algorithms for reconstruction, resolving high-resolution structures, validation, structural variability in heterogeneous samples, and other topics.

Organizers:
Roy Lederman (*Yale University*)
Joakim Andén (*Flatiron Institute*)

09:30 Overview of computational challenges in cryo-EM analysis

Amit Singer (*Princeton University*)

10:00 Atomic resolution single particle Cryo-EM

Alberto Bartesaghi (*CCR/NCI/NIH*)

10:30 Viewing direction estimation for molecules with rotational symmetry

Gabi Pragier (*Tel Aviv University*)

11:00 Fast Algorithms for CryoEM Reconstruction

Marina Spivak (*Flatiron Institute*)

MS52-1 A DENOISER CAN DO MUCH MORE THAN JUST... DENOISING

Thursday, 07 at 09:30
Room A (Palazzina A - Building A, floor 0)

The task of image denoising is extensively studied for decades. A recent advance in this field results in dazzling results, so much so that some researchers believe that working on this problem leads to a dead avenue. Is this truly the case? What are the new trends in this field? Deep learning? New optimization methods? Can we leverage this impressive achievement and tackle other restoration problems, pushing these to new heights? All of these questions and more are the matter of this minisymposium.

Organizers:
Yaniv Romano (*Technion - Israel Institute of Technology*)
Peyman Milanfar (*Google Research*)
Michael Elad (*The Technion - Israel Institute of Technology*)

09:30 Regularization by Denoising (RED): New and surprising uses of an old problem

Michael Elad (*The Technion - Israel Institute of Technology*)
Peyman Milanfar (*Google Research*)
Yaniv Romano (*Technion - Israel Institute of Technology*)

10:00 Fast Algorithms for Regularization-by-Denoising

Edward Reehorst (*The Ohio State University*)
Adam Rich (*The Ohio State University, United States*)
Ahmad Rizwan (*The Ohio State University*)
Phil Schniter (*The Ohio State University*)

10:30 Image Restoration by Iterative Denoising and Backward Projections

Raja Giryes (*Tel Aviv University*)
Tom Tirer (*Tel Aviv University*)

11:00 Divide and Conquer: Class-adapted Denoisers for Imaging Inverse Problems

Jose Bioucas-Dias (*Universidade de Lisboa, Instituto Superior Técnico (IST), Instituto de Telecomunicações (IT)*)
Mário Figueiredo (*Instituto de Telecomunicações and IST, University of Lisboa*)
Afonso M. Teodoro (*Technical University of Lisbon*)

MT2 REGULARIZATION OF INVERSE PROBLEM

Thursday, 07 at 09:30
Room B (Palazzina A - Building A, floor 1)

Inverse Problems is an interdisciplinary research area with profound applications in many areas of science, engineering, technology, and medicine. Nowadays, a core technique for solving imaging problems are regularization methods. The foundations of these approximation methods were laid by Tikhonov decades ago, when he generalized the classical

definition of well-posedness. In the early days of regularization methods, they were analyzed mostly theoretically, while later on numerics, efficient solutions, and applications of regularization methods became important. This Minitutorial gives a survey on theoretical developments in regularization theory: Starting from quadratic regularization methods for linear ill-posed problems, to convex regularization, and to non-convex regularization methods of non-linear problems. The theoretical analysis will be supported by particular imaging examples.

Chairs:
Per Christian Hansen (*Technical University of Denmark*)

Otmar Scherzer (*Computational Science Center, University of Vienna*)

CP6 CONTRIBUTED SESSION 6

Thursday, 07 at 09:30
Room 1 (Redenti, floor 0)

Chairs:
Luigi Di Stefano (*Dept. Computer Science and Engineering, University of Bologna*)

09:30 Comparison of unsupervised methods to quantify the width of elongated structures.

Frederic de Gournay (*INSA Toulouse*)
Jerome Fehrenbach (*University of Toulouse*)

09:50 Clustering based dictionary learning

Renato Budinich (*University of Göttingen*)
Gerlind Plonka (*University of Goettingen*)

10:10 Non-negative image reconstruction based on tensor dictionary learning

Misha Kilmer (*Tufts University*)
Elizabeth Newman (*Tufts University*)

10:30 Comparison of Generalized and Classical Reweighted Algorithms for Recovering Sparse Signals

Edward Arroyo (*School of Professional Studies, Northwestern University*)
Fangjun Arroyo (*Francis Marion University*)

10:50 From digital images to bar codes

My Ismail Mamouni (*CRMEF Rabat*)

11:10 Combined Shearlet shrinkage and Yaroslavsky's filter for image denoising

Reza Abazari (*University of Tabriz*)
Mehrdad Lakestani (*University of Tabriz*)

IP5 IMAGE SEGMENTATION AND UNDERSTANDING: A CHALLENGE FOR MATHEMATICIANS

Thursday, 07 at 13:00
Room A (Palazzina A - Building A, floor 0)

The tremendous need for the analysis of massive image data sets in many application areas has been mainly promoting pragmatic approaches to imaging analysis during the last years: adopt a computational model with adjustable parameters and predictive power. This development poses a challenge to the mathematical imaging community: (i) shift the focus from low-level problems (like denoising) to mid- and high-level problems of image analysis (a.k.a. image understanding); (ii) devise mathematical approaches and algorithms that advance our understanding of structure detection in image data beyond a set of rules for adjusting the parameters of black-box approaches. The purpose of this talk is to stimulate the corresponding discussion by sketching past and current major trends including own recent work.

Chairs:
Lars Ruthotto (*Department of Mathematics and Computer Science, Emory University*)

Christoph Schnörr (*Institute of Applied Mathematics, University of Heidelberg*)

MS30-1 IMAGING, MODELING, VISUALIZATION AND BIOMEDICAL COMPUTING

Thursday, 07 at 14:00
Matemates (Matemates, floor 0)

The rapid advances in technology, data acquisition, storage and computing power have transformed medicine and from a traditional discipline that empowered the clinician to a quantitative data science approach that relies on signal, images, and their processing, manipulation, interpretation, and use for various applications. Imaging has become a quintessential tool that enables the non-invasive or minimally invasive exploration of the anatomy and function either to detect and diagnose disease, plan treatments, or guide and deliver therapies. However, to enable all of the above, access to computational modeling and visualization tools is as critical as image acquisition. This minisymposium is an interdisciplinary venue at the intersection of imaging and computing and welcomes participation from computer science, engineering, mathematical modeling, imaging science and other related fields. Featured presentations will range from algorithms for image computing to applications in computer-aided diagnosis and minimally invasive therapy, as well as mixed reality visualization for simulation, teaching and training.

Organizers:
Cristian Linte (*Biomedical Engineering and Center for Imaging Science, Rochester Institute of Technology*)
Suzanne Shontz (*University of Kansas*)

14:00 High-order Curvilinear Tetrahedral Meshes of the Cardiac Anatomy

Cristian Linte (*Biomedical Engineering and Center for Imaging Science, Rochester Institute of Technology*)
Niels Otani (*Rochester Institute of Technology*)
Suzanne Shontz (*University of Kansas*)
Mike Stees (*University of Kansas*)

14:30 Mesh Adaptation-aided Image Segmentation

Alberto Silvio Chiappa (*Politecnico di Milano*)
Stefano Micheletti (*MOX, Politecnico di Milano*)
Riccardo Peli (*Politecnico di Milano*)
Simona Perotto (*MOX, Politecnico di Milano*)

15:00 Coupling Brain-Tumor Biophysical Models and Diffeomorphic Image Registration

George Biros (*Institute for Computational Engineering and Sciences, University of Texas at Austin*)
Christos Davatzikos (*University of Pennsylvania*)
Amir Gholami (*UC Berkeley*)
Andreas Mang (*Department of Mathematics, University of Houston*)
Miriam Mehl (*Universitat Stuttgart*)
Klaudius Scheufele (*University of Stuttgart*)

15:30 Patient-specific reconstruction and CFD analysis of coronary stented arteries

Alessandro Veneziani (*Emory University*)

MS33-1 ADVANCES IN RECONSTRUCTION ALGORITHMS FOR COMPUTED TOMOGRAPHY

Thursday, 07 at 14:00
Room D (Palazzina A - Building A, floor 1)

Computed tomography (CT), which uses x-rays to image object interiors from the outside, is an established imaging modality in medicine, invaluable for diagnosis and treatment. In recent years, CT has found applications in other fields as well, e.g. nondestructive testing of components in manufacturing, analysis of material microstructures using micro-CT. Such a diverse set of applications and reconstruction scenarios require specialized algorithms that can handle different conditions and configurations, such as, limited data or low dose reconstruction, high resolution from large-scale data, unconventional source-detector geometries. This minisymposium will showcase novel reconstruction approaches to address such challenges in CT. Examples will include iterative reconstruction algorithms, discrete tomography, customized regularization approaches.

Organizers:
Gunay Dogan (*Theiss Research, NIST*)
Harbir Antil (*George Mason University*)
Elena Loli Piccolomini (*Dept. Computer Science and Engineering, University of Bologna*)
Samuli Siltanen (*University of Helsinki*)

14:00 3D reconstruction of human trabecular bone using sparse X-ray tomography

Zenith Purisha (*University of Helsinki*)
Samuli Siltanen (*University of Helsinki*)

14:30 A nonsmooth approach for sparse dynamic tomography based on shearlets

Tatiana Bubba (*University of Helsinki*)

15:00 Algorithm-enabled multi-spectral X-ray tomography

Xiaochuan Pan (*University of Chicago*)

15:30 Evaluating tomographic reconstruction methods in applications

Sara Vecchio (*IMS Company, Bologna*)

MS41-2 FRAMELETS, OPTIMIZATION, AND IMAGE PROCESSING

Thursday, 07 at 14:00
Room I (Palazzina B - Building B, floor 0)

Frame-based methods together with optimization modeling have been shown to be one of the most effective approaches in imaging processing. This minisymposium focuses on solving various image processing problems, e.g., image denoising/inpainting, image restoration, pMRI and CT in medical imaging, etc., based on multiscale representation systems and optimization techniques. We will have speakers coming from mainland China, Hong Kong SAR, Canada, and USA to present their work on mathematical imaging using framelets, affine shear frames, optimization (convex or non-convex) techniques, deep neural networks, or kernel-based approaches. We believe that the audience of this minisymposium would greatly benefit from their perspectives on this area.

Organizers:
Xiaosheng Zhuang (*City University of Hong Kong*)
Lixin Shen (*Syracuse University*)
Bin Han (*University of Alberta*)
Yan-Ran Li (*Shenzhen Univeristy*)

14:00 Parallel Magnetic Resonance Imaging by 3-D Regularization

Yan-Ran Li (*Shenzhen Univeristy*)

14:30 The Convex Geometry of Learning Single-hidden-layer Neural Networks

Gongguo Tang (*Colorado School of Mines*)

15:00 Framelets on Graphs with Applications in Multi-scale Data Analysis

Xiaosheng Zhuang (*City University of Hong Kong*)

15:30 Medical Image Analysis and Its Applications

Yao Lu (*Sun Yat-sen University*)

16:00 Kernel-based Approximation Methods for Generalized Interpolations: A Deterministic or Stochastic Problem?

Qi Ye (*South China Normal University*)

MS42-2 LOW DIMENSIONAL STRUCTURES IN IMAGING SCIENCE

Thursday, 07 at 14:00
Room M (Palazzina B - Building B, floor 0)

Many objects of interest in imaging science exhibit a low-dimensional structure, which could mean, for instance, low sparsity of a vector, low-rank property of a large matrix, or low-dimensional manifold model for a data set. Many successful methods rely on deep understanding and clever exploitation of such low-dimensional structures. The goal of this mini-symposium is to bring together researchers actively working on imaging techniques based on low-dimensional models, and to explore some recent state-of-the-art work in scientific computation, machine learning and optimization related with imaging science.

Organizers:
Wenjing Liao (*Georgia Institute of Technology*)
Haizhao Yang (*Duke University*)
Zhizhen Zhao (*University of Illinois Urbana-Champaign*)

14:00 Composition-aware spectroscopic tomography

Rohit Bhargava (*University of Illinois at Urbana-Champaign*)

Yoram Bresler (*University of Illinois at Urbana-Champaign*)
P. Scott Carney (*Dept. of ECE, University of Illinois at Urbana-Champaign*)
Luke Pfister (*Dept. of ECE, University of Illinois at Urbana-Champaign*)

14:30 Multiscale vector quantization

Lorenzo Rosasco (*University of Genoa, Istituto Italiano di Tecnologia; Massachusetts Institute of Technology*)

15:00 Steerable graph-Laplacian filters for image-valued manifolds

Boris Landa (*Tel Aviv University*)
Yoel Shkolnisky (*Tel Aviv University*)

15:30 Regularization by invariant multiscale statistics

Ivan Dokmanic (*University of Illinois at Urbana–Champaign*)

MS47-2 SPLINES IN IMAGING

Thursday, 07 at 14:00
Room G (Palazzina A - Building A, floor 0)

Splines are unifying mathematical objects that allow making the link between the real continuous world of physics and the digital world of computers. In the field of imaging, a whole class of problems are usually formulated in the continuous domain but call for a digital implementation, which can be efficiently achieved relying on splines. Spline models are advantageous not only computationally, but also conceptually as they allow drawing a number of fundamental connections between disciplines. This mini-symposium focuses on research topics that are relevant to image processing including but not limited to the development of novel spline tools for image processing, segmentation, and for the efficient resolution of inverse problems such as computed tomography. It will also explore the deep connection between splines and variational methods, including Bayesian estimation as well as sparsity-promoting schemes.

Organizers:
Carolina Beccari (*Dept. Mathematics, University of Bologna*)
Virginie Uhlmann (*EPFL, Lausanne*)
Michael Unser (*EPFL, Lausanne*)

14:00 Statistical optimality of Hermite splines for the reconstruction of self-similar signals

Virginie Uhlmann (*EPFL, Lausanne*)

14:30 The Role of Discretization in X-Ray CT Reconstruction

Michael McCann (*EPFL*)

15:00 Subdivision-based Active Contours

Anaïs Badoual (*EPFL, Lausanne*)

15:30 Sparse Approximation of Images by Adaptive Thinning

Armin Iske (*Dept. Mathematics, University of Hamburg*)

MS50-2 ANALYSIS, OPTIMIZATION, AND APPLICATIONS OF MACHINE LEARNING IN IMAGING

Thursday, 07 at 14:00
Room C (Palazzina A - Building A, floor 1)

Energy minimization methods have been among the most powerful tools for tackling ill-posed image processing problems. They are extremely versatile, are able to model the data formation process explicitly, and allow a detailed mathematical analysis of the solution properties. An alternative approach is to consider a parameterized function, a network, that directly maps from the input data to the desired solution and try to learn the optimal parameters of this mapping on a set of training data. While such learning based approaches have recently outperformed energy minimization methods on many image processing problems, several challenging mathematical questions regarding their training as well as the analysis and control of the produced outputs are not well-understood yet. The goal of this minisymposium is to bring together experts from the fields of machine learning, image processing, and optimization to discuss novel approaches to the design of networks, the solution of the nested non-convex and non-smooth optimization problems to be solved for their training, and the analysis of the resulting solutions.

Organizers:
Michael Moeller (*University of Siegen*)
Gitta Kutyniok (*Technische Universität Berlin*)

14:00 Breaking the Curse of Dimensionality with Convex Neural Networks

Francis Bach (*Departement d'Informatique de l'Ecole Normale Superieure Centre de Recherche INRIA de Paris*)

14:30 Prediction Methods for training Generative Image Models

Tom Goldstein (*University of Maryland*)
Abhay Kumar (*University of Maryland*)
Sohil Shah (*University of Maryland*)
Zheng Xu (*University of Maryland*)

15:00 An Optimal Control Framework for Efficient Training of Deep Neural Networks

Eldad Haber (*University of British Columbia*)
Lars Ruthotto (*Department of Mathematics and Computer Science, Emory University*)

15:30 Are neural networks convergent regularisation methods?

Martin Benning (*University of Cambridge*)

MS51-2 ALGORITHMS FOR SINGLE PARTICLE RECONSTRUCTION IN CRYO-ELECTRON MICROSCOPY (CRYO-EM).

Thursday, 07 at 14:00
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

Cryo-electron microscopy (cryo-EM) is a technique for three-dimensional imaging of biological macromolecules. Molecules are frozen in a thin layer of ice and their tomographic projections are recorded in an electron microscope. Recent advances have yielded molecular reconstructions at near-atomic resolution, and in 2017 the Nobel Prize in Chemistry was awarded to three pioneers of the field. The goal of this minisymposium is to bring together the communities of cryo-EM and computational imaging to facilitate

the exchange of new ideas and perspectives. It will cover fast algorithms for reconstruction, resolving high-resolution structures, validation, structural variability in heterogeneous samples, and other topics.

Organizers:
Roy Lederman (*Yale University*)
Joakim Andén (*Flatiron Institute*)

14:00 Resolution measures in Electron Microscopy reconstructions

Carlos Oscar Sorzano (*Centro Nacional Biotecnología*)

14:30 Hyper-molecules for continuous heterogeneity in Cryo-EM

Roy Lederman (*Yale University*)

15:00 Manifold denoising for cryo-EM data sets

Boris Landa (*Tel Aviv University*)
Yoel Shkolnisky (*Tel Aviv University*)

MS52-2 A DENOISER CAN DO MUCH MORE THAN JUST... DENOISING

Thursday, 07 at 14:00
Room A (Palazzina A - Building A, floor 0)

The task of image denoising is extensively studied for decades. A recent advance in this field results in dazzling results, so much so that some researchers believe that working on this problem leads to a dead avenue. Is this truly the case? What are the new trends in this field? Deep learning? New optimization methods? Can we leverage this impressive achievement and tackle other restoration problems, pushing these to new heights? All of these questions and more are the matter of this minisymposium.

Organizers:
Yaniv Romano (*Technion - Israel Institute of Technology*)
Peyman Milanfar (*Google Research*)
Michael Elad (*The Technion - Israel Institute of Technology*)

14:00 Learning to Mean-Shift in O(1) for Bayesian Image Restoration

Siavash Arjomand Bigdeli (*EPFL*)
Paolo Favaro (*University of Bern*)
Meiguang Jin (*University of Bern*)
Matthias Zwicker (*University of Maryland*)

14:30 Connect Maximum A Posteriori (MAP) Inference with Convolutional Neural Network for Image Restoration

Shuhang Gu (*The Hong Kong Polytechnic University*)
Kai Zhang (*The Hong Kong Polytechnic University*)
Lei Zhang (*Hong Kong Polytechnic University*)
Wangmeng Zuo (*Harbin Institute of Technology*)

15:00 On the Confluence of Deep Learning and Inverse Problems

Daniel Cremers (*Technische Universität München*)
Thomas Frerix (*Technical University of Munich*)
Caner Hazirbas (*Technical University of Munich*)
Tim Meinhardt (*Technical University of Munich*)
Michael Moeller (*University of Siegen*)
Thomas Möllenhoff (*Technical University of Munich*)

MS53-1 DIMENSIONALITY REDUCTION ALGORITHMS FOR LARGE-SCALE IMAGES

Thursday, 07 at 14:00
Room H (Palazzina B - Building B, floor 0)

Technological and theoretical advances in all scientific disciplines ranging from Engineering to Sciences have provided us with numerous large scale datasets to analyze. A fundamental question is how extract low dimensional models that will reflect in an efficient manner the most-important states and dynamics of the system under study. To tackle with such problems this symposium confront with two challenges: that of dimensionality reduction and the problem of data mining. Algorithms and methods that have the potential to facilitate better understanding, predicting and modelling of large-scale data and images with important health, social and economical impact will be discussed.

Organizers:
Salvatore Cuomo (*Dept. Mathematics and Applications "Renato Caccioppoli", University of Naples*)
Costantinos Siettos (*National Technical University of Athens*)
Lucia Russo (*Consiglio Nazionale delle Ricerche, Istituto di Ricerche sulla Combustione*)

14:00 MRI image enhancement by using a numerical procedure combining TV-ROF and histogram specification methods

Salvatore Cuomo (*Dept. Mathematics and Applications "Renato Caccioppoli", University of Naples*)

14:30 On the generation of reduced models by Proper Orthogonal Decomposition from experimental image data

Gaetano Continillo (*University of Sannio, Benevento*)
Lucia Russo (*Consiglio Nazionale delle Ricerche, Istituto di Ricerche sulla Combustione*)

15:00 Intrinsic Isometric Manifold Learning with Application to Unsupervised Localization from Image Data

Ariel Schwartz (*Technion - Israel Institute of Technology*)
Ronen Talmon (*Israel Institute of Technology*)

15:30 Construction of low dimensional Functional connectivity networks from fMRI data using manifold learning algorithms

Costantinos Siettos (*National Technical University of Athens*)

MS54-1 HYBRID APPROACHES THAT COMBINE DETERMINISTIC AND STATISTICAL REGULARIZATION FOR APPLIED INVERSE PROBLEMS

Thursday, 07 at 14:00
Room L (Palazzina B - Building B, floor 0)

Techniques that combine deterministic and statistical methods to solve inverse problems will be the focus of the minisymposium. The speakers and audience may range from

practitioners in medical imaging to more specialized mathematicians/statisticians working on applied inverse problems. This type of blended expertise is relevant to solving applied problems in imaging, particularly ones that are ill-posed in nature including electrical impedance tomography and optical tomography. In recent years, there has been a tremendous growth in devising new techniques both deterministic and statistical, such as model reduction using reduced basis method, sparsity, Bayesian inversion, Markov Chain Monte Carlo (MCMC) methods etc. The statistical approaches are becoming more popular due to the growth of computational power in the last several decades.

Organizers:
Cristiana Sebu (*University of Malta*)
Taufiquar Khan (*Clemson University*)

14:00 Damage Detection in Concrete Using Electrical Impedance Tomography: Deterministic and Statistical Perspectives

Taufiquar Khan (*Clemson University*)
Thilo Strauss (*University of Washington*)

14:30 Ultrahighfield Magnetic Resonance Imaging of the Heart

Laura Schreiber (*Comprehensive Heart Failure Centre, University of Wurzburg*)

15:00 Bayesian approach to optical flow in synthetic schlieren tomography

Aki Pulkkinen (*University of Eastern Finland*)

15:30 Electrical impedance tomography-based abdominal obesity estimation using deep learning

Kyounghun Lee (*Yonsei University*)
Jin Keun Seo (*Yonsei University*)
Minha Yoo (*National Institute for Mathematical Sciences*)

MS55-1 ADVANCES OF REGULARIZATION TECHNIQUES IN ITERATIVE RECONSTRUCTION

Thursday, 07 at 14:00
Room P (Palazzina B - Building B, floor 0)

Regularization plays a vital role in achieving complete answers of complex inverse problems and in resolving ill conditioning associated with factors such as limited data and uncertainties of the experimental environment. Recent advances have been made on developing different types of regularizers based on prior knowledge of the unknown parameters. Alternatively, Observations obtained from multiple modalities provide another form of regularizer for improved solution and incorporation of available knowledge, whether as a result of complementary information or as a means to lower measurement noise. This minisymposium brings together experts from the areas of optimization, numerical methods, and a wide range of imaging applications to discuss new regularizing approaches and identify promising future research directions.

Organizers:
Zichao (Wendy) Di (*Argonne National Lab*)
Marc Aurèle Gilles (*Cornell University*)

14:00 3D x-ray imaging beyond the depth of focus limit

Marc Aurèle Gilles (*Cornell University*)

14:30 Reducing the effects of bad data measurements using variance based weighted joint sparsity

Anne Gelb (*Dartmouth College*)
Theresa Scarnati (*Air Force Research Laboratory*)

15:00 Plug-and-Play Unplugged: Optimization Free Regularization using Consensus Equilibrium

Charles Bouman (*Purdue University*)

15:30 Learning better models for inverse problems in imaging

Kerstin Hammernik (*Graz University of Technology*)
Teresa Klatzer (*Graz University of Technology*)
Florian Knoll (*New York University*)
Erich Kobler (*Graz University of Technology*)
Thomas Pock (*Graz University of Technology*)

MS57-1 RECENT TRENDS IN PHOTOMETRIC 3D-RECONSTRUCTION

Thursday, 07 at 14:00
Room E (Palazzina A - Building A, floor 2)

Many computer vision techniques for 3D-reconstruction have been developped, building upon different clues. Most of them are based on triangulation, which provides the 3D-position of a point seen from at least two viewpoints. From theory to applications, these techniques have been widely studied, with undeniable success. However, even up-to-date techniques such as structure-from-motion or multi-view stereo reach their limits when faced to specular materials i.e., when a 3D-point does not look equally bright from different viewpoints. Another limit of triangulation is that it may provide the 3D-shape, but not the reflectance of a scene. These limitations have motivated recently a renewed interest in photometric 3D-reconstruction. Such techniques as shape-from-shading, photometric stereo, or shape-from-polarization rely on the relationship between the image color and the characteristics of the triplet scene-lighting-camera. In order to estimate geometric and photometric clues, their goal is to invert the image formation process. To this end, various mathematical tools can be employed, for instance variational methods, PDEs or machine learning. The field of photometric 3D-reconstruction has taken advantage of the complementarity of two research communities: mathematical imaging and computer vision. The aim of the proposed minisymposium is to bring together researchers from both these communities, in order to discuss the recent advances in the field.

Organizers:
Jean-Denis Durou (*IRIT, Université de Toulouse*)
Maurizio Falcone (*Dipartimento di Matematica, Università di Roma "La Sapienza"*)

14:00 On Overparametrized Variational Methods for Photometric Problems

Alfred Bruckstein (*Technion, Israel Institute of Technology*)

14:30 Combining Photometric Techniques with RGB-D Sensing

Björn Häfner (*Technical University Munich*)

15:00 Critical contours anchor shape inferences

Benjamin Kunsberg (*Brown University*)

Steven Zucker (*Yale University*)

15:30 A Variational Approach to Shape-from-shading Under Natural Illumination

Yvain Quéau (*L@bISEN Yncrea Ouest-Vision Lab / TU Munich*)

MS58-1 INSTRUMENTS AND TECHNIQUES FOR BIOMEDICAL RESEARCH

Thursday, 07 at 14:00
Room F (Palazzina A - Building A, floor 2)

Biomedical research in orthopaedics investigates major anatomical and functional features of the human body. This is performed on natural, pathological and treated anatomical regions (replacement, reconstructions etc.), to understand the relevant conditions, and in case to design and/or to assess the most appropriate treatment. There is huge literature on these studies, and major relevant advancements have resulted from this knowledge, but new potential benefits of the most recent instruments and techniques still needs to be fully comprehended and discussed. The faculty gathered for this symposium are authorities in this emerging discipline, and can also bring a number of real relevant cases.

Organizers:
Alberto Leardini (*Laboratory of Movement Analysis and Functional-Clinical Evaluation of Prosthesis, Istituto Ortopedico Rizzoli, Bologna*)

14:00 Quantitative Cone-Beam CT: New Technologies, Algorithms, and Applications in Orthopedic Imaging

Michael Brehler (*Department of Biomedical Engineering, Johns Hopkins University*)
Qian Cao (*Department of Biomedical Engineering, Johns Hopkins University*)
Jeffrey Siewerdsen (*Johns Hopkins University*)
Alejandro Sisniega (*Department of Biomedical Engineering, Johns Hopkins University*)
J. Webster Stayman (*Department of Biomedical Engineering, Johns Hopkins University*)
Steven Tilley II (*Department of Biomedical Engineering, Johns Hopkins University*)
Wojciech Zbijewski (*Johns Hopkins University, Baltimore*)

14:30 Advances in Cone-Beam CT Image Quality and Dose Reduction Using Optimization-Based Image Reconstruction

Grace J. Gang (*Department of Biomedical Engineering, Johns Hopkins University*)
Matthew Jacobson (*Department of Biomedical Engineering, Johns Hopkins University*)
Jeffrey Siewerdsen (*Johns Hopkins University*)
Alejandro Sisniega (*Department of Biomedical Engineering, Johns Hopkins University*)
J. Webster Stayman (*Department of Biomedical Engineering, Johns Hopkins University*)
Ali Uneri (*Department of Biomedical Engineering, Johns Hopkins University*)
Wojciech Zbijewski (*Johns Hopkins University, Baltimore*)

15:00 3D-Printed Anti-Scatter Collimators for Artifact Reduction in Cone-Beam CT

Santiago Cobos Cobos (*Robarts Research Institute, Western University*)
David Holdsworth (*Robarts Research Institute, Western University*)
Hristo Nikolov (*Robarts Research Institute, Western University*)
Steven Pollmann (*Robarts Research Institute, Western University*)

15:30 A Deep Imaging Architecture for Sparse-View Cone-Beam CT

David Foos (*Carestream health, Inc*)
Zhimin Huo (*Carestream Health, Inc*)
Weijian Li (*University of Rochester*)
Haofu Liao (*University of Rochester*)
Yuan Lin (*Carestream Health, Inc*)
Jiebo Luo (*Department of Computer Science, University of Rochester*)
William Sehnert (*Carestream Health Inc., Rochester*)

MS59-1 APPROACHES FOR FAST OPTIMISATION IN IMAGING AND INVERSE PROBLEMS

Thursday, 07 at 14:00
Room B (Palazzina A - Building A, floor 1)

Over the past decades, first-order operator splitting methods have become ubiquitous for many fields including signal/image processing and inverse problems owing to their simplicity and efficiency. In recent years, with the increasing of model complexity and data size, the needs for fast optimisation methods is becoming increasingly stronger. The aim of this mini-symposium is to highlight the recent advances in the acceleration of optimisation methods. The main topics of the mini-symposium will cover: inertial and acceleration schemes, preconditioning techniques, half quadratic regularisation, Krylov subspace, quasi-Newton method and other related ones.

Organizers:
Jingwei Liang (*University of Cambridge*)
Carola-Bibiane Schönlieb (*University of Cambridge*)
Mila Nikolova (*CMLA - CNRS ENS Cachan, University Paris-Saclay*)

14:00 Convergence of Inertial Dynamics and Proximal-based Algorithms Governed by Maximal Monotone Operators

Hedy Attouch (*Université de Montpellier*)

14:30 Proximal Interior Point Algorithm For Large Scale Image Processing Problems

Emilie Chouzenoux (*Université Paris-Est Marne-la-Vallée*)
Marie-Caroline Corbineau (*CentraleSupélec, Université Paris Saclay, Gif-sur-Yvette*)
Jean-Christophe Pesquet (*Université Paris-Saclay*)

15:00 Preconditioned Proximal-Point Methods for Imaging Applications

Tuomo Valkonen (*University of Liverpool*)

15:30 Adaptive Fista

Peter Ochs (*Saarland University*)
Thomas Pock (*Graz University of Technology*)

CP7 CONTRIBUTED SESSION 7

Thursday, 07 at 14:00
Room 1 (Redenti, floor 0)

Chairs:
Gerardo Toraldo (*University of Naples Federico II*)

14:00 Image Compression Using Two Dimensional DCT and Least Squares Interpolation

Sameh Eisa (*University of California, Irvine*)

14:20 Fast Tensor Principal Component Analysis for Volumetric Image Processing

Atsushi Imiya (*IMIT, Chiba University*)

14:40 Mathematical analysis on out-of-sample extensions of dimensionality reduction by diffusion mapping

Jianzhong Wang (*Sam Houston State University*)

15:00 Adaptive Eigenspace Regularization For Inverse Scattering Problems

Marcus Grote (*University of Basel*)
Uri Nahum (*University of Basel*)

15:20 An improved nonlocal L_1 minimization method for image denoising

Byeongseon Jeong (*Institute of Mathematical Sciences, Ewha Womans University, Seoul 120-750*)
Yunjin Park (*Department of Mathematics, Ewha Womans University, Seoul 120-750*)
Hyoseon Yang (*Institute of Mathematical Sciences, Ewha Womans University*)
Jungho Yoon (*Department of Mathematics, Ewha Womans University, Seoul 120-750*)

15:40 Texture Inpainting Using Efficient Gaussian Conditional Simulation

Bruno Galerne (*Université Paris Descartes*)
Arthur Leclaire (*CMLA, ENS Cachan*)

MS30-2 IMAGING, MODELING, VISUALIZATION AND BIOMEDICAL COMPUTING

Thursday, 07 at 16:30
Matemates (Matemates, floor 0)

The rapid advances in technology, data acquisition, storage and computing power have transformed medicine and from a traditional discipline that empowered the clinician to a quantitative data science approach that relies on signal, images, and their processing, manipulation, interpretation, and use for various applications. Imaging has become a quintessential tool that enables the non-invasive or minimally invasive exploration of the anatomy and function either to detect and diagnose disease, plan treatments, or guide and deliver therapies. However, to enable all of the above, access to computational modeling and visualization tools is as critical as image acquisition. This minisymposium is an interdisciplinary venue at the intersection of imaging and computing and welcomes participation from computer science, engineering, mathematical modeling, imaging science and other related fields. Featured presentations will range from algorithms for image computing to applications in computer-aided diagnosis and minimally invasive therapy, as well as mixed reality visualization for simulation, teaching and training.

Organizers:
Cristian Linte (*Biomedical Engineering and Center for Imaging Science, Rochester Institute of Technology*)
Suzanne Shontz (*University of Kansas*)

16:30 Medical Imaging and Visualization: Enabling Computer-assisted Diagnosis and Therapy

Cristian Linte (*Biomedical Engineering and Center for Imaging Science, Rochester Institute of Technology*)

17:00 Segmentation of Biomedical Images - Algorithms and Applications

João Manuel R. S. Tavares (*Faculty of Engineering of the University of Porto*)

17:30 High-resolution MRI-based heart models for image-guided electrophysiology procedures

Mihaela Pop (*University of Toronto*)

18:00 Augmented Reality for Cardiac Interventions

Terry M. Peters (*Robarts Research Institute/Western University*)

MS33-2 ADVANCES IN RECONSTRUCTION ALGORITHMS FOR COMPUTED TOMOGRAPHY

Thursday, 07 at 16:30
Room D (Palazzina A - Building A, floor 1)

Computed tomography (CT), which uses x-rays to image object interiors from the outside, is an established imaging modality in medicine, invaluable for diagnosis and treatment. In recent years, CT has found applications in other fields as well, e.g. nondestructive testing of components in manufacturing, analysis of material microstructures using micro-CT. Such a diverse set of applications and reconstruction scenarios require specialized algorithms that can handle different conditions and configurations, such as, limited data or low dose reconstruction, high resolution from large-scale data, unconventional source-detector geometries. This minisymposium will showcase novel reconstruction approaches to address such challenges in CT. Examples will include iterative reconstruction algorithms, discrete tomography, customized regularization approaches.

Organizers:
Gunay Dogan (*Theiss Research, NIST*)
Harbir Antil (*George Mason University*)
Elena Loli Piccolomini (*Dept. Computer Science and Engineering, University of Bologna*)
Samuli Siltanen (*University of Helsinki*)

16:30 Fast iterative model based methods from reduced sampling in 3D X-rays CT

Elena Loli Piccolomini (*Dept. Computer Science and Engineering, University of Bologna*)

17:00 A Novel Convex Relaxation for Non-binary Discrete Tomography

Jan Kuske (*Heidelberg University*)
Stefania Petra (*University of Heidelberg*)

Paul Sowoboda (*Institute of Science and Technology (IST) Austria, Klosterneuburg*)

17:30 How microlocal analysis can inform algorithm development

Leise Borg (*University of Copenhagen*)
Jürgen Frikel (*OTH Regensburg*)
Jakob Jorgensen (*University of Manchester*)
Todd Quinto (*Tufts University*)

18:00 Iterative methods for spectral breast tomosynthesis

Germana Landi (*University of Bologna*)
Elena Loli Piccolomini (*Dept. Computer Science and Engineering, University of Bologna*)

MS41-3 FRAMELETS, OPTIMIZATION, AND IMAGE PROCESSING

Thursday, 07 at 16:30
Room I (Palazzina B - Building B, floor 0)

Frame-based methods together with optimization modeling have been shown to be one of the most effective approaches in imaging processing. This minisymposium focuses on solving various image processing problems, e.g., image denoising/inpainting, image restoration, pMRI and CT in medical imaging, etc., based on multiscale representation systems and optimization techniques. We will have speakers coming from mainland China, Hong Kong SAR, Canada, and USA to present their work on mathematical imaging using framelets, affine shear frames, optimization (convex or non-convex) techniques, deep neural networks, or kernel-based approaches. We believe that the audience of this minisymposium would greatly benefit from their perspectives on this area.

Organizers:
Xiaosheng Zhuang (*City University of Hong Kong*)
Lixin Shen (*Syracuse University*)
Bin Han (*University of Alberta*)
Yan-Ran Li (*Shenzhen Univeristy*)

MS42-3 LOW DIMENSIONAL STRUCTURES IN IMAGING SCIENCE

Thursday, 07 at 16:30
Room M (Palazzina B - Building B, floor 0)

Many objects of interest in imaging science exhibit a low-dimensional structure, which could mean, for instance, low sparsity of a vector, low-rank property of a large matrix, or low-dimensional manifold model for a data set. Many successful methods rely on deep understanding and clever exploitation of such low-dimensional structures. The goal of this mini-symposium is to bring together researchers actively working on imaging techniques based on low-dimensional models, and to explore some recent state-of-the-art work in scientific computation, machine learning and optimization related with imaging science.

Organizers:
Wenjing Liao (*Georgia Institute of Technology*)
Haizhao Yang (*Duke University*)
Zhizhen Zhao (*University of Illinois Urbana-Champaign*)

16:30 Super-resolution, subspace methods and conditioning of Vandermonde matrices

Wenjing Liao (*Georgia Institute of Technology*)

17:00 An analysis of the BLASSO method for the multi-dimensional super-resolution problem

Gabriel Peyré (*ENS Paris*)
Clarice Poon (*University of Cambridge*)

17:30 Spectral super-resolution via projected gradient descent

Jian-Feng Cai (*Hong Kong University of Science and Technology*)
Tianming Wang (*University of Iowa*)
Ke Wei (*Fudan University*)

18:00 PET-MRI Joint Reconstruction by Joint Sparsity Based Tight Frame Regularization

Chenglong Bao (*Yau Mathematical Sciences Center, Tsinghua University*)
Jae Kyu Choi (*Institute of Natural Sciences, Shanghai Jiao Tong University*)
Xiaoqun Zhang (*Institute of Natural Sciences, School of Mathematical Sciences, and MOE-LSC, Shanghai Jiao Tong University*)

MS47-3 SPLINES IN IMAGING

Thursday, 07 at 16:30
Room G (Palazzina A - Building A, floor 0)

Splines are unifying mathematical objects that allow making the link between the real continuous world of physics and the digital world of computers. In the field of imaging, a whole class of problems are usually formulated in the continuous domain but call for a digital implementation, which can be efficiently achieved relying on splines. Spline models are advantageous not only computationally, but also conceptually as they allow drawing a number of fundamental connections between disciplines. This mini-symposium focuses on research topics that are relevant to image processing including but not limited to the development of novel spline tools for image processing, segmentation, and for the efficient resolution of inverse problems such as computed tomography. It will also explore the deep connection between splines and variational methods, including Bayesian estimation as well as sparsity-promoting schemes.

Organizers:
Carolina Beccari (*Dept. Mathematics, University of Bologna*)
Virginie Uhlmann (*EPFL, Lausanne*)
Michael Unser (*EPFL, Lausanne*)

16:30 Applications of nonstationary wavelet filters in image processing

Vittoria Bruni (*Dept. of Basic and Applied Sciences for Engineering, University of Rome "La Sapienza"*)
Mariantonia Cotronei (*University of Reggio Calabria*)
Francesca Pitolli (*Dept. of Basic and Applied Sciences for Engineering, University of Rome "La Sapienza"*)

17:00 Acceleration of B-spline based nonrigid image registration

Wyke Huizinga (*Biomedical Imaging Group Rotterdam, Erasmus MC*)
Stefan Klein (*Biomedical Imaging Group Rotterdam, Erasmus MC*)
Dirk Poot (*Biomedical Imaging Group Rotterdam, Erasmus MC*)
Marius Staring (*Division of Image Processing (LKEB), Dept. of Radiology, Leiden University Medical Center*)

17:30 High-dimensional and accurate MRF dictionary-based fitting with spline interpolation

Stefan Klein (*Biomedical Imaging Group Rotterdam, Erasmus MC*)
Dirk Poot (*Biomedical Imaging Group Rotterdam, Erasmus MC*)
Willem van Valenberg (*Quantitative Imaging Group, Delft University of Technology, Biomedical Imaging Group Rotterdam, Erasmus MC*)
Lucas van Vliet (*Quantitative Imaging Group, Delft University of Technology*)
Frans Vos (*Quantitative Imaging Group, Delft University of Technology, Radiology, Academic Medical Center, Amsterdam*)

18:00 DTHB3D_Reg: Dynamic Truncated Hierarchical B-Spline Based 3D Nonrigid Image Registration

Cosmin Anitescu (*University of Weimar*)
Yue Jia (*Northwestern Polytechnical University*)
Aishwarya Pawar (*Department of Mechanical Engineering, Carnagie Mellon University, Pittsburgh*)
Timon Rabczuk (*University of Weimar*)
Jessica Zhang (*Department of Mechanical Engineering, Carnagie Mellon University, Pittsburgh*)

MS50-3 ANALYSIS, OPTIMIZATION, AND APPLICATIONS OF MACHINE LEARNING IN IMAGING

Thursday, 07 at 16:30
Room C (Palazzina A - Building A, floor 1)

Energy minimization methods have been among the most powerful tools for tackling ill-posed image processing problems. They are extremely versatile, are able to model the data formation process explicitly, and allow a detailed mathematical analysis of the solution properties. An alternative approach is to consider a parameterized function, a network, that directly maps from the input data to the desired solution and try to learn the optimal parameters of this mapping on a set of training data. While such learning based approaches have recently outperformed energy minimization methods on many image processing problems, several challenging mathematical questions regarding their training as well as the analysis and control of the produced outputs are not well-understood yet. The goal of this minisymposium is to bring together experts from the fields of machine learning, image processing, and optimization to discuss novel approaches to the design of networks, the solution of the nested non-convex and non-smooth optimization problems to be solved for their training, and the analysis of the resulting solutions.

Organizers:
Michael Moeller (*University of Siegen*)
Gitta Kutyniok (*Technische Universität Berlin*)

16:30 Fast Learning and Inference for Computational Imaging

Ignacio Garcia-Dorado (*Google Research*)
Pascal Getreuer (*Google Research*)
John Isidoro (*Google Research*)
Peyman Milanfar (*Google Research*)
Yaniv Romano (*Technion - Israel Institute of Technology*)

17:00 Unraveling the mysteries of stochastic gradient descent on deep networks

Pratik Chaudhari (*University of California, Los Angeles, UCLA*)

17:30 Proximal Backpropagation

Thomas Frerix (*Technical University of Munich*)
Thomas Möllenhoff (*Technical University of Munich*)

18:00 A shearlet-based deep learning approach to limited-angle tomography

Gitta Kutyniok (*Technische Universität Berlin*)
Maximilian März (*Technische Universität Berlin*)
Wojciech Samek (*Fraunhofer Institute for Telecommunications–Heinrich Hertz Institute*)
Vignesh Srinivasan (*Fraunhofer Institute for Telecommunications–Heinrich Hertz Institute*)

MS51-3 ALGORITHMS FOR SINGLE PARTICLE RECONSTRUCTION IN CRYO-ELECTRON MICROSCOPY (CRYO-EM).

Thursday, 07 at 16:30
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

Cryo-electron microscopy (cryo-EM) is a technique for three-dimensional imaging of biological macromolecules. Molecules are frozen in a thin layer of ice and their tomographic projections are recorded in an electron microscope. Recent advances have yielded molecular reconstructions at near-atomic resolution, and in 2017 the Nobel Prize in Chemistry was awarded to three pioneers of the field. The goal of this minisymposium is to bring together the communities of cryo-EM and computational imaging to facilitate the exchange of new ideas and perspectives. It will cover fast algorithms for reconstruction, resolving high-resolution structures, validation, structural variability in heterogeneous samples, and other topics.

Organizers:
Roy Lederman (*Yale University*)
Joakim Andén (*Flatiron Institute*)

16:30 Parameter estimation in heterogeneous mixtures

Yariv Aizenbud (*Tel Aviv University*)
Boris Landa (*Tel Aviv University*)
Yoel Shkolnisky (*Tel Aviv University*)

17:00 3D ab initio modeling in cryo-EM by autocorrelation analysis

Tamir Bendory (*Princeton University*)
Nicolas Boumal (*Princeton University*)
Joe Kileel (*Princeton University*)
Eitan Levin (*Princeton University*)

Amit Singer (*Princeton University*)

17:30 Resolving cryo-EM heterogeneity with low-rank methods

Joakim Andén (*Flatiron Institute*)

MS53-2 DIMENSIONALITY REDUCTION ALGORITHMS FOR LARGE-SCALE IMAGES

Thursday, 07 at 16:30
Room H (Palazzina B - Building B, floor 0)

Technological and theoretical advances in all scientific disciplines ranging from Engineering to Sciences have provided us with numerous large scale datasets to analyze. A fundamental question is how extract low dimensional models that will reflect in an efficient manner the most-important states and dynamics of the system under study. To tackle with such problems this symposium confront with two challenges: that of dimensionality reduction and the problem of data mining. Algorithms and methods that have the potential to facilitate better understanding, predicting and modelling of large-scale data and images with important health, social and economical impact will be discussed.

Organizers:
Salvatore Cuomo (*Dept. Mathematics and Applications "Renato Caccioppoli", University of Naples*)
Costantinos Siettos (*National Technical University of Athens*)
Lucia Russo (*Consiglio Nazionale delle Ricerche, Istituto di Ricerche sulla Combustione*)

16:30 Contrast enhancement operators based on attractors identification in nonlinear dynamical systems

Jacques Demongeot (*University of Grenoble Alpes (UGA)*)

17:00 Neural Manifolds: Sparse Dictionary Learning Approaches

Francesco Donnarumma (*Institute of Cognitive Sciences and Technologies, Rome*)
Roberto Prevete (*DIETI University of Naples Federico II*)

17:30 Application of the Optical Flow Method for the analysis of flame propagation in a transparent internal combustion engine

Gaetano Continillo (*University of Sannio, Benevento*)
Simone Lombardi (*Università degli Studi del Sannio*)
Paolo Sementa (*Istituto Motori, Consiglio Nazionale delle Ricerche*)
Bianca Maria Vaglievo (*Istituto Motori, Consiglio Nazionale delle Ricerche*)

18:00 Application of Decomposition Methods to the study of flames via image sequences

Gaetano Continillo (*University of Sannio, Benevento*)

MS54-2 HYBRID APPROACHES THAT COMBINE DETERMINISTIC AND STATISTICAL REGULARIZATION FOR APPLIED INVERSE PROBLEMS

Thursday, 07 at 16:30
Room L (Palazzina B - Building B, floor 0)

Techniques that combine deterministic and statistical methods to solve inverse problems will be the focus of the minisymposium. The speakers and audience may range from practitioners in medical imaging to more specialized mathematicians/statisticians working on applied inverse problems. This type of blended expertise is relevant to solving applied problems in imaging, particularly ones that are ill-posed in nature including electrical impedance tomography and optical tomography. In recent years, there has been a tremendous growth in devising new techniques both deterministic and statistical, such as model reduction using reduced basis method, sparsity, Bayesian inversion, Markov Chain Monte Carlo (MCMC) methods etc. The statistical approaches are becoming more popular due to the growth of computational power in the last several decades.

Organizers:
Cristiana Sebu (*University of Malta*)
Taufiquar Khan (*Clemson University*)

16:30 Imaging the solar interior

Damien Fournier (*University of Goettingen*)
Laurent Gizon (*Max-Planck-Institut für Sonnensystemforschung*)
Thorsten Hohage (*University of Goettingen*)

17:00 Maximum-a-posteriori estimation with unknown regularisation parameters: combining deterministicand Bayesian approaches

Ana Fernandez Vidal (*Heriot-Watt University*)
Marcelo Pereyra (*Harriott-Watt University*)

17:30 Photoacoustic imaging using sparsity in curvelet frame

Simon Arridge (*University College London*)
Marta Betcke (*University College London*)
Ben Cox (*Department of Medical Physics, University College London*)
Nam Huynh (-)
Felix Lucka (*CWI & UCL*)
Bolin Pan (*University College London*)

18:00 Reconstructing a convex inclusion with one measurement of electrode data in the inverse conductivity problem

Bastian Harrach (*Goethe-Universität Frankfurt am Main*)
Masaru Ikehata (*Hiroshima University*)
Vesa Kaarnioja (*University of Helsinki*)
Minh Mach (*University of Helsinki*)

MS55-2 ADVANCES OF REGULARIZATION TECHNIQUES IN ITERATIVE RECONSTRUCTION

Thursday, 07 at 16:30
Room P (Palazzina B - Building B, floor 0)

Regularization plays a vital role in achieving complete answers of complex inverse problems and in resolving ill conditioning associated with factors such as limited data and

uncertainties of the experimental environment. Recent advances have been made on developing different types of regularizers based on prior knowledge of the unknown parameters. Alternatively, Observations obtained from multiple modalities provide another form of regularizer for improved solution and incorporation of available knowledge, whether as a result of complementary information or as a means to lower measurement noise. This minisymposium brings together experts from the areas of optimization, numerical methods, and a wide range of imaging applications to discuss new regularizing approaches and identify promising future research directions.

Organizers:
Zichao (Wendy) Di (*Argonne National Lab*)
Marc Aurèle Gilles (*Cornell University*)

16:30 Optimization Problems with Sparsity-Inducing Terms

Amir Beck (*Tel-Aviv University*)
Nadav Hallak (*Technion - Israel Institute of Technology*)

17:00 High-resolution x-ray imaging from sparse, incomplete and uncertain data

Doga Gursoy (*Argonne National Laboratory*)

17:30 Spectral approximation of fractional PDEs in image processing and phase field modeling

Harbir Antil (*George Mason University*)

18:00 Blind Image Fusion for Hyperspectral Imaging with Directional Total Variation

Leon Bungert (*University of Münster*)
David Coomes (*Forest Ecology and Conservation Group, Department of Plant Sciences, University of Cambridge*)
Matthias J. Ehrhardt (*University of Cambridge*)
Marc Aurèle Gilles (*Cornell University*)
Jennifer Rasch (*Fraunhofer Heinrich Hertz Institute*)
Rafael Reisenhofer (*University of Bremen*)
Carola-Bibiane Schönlieb (*University of Cambridge*)

MS57-2 RECENT TRENDS IN PHOTOMETRIC 3D-RECONSTRUCTION

Thursday, 07 at 16:30
Room E (Palazzina A - Building A, floor 2)

Many computer vision techniques for 3D-reconstruction have been developped, building upon different clues. Most of them are based on triangulation, which provides the 3D-position of a point seen from at least two viewpoints. From theory to applications, these techniques have been widely studied, with undeniable success. However, even up-to-date techniques such as structure-from-motion or multi-view stereo reach their limits when faced to specular materials i.e., when a 3D-point does not look equally bright from different viewpoints. Another limit of triangulation is that it may provide the 3D-shape, but not the reflectance of a scene. These limitations have motivated recently a renewed interest in photometric 3D-reconstruction. Such techniques as shape-from-shading, photometric stereo, or shape-from-polarization rely on the relationship between the image color and the characteristics of the triplet scene-lighting-camera. In order to estimate geometric and photometric clues, their goal is to invert the image formation process. To this end, various mathematical tools can be employed, for instance variational methods, PDEs or machine learning. The field of photometric 3D-reconstruction has taken advantage of the complementarity of two research communities: mathematical imaging and computer vision. The aim of the proposed minisymposium is to bring together researchers from both these communities, in order to discuss the recent advances in the field.

Organizers:
Jean-Denis Durou (*IRIT, Université de Toulouse*)
Maurizio Falcone (*Dipartimento di Matematica, Università di Roma "La Sapienza"*)

16:30 Models and numerics for extending classic photometric stereo

Michael Breuss (*Brandenburg University of Technology*)

17:00 Variational Reflectance Estimation from Multi-view Images

Jean Mélou (*IRIT, Université de Toulouse*)

17:30 A unified differential approach to photo-polarimetric shape estimation

Silvia Tozza (*INdAM/Dept. Mathematics, University of Rome "La Sapienza"*)

18:00 High-Quality 3D Reconstruction by Joint Appearance and Geometry Optimization with Spatially-Varying Lighting

Robert Maier (*TU Munich*)

MS58-2 INSTRUMENTS AND TECHNIQUES FOR BIOMEDICAL RESEARCH

Thursday, 07 at 16:30
Room F (Palazzina A - Building A, floor 2)

Biomedical research in orthopaedics investigates major anatomical and functional features of the human body. This is performed on natural, pathological and treated anatomical regions (replacement, reconstructions etc.), to understand the relevant conditions, and in case to design and/or to assess the most appropriate treatment. There is huge literature on these studies, and major relevant advancements have resulted from this knowledge, but new potential benefits of the most recent instruments and techniques still needs to be fully comprehended and discussed. The faculty gathered for this symposium are authorities in this emerging discipline, and can also bring a number of real relevant cases.

Organizers:
Alberto Leardini (*Laboratory of Movement Analysis and Functional-Clinical Evaluation of Prosthesis, Istituto Ortopedico Rizzoli, Bologna*)

16:30 Multi-instrument Medical Imaging Analysis for Personalized Joint Replacement Design

Claudio Belvedere (*Istituto Ortopedico Rizzoli, Bologna*)
Paolo Caravaggi (*Istituto Ortopedico Rizzoli, Bologna*)
Stefano Durante (*Istituto Ortopedico Rizzoli, Bologna*)

Alberto Leardini (*Laboratory of Movement Analysis and Functional-Clinical Evaluation of Prosthesis, Istituto Ortopedico Rizzoli, Bologna*)
Sorin Siegler (*Drexel University, Philadelphia*)

17:00 Roentgen-Stereophotogrammetric-Analysis (RSA) for the assessment of Joint Replacements

Richie Gill (*Department of Mechanical Engineering, University of Bath*)

17:30 ALBA: a Rapid Prototyping Framework for Computer Aided Medicine

Gianluigi Crimi (*Istituto Ortopedico Rizzoli, Bologna*)
Enrico Schileo (*Istituto Ortopedico Rizzoli, Bologna*)
Fulvia Taddei (*Istituto Ortopedico Rizzoli, Bologna*)
Giordano Valente (*Istituto Ortopedico Rizzoli, Bologna*)
Nicola Vanella (*Istituto Ortopedico Rizzoli, Bologna*)

18:00 Virtual Modeling e 3D Printing to support clinical research

Laura Cercenelli (*Laboratory of Bioengineering, Department of Experimental Diagnostic and Specialty Medicine (DIMES), University of Bologna, Policlinico S. Orsola Malpighi*)
Emanuela Marcelli (*Laboratory of Bioengineering, Department of Experimental Diagnostic and Specialty Medicine (DIMES), University of Bologna, Policlinico S. Orsola Malpighi*)

MS59-2 APPROACHES FOR FAST OPTIMISATION IN IMAGING AND INVERSE PROBLEMS

Thursday, 07 at 16:30
Room B (Palazzina A - Building A, floor 1)

Over the past decades, first-order operator splitting methods have become ubiquitous for many fields including signal/image processing and inverse problems owing to their simplicity and efficiency. In recent years, with the increasing of model complexity and data size, the needs for fast optimisation methods is becoming increasingly stronger. The aim of this mini-symposium is to highlight the recent advances in the acceleration of optimisation methods. The main topics of the mini-symposium will cover: inertial and acceleration schemes, preconditioning techniques, half quadratic regularisation, Krylov subspace, quasi-Newton method and other related ones.

Organizers:
Jingwei Liang (*University of Cambridge*)
Carola-Bibiane Schönlieb (*University of Cambridge*)
Mila Nikolova (*CMLA - CNRS ENS Cachan, University Paris-Saclay*)

16:30 Inertial Proximal ADMM for Linearly Constrained Separable Convex Optimization

Raymond H. Chan (*Department of Mathematics, The Chinese University of Hong Kong*)

17:00 Accelerated Alternating Descent Methods for Dykstra-like Problems

Pauline Tan (*CMLA, École normale supérieure Paris-Saclay*)

17:30 Preconditioning and Acceleration Techniques for the Douglas-Rachford Iteration

Kristian Bredies (*Universität Graz*)
Hongpeng Sun (*Renmin University of China*)

18:00 Lower Complexity Bound for Linearized Augmented Lagrangian Method

Yangyang Xu (*Rensselaer Polytechnic Institute*)

MS60-1 COMPUTATIONAL AND COMPRESSIVE IMAGING TECHNOLOGIES AND APPLICATIONS

Thursday, 07 at 16:30
Room A (Palazzina A - Building A, floor 0)

Compressive and computational imaging offers the potential for radical new sensor designs coupled with a new way to envision the collection of image information. New theories in sparse Image models, sensor architectures, and reconstruction algorithms all play an integrated role in the design of the next generation imaging sensors. This minisymposium will explore some of the latest theoretical developments, application areas that could benefit from a different sensing paradigm, and current results from prototype compressive and computational imaging devices.

Organizers:
Robert Muise (*Lockheed Martin*)
Richard Baraniuk (*Rice University*)

16:30 A concept for Wide Field-of-View Imaging

Robert Muise (*Lockheed Martin*)

17:00 Computational sensing approaches for enhanced active imaging

Martin Laurenzis (*French-German Research Institute of Saint-Louis*)

17:30 Time-of-Flight Imaging in Scattering Environments

Marco La Manna (*University of Wisconsin - Madison*)

18:00 Spectral Methods for Passive Imaging: Non-asymptotic Performance and Robustness

Justin Romberg (*Georgia Tech*)

CP8 CONTRIBUTED SESSION 8

Thursday, 07 at 16:30
Room 1 (Redenti, floor 0)

Chairs:
Luca Zanni (*University of Modena and Reggio Emilia*)

16:30 Fast super-resolution of hyperspectral 2D Raman maps with a joint positivity constraint

Tim Batten (*Spectroscopy Products Division, Renishaw plc*)
Bernard Humbert (*Institute des Materiaux Jean Rouxel Nantes, University of Nantes*)
Said Moussaoui (*Laboratoire des Sciences du Numérique de Nantes UMR CNRS 6004, Ecole Centrale de Nantes*)
Dominik J. Winterauer (*Renishaw plc, University of Nantes*)

16:50 Sparse Diffraction Signature Modeling of Progressively Loaded Aluminum Alloy

Daniel Banco (*Tufts University*)

Armand Beaudoin (*University of Illinois Urbana-Champaign*)
Eric Miller (*Tufts University*)
Matthew Miller (*Cornell University*)

17:10 On the uniqueness for an inverse mixed elastic scattering problem

Vassilios Sevroglou (*University of Piraeus*)

17:30 Joint image formation and phase error correction using synthetic aperture radar data

Anne Gelb (*Dartmouth College*)
Theresa Scarnati (*Air Force Research Laboratory*)

17:50 Variational Approach to Fourier Phase Retrieval

Tsipenyuk Arseniy (*Technical University of Munich*)
Gero Friesecke (*Technical University of Munich*)

18:10 State estimation with golden angle acquisition in fMRI

Ville-Veikko Wettenhovi (*University of Eastern Finland*)

Friday, June 08

IP6 LINEARLY-CONVERGENT STOCHASTIC GRADIENT ALGORITHMS

Friday, 08 at 08:15
Room A (Palazzina A - Building A, floor 0)

Many machine learning and signal processing problems are traditionally cast as convex optimization problems where the objective function is a sum of many simple terms. In this situation, batch algorithms compute gradients of the objective function by summing all individual gradients at every iteration and exhibit a linear convergence rate for strongly-convex problems. Stochastic methods, rather, select a single function at random at every iteration, classically leading to cheaper iterations but with a convergence rate which decays only as the inverse of the number of iterations. In this talk, I will present the stochastic averaged gradient (SAG) algorithm which is dedicated to minimizing finite sums of smooth functions; it has a linear convergence rate for strongly-convex problems, but with an iteration cost similar to stochastic gradient descent, thus leading to faster convergence for machine learning and signal processing problems. I will also mention several extensions, in particular to saddle-point problems, showing that this new class of incremental algorithms applies more generally.

Chairs:
Xue-Cheng Tai (*Hong Kong Baptist University*)

Francis Bach (*Departement d'Informatique de l'Ecole Normale Superieure Centre de Recherche INRIA de Paris*)

MS33-3 ADVANCES IN RECONSTRUCTION ALGORITHMS FOR COMPUTED TOMOGRAPHY

Friday, 08 at 09:30
Room A (Palazzina A - Building A, floor 0)

Computed tomography (CT), which uses x-rays to image object interiors from the outside, is an established imaging modality in medicine, invaluable for diagnosis and treatment. In recent years, CT has found applications in other fields as well, e.g. nondestructive testing of components in manufacturing, analysis of material microstructures using micro-CT. Such a diverse set of applications and reconstruction scenarios require specialized algorithms that can handle different conditions and configurations, such as, limited data or low dose reconstruction, high resolution from large-scale data, unconventional source-detector geometries. This minisymposium will showcase novel reconstruction approaches to address such challenges in CT. Examples will include iterative reconstruction algorithms, discrete tomography, customized regularization approaches.

Organizers:
Gunay Dogan (*Theiss Research, NIST*)
Harbir Antil (*George Mason University*)
Elena Loli Piccolomini (*Dept. Computer Science and Engineering, University of Bologna*)
Samuli Siltanen (*University of Helsinki*)

09:30 Iterative reconstruction combining attenuation and Compton scattering for few-view X-ray tomography systems

Brian Tracey (*Tufts University*)

10:00 Learned iterative reconstruction for CT

Jonas Adler (*KTH Royal Institute of Technology*)
Ozan Öktem (*KTH - Royal Institute of Technology*)

10:30 Limited-data x-ray CT for underwater pipeline inspection using shearlet-based regularization

Yiqiu Dong (*Technical University of Denmark*)
Jacob Frøsig (*FORCE Technology*)
Per Christian Hansen (*Technical University of Denmark*)
Nicolai André Brogaard Riis (*Technical University of Denmark*)

11:00 Exploiting structural similarities in multi-energy tomographic reconstructions

Alexander Meaney (*University of Helsinki*)

MS40 RECENT ADVANCES IN CONVOLUTIONAL SPARSE REPRESENTATIONS

Friday, 08 at 09:30
Room F (Palazzina A - Building A, floor 2)

Convolutional sparse representations have recently attracted significant attention from the imaging community, thanks to their structural properties and their success in numerous imaging applications, ranging from restoration to super resolution and HDR imaging. Despite the development of efficient sparse coding and dictionary learning algorithms, several theoretical as well as practical aspects of these representations are still not thoroughly understood, and convolutional sparse representations remain, as a technique, far less mature than standard sparse representations. This minisymposium provides a selection of recent progress in this area, including dictionary learning algorithms, connections with deep learning, and new applications.

Organizers:
Giacomo Boracchi (*Politecnico di Milano*)
Alessandro Foi (*Tampere University of Technology*)
Brendt Wohlberg (*Los Alamos National Laboratory*)

09:30 Online Convolutional Dictionary Learning for Multimodal Imaging

Kévin Degraux (*Université catholique de Louvain*)
Ulugbek Kamilov (*Washington University in St. Louis*)

10:00 From convolutional analysis operator learning (CAOL) to convolutional neural network (CNN)

Il Yong Chun (*University of Michigan*)
Jeffrey A. Fessler (*University of Michigan*)

10:30 Greedy and learned approaches for convolutional sparse coding

Raja Giryes (*Tel Aviv University*)

11:00 Convolutional Sparse Coding vs Aggregation of Independent Estimates

Giacomo Boracchi (*Politecnico di Milano*)
Diego Carrera (*Politecnico di Milano*)
Alessandro Foi (*Tampere University of Technology*)
Brendt Wohlberg (*Los Alamos National Laboratory*)

MS49-2 IMAGE RESTORATION, ENHANCEMENT AND RELATED ALGORITHMS

Friday, 08 at 09:30
Room E (Palazzina A - Building A, floor 2)

High quality images are important for both visualization and analysis purpose. Image reconstruction, the process to compute high quality images from raw hardware measurements and image enhancement, the process to obtain higher quality images from different low quality images (e.g., noisy, blurred, low resolution) of the same scene/object are important imaging problems. Appropriate modeling and efficient algorithms are substantial in both problems. This 4-session mini-symposium gathers together the latest theoretical and practical development in this broad topic. Three sessions focus on (depending on titles) while one session focuses on enhancing resolution of multi-spectral and high-spectral images.

Organizers:
Weihong Guo (*Case Western Reserve University*)
Ke Chen (*University of Liverpool*)
Xue-Cheng Tai (*Hong Kong Baptist University*)
Guohui Song (*Clarkson University*)

09:30 Fast multilevel algorithms for nonlinear optimization in image processing

Ke Chen (*University of Liverpool*)
Abdul Jumaat (*University of Liverpool*)

10:00 Variational Phase Retrieval with globally convergent preconditioned Proximal Algorithm

Yifei Lou (*University of Texas at Dallas*)

10:30 A Multigrid Approach for Multi Scale Total Variation Models

Ke Yin (*Huazhong Univeristy of Science and Technology*)

MS61-1 IMAGING WITH LIGHT AND SOUND

Friday, 08 at 09:30
Room H (Palazzina B - Building B, floor 0)

Recent years have seen increasing interest in imaging with photons in the visible and near-infrared spectrum. The physiological nature of chromophores in tissue gives rise to a rich set of contrasts but at the cost of complex models of light propagation and usually poor resolution resulting from the strongly ill-posed and non-linear nature of the corresponding inverse problem. Combining optical and other modalities in "Coupled Physics Imaging" can overcome these limitations, e.g., light-plus-sound modalities such as photo-acoustics and ultrasound modulated optical tomography. In this minisymposium we bring together leading researchers in the fields of optical, acoustic and coupled imaging.

Organizers:
Felix Lucka (*CWI & UCL*)
Tanja Tarvainen (*University of Eastern Finland*)

09:30 A stability analysis for photoacoustics in the presence of attenuation

Peter Elbau (*University of Vienna*)
Otmar Scherzer (*Computational Science Center, University of Vienna*)
Cong Shi (*Georg-August-Universität Göttingen*)

10:00 Photoacoustic computed tomography in heterogeneous elastic media

Mark Anastasio (*Washington University in St. Louis*)

10:30 The Averaged Kaczmarz Iteration for Solving Inverse Problems

Markus Haltmeier (*University Innsbruck*)
Housen Li (*Georg-August-Universität Göttingen*)

11:00 Bayesian approach to photoacoustic image reconstruction

Aki Pulkkinen (*University of Eastern Finland*)
Tanja Tarvainen (*University of Eastern Finland*)
Jenni Tick (*University of Eastern Finland*)

MS62-1 IMAGING MODELS WITH NON-LINEAR CONSTRAINTS

Friday, 08 at 09:30
Room M (Palazzina B - Building B, floor 0)

The talks in our minisymposium discuss numerical methods and practise of imaging problems that are linked to measurements in a non-linear fashion. This linkage take, for instance, the form of a control constraint on the solution of an optimisation problem. As an example, the constraint can arise through a PDE modelling the relationship of boundary measurements to desired interior data; such imaging modalities include various forms of electrical, optical, and acoustic tomography. The linkage can also arise from the desire to optimise, to train, an inner imaging model to available true data or fitness functions. The inner model can take the form of a non-linear neural network, or an optimisation problem itself. While the former needs to mention, the latter methodology has also gained significant popularity as an approach to optimise conventional, more analytically justified imaging models to expected data.

Organizers:
Tuomo Valkonen (*University of Liverpool*)
Juan Carlos De Los Reyes (*Escuela Politécnica Nacional*)

09:30 Learning neural field equations for brain imaging

Christoph Brune (*University of Twente*)

10:00 A New Variational Approach for Limited Angle Tomography

Martin Benning (*University of Cambridge*)
Christoph Brune (*University of Twente*)
Rien Lagerwerf (*Centrum Wiskunde & Informatica*)
Carola-Bibiane Schönlieb (*University of Cambridge*)
Rob Tovey (*University of Cambridge*)

10:30 Total variation priors in electrical impedance tomography

Gerardo González (*University of Eastern Finland*)
Ville Kolehmainen (*University of Eastern Finland*)
Mohammad Pour-Ghaz (*North Carolina State University*)

Aku Seppänen (*University of Eastern Finland*)

11:00 A semi-infinite bilevel optimization approach for spatially-dependent parameter selection in total generalized variation image denoising

Kateryn Herrera (*Escuela Politécnica Nacional*)

MS63 GEOMETRIC METHODS FOR SHAPE ANALYSIS WITH APPLICATIONS TO BIOMEDICAL IMAGING AND COMPUTATIONAL ANATOMY

Friday, 08 at 09:30
Room I (Palazzina B - Building B, floor 0)

This minisymposium will focus on fundamental and applied aspects of shape analysis. Shape analysis remains one of the key problems to applications ranging from automatic object recognition to the field of biomedical imaging in which datasets typically involve multiple geometric structures with morphological variability. Modern methods are at the intersection of several fields in mathematics that span finite and infinite dimensional geometry, optimal control, optimal transport and statistical data analysis. The objective of the mininisymposium is to bring together researchers covering those multiple aspects to present recent ideas in the field and discuss new directions of interest for the community.

Organizers:
Martin Bauer (*Florida State University*)
Nicolas Charon (*Johns Hopkins University*)

09:30 Barycentric Subspace Analysis, a generalisation of PCA to Manifolds

Xavier Pennec (*Université Côte d'Azur and Inria*)

10:00 Generalizations of Wasserstein metric and their applications to shape matching

François-Xavier Vialard (*University Paris-Dauphine*)

10:30 LDDMM models of a heart contraction

Sylvain Arguillere (*Institut Camille Jordan*)

11:00 Regularized optimal mass transport with applications to density matching

Martin Bauer (*Florida State University*)

MS64 IMAGES AND FINITE ELEMENTS

Friday, 08 at 09:30
Room L (Palazzina B - Building B, floor 0)

Images are most often represented by pixel data on Cartesian grids. However, finite element models may be preferred in certain situations. Examples include images on triangulated surfaces, or when higher-order representations and adaptivity play a role. Choosing a finite element discretization has interesting implications on the algorithmic solution of image restoration and related problems as well as their duals, which will be highlighted by the speakers in this minisymposium.

Organizers:
Roland Herzog (*Technische Universität Chemnitz*)
Stephan Schmidt (*University of Würzburg*)

09:30 Discrete total variation with finite elements

Marc Herrmann (*University of Würzburg*)
Roland Herzog (*Technische Universität Chemnitz*)
Stephan Schmidt (*University of Würzburg*)
José Vidal Núñez (*Technische Universität Chemnitz*)
Gerd Wachsmuth (*Technische Universität Chemnitz*)

10:00 Adaptive finite element approximation of the ROF model

Sören Bartels (*University of Freiburg*)
Marijo Milicevic (*University of Freiburg*)

10:30 Fast and robust boundary segmentation using 2nd order shape sensitivity of variational models

Gunay Dogan (*Theiss Research, NIST*)

11:00 Adaptive finite elements for Mumford-Shah-type functionals in transport network modelling

Rossmanith Carolin (*Westfälische Wilhelms-Universität Münster*)
Benedikt Wirth (*Universität Münster*)

MS65-1 MACHINE LEARNING TECHNIQUES FOR IMAGE RECONSTRUCTION

Friday, 08 at 09:30
Room P (Palazzina B - Building B, floor 0)

The development of fast and accurate reconstruction algorithms is a central mathematical aspect of imaging. Most traditional image reconstruction methods can basically be classified in either analytical or iterative methods. Recently, a new class of image reconstruction methods appeared which use methods from machine learning, especially from deep learning. Initial results using deep learning techniques for image reconstruction demonstrate great promise, for example, for improving image quality, reducing computation time, or reducing radiation exposure. In this minisymposium leading experts will report on recent progress towards using machine learning for image reconstruction.

Organizers:
Markus Haltmeier (*University Innsbruck*)
Linh Nguyen (*University of Idaho*)

09:30 Deep learning for photoacoustic tomography

Markus Haltmeier (*University Innsbruck*)
Linh Nguyen (*University of Idaho*)

10:00 Deep Learning Approaches for MR Image Reconstruction

Daniel Rueckert (*Imperial College London*)

10:30 Deep convolutional framelets: a general deep learning framework for inverse problems

Eunju Cha (*KAIST*)
Yoseob Han (*KAIST*)
Jong Chul Ye (*Department of Bio and Brain Engineering, Korea Advanced Institute of Science and Technology*)

11:00 Deep Learning for Photoacoustic Tomography from Sparse Data

Stephan Antholzer (*University of Innsbruck*)
Markus Haltmeier (*University Innsbruck*)
Robert Nuster (*Karl-Franzens-Universität Graz*)
Johannes Schwab (*Universität Innsbruck*)

MS66 SPATIAL STATISTICS IN MICROSCOPY IMAGING

Friday, 08 at 09:30
Matemates (Matemates, floor 0)

Spatial statistics and point processes, have been a fundamental field of research for decades. Leading methods in image processing rely on powerful image models/priors, e.g., marked point processes and random sets. They are now especially appropriate to analyze the spatial distribution of proteins or single molecules observed in fluorescence microscopy and super-resolution imaging. Recently, they have been utilized for solving inverse problems in bioimaging (e.g. deconvolution), tracking moving particles or co-localisation in fluorescence microsopy. Machine learning techniques and convolutional neural networks are now investigated to address similar issues. The proposed minisymposium consists of two sessions, covering a series of problems in this field.

Organizers:
Charles Kervrann (*Inria*)

09:30 GcoPS: a fast automatic colocalization method for 3D live cell imaging and super-resolution microscopy

Charles Kervrann (*Inria*)

10:00 Marked point processes for detecting objects in microscopy

Descombes Xavier (*Inria Sophia-Antipolis*)

10:30 Spatial statistics extends co-localization analysis to non-local interaction analysis

Ivo Sbalzarini (*TU Dresden / Max Planck Insitute of Molecular Cell Biology and Genetics*)

11:00 Spatial patterns in large-scale bioimaging data: applications in spatial transcriptomics and phenomics

Walter Thomas (*CBIO, Mines ParisTech*)

MS67-1 ADVANCES AND NEW DIRECTIONS IN SEISMIC IMAGING AND INVERSION

Friday, 08 at 09:30
Room G (Palazzina A - Building A, floor 0)

Seismic data are inverted to estimate subsurface model parameters. We would like to address current challenges and directions in seismic data inversion and parameter estimation. Questions to address include inversion of non-ideal data, the influence of parametrization on the retrieval of velocity models, inversion of data in the absence of frequencies, and estimation methods for models with sharp discontinuities. Issues to discuss in this mini-symposium are of current importance. With the advent of algorithms for seismic full-waveform inversion, new problems have arisen, and a definite necessity for formulating new directions in seismic inversion and geophysical estimation theory.

Organizers:
Mauricio Sacchi (*University of Alberta*)
Sergey Fomel (*University of Texas, Austin*)
Laurent Demanet (*MIT*)

09:30 Comet interior imaging using radar tomography.

Paul Sava (*Colorado School of Mines*)

10:00 Seismic image matching

Sergey Fomel (*University of Texas, Austin*)
Sarah Greer (*University of Texas at Austin*)

10:30 Data-to-Born transform for inversion and imaging with seismic waves

Alexander Mamonov (*University of Houston*)

11:00 Direct waveform inversion (DWI) by explicit time-space causality

Yingcai Zheng (*University of Houston*)

MS68 MULTI-CHANNEL IMAGE RECONSTRUCTION APPROACHES

Friday, 08 at 09:30
Room C (Palazzina A - Building A, floor 1)

State-of-the-art image reconstruction techniques for multi-channel inverse problems employ various inter-channel correlation and regularization techniques to address low data signal-to-noise ratio (SNR) and reconstruction artifacts. This can be imposed through statistical noise dependencies between channels or regularisation penalties employing joint structural regularities across the channel space. For the latter case one can use various vector and matrix norms enabling joint directions of smoothing. This mini-symposium will demonstrate current tendencies in multi-channel image reconstruction through correlative regularisation approaches as well as applications such as spectral computed tomography.

Organizers:
Jakob Jorgensen (*University of Manchester*)
Daniil Kazantsev (*University of Manchester*)

09:30 Joint image reconstruction of multi-channel X-ray computed tomography data for material science

Daniil Kazantsev (*University of Manchester*)

10:00 Collaborative Regularization Models for Color Imaging Problems

Joan Duran (*Universitat de les Illes Balears*)
Catalina Sbert (*Universitat de les Illes Balears*)

10:30 Electron tomography combining spectral and non-spectral modalities

Joost Batenburg (*CWI, Amsterdam*)
Zhichao Zhong (*Centrum Wiskunde & Informatica*)

11:00 Multi-channel high-resolution x-ray tomography

Doga Gursoy (*Argonne National Laboratory*)

MS70-1 INNOVATIVE CHALLENGING APPLICATIONS IN IMAGING SCIENCES

Friday, 08 at 09:30
Room D (Palazzina A - Building A, floor 1)

Computing reliable solutions to ill-posed inverse problems is one of the most important tasks in imaging science. The aim of this minisymposium is to present new trends in computer vision, numerical analysis, optimization, shape analysis with their applications in the real world. The presentations will promote interactions of these new challenging methods in

many fields of imaging science, such as science, medicine, engineering with particular focus on 3D reconstructions, medical imaging, fingerprints and barcode problems. The speakers span from industrial to academic mathematical community to highlight interdisciplinary aspects of imaging science and to share the latest developments in this field.

Organizers:
Roberto Mecca (*University of Bologna and University of Cambridge*)
Giulia Scalet (*Dept. Civil Engineering and Architecture, University of Pavia*)
Federica Sciacchitano (*Dept. Mathematics, University of Genoa*)

09:30 Modeling and Learning Deep Representations, in Theory and in Practice

Pratik Chaudhari (*University of California, Los Angeles, UCLA*)
Stefano Soatto (*University of California, Los Angeles*)

10:00 Case study in learning to understand: 3D face reconstruction

Ron Kimmel (*Technion - Israel Institute of Technology*)

10:30 A Multidisciplinary Approach to Personalized Design of Orthopaedic Implants and other Devices

Claudio Belvedere (*Istituto Ortopedico Rizzoli, Bologna*)
Paolo Caravaggi (*Istituto Ortopedico Rizzoli, Bologna*)
Stefano Durante (*Istituto Ortopedico Rizzoli, Bologna*)
Alessandro Fortunato (*University of Bologna*)
Alberto Leardini (*Laboratory of Movement Analysis and Functional-Clinical Evaluation of Prosthesis, Istituto Ortopedico Rizzoli, Bologna*)

11:00 Pancreatic cancer identification strategy on CT images based on higher-order statistics

Ferdinando Auricchio (*Department of Civil Engineering and Architecture, University of Pavia*)
Stefania Marconi (*Department of Civil Engineering and Architecture, University of Pavia*)
Erika Negrello (*University of Pavia*)
Andrea Pietrabissa (*Policlinico San Matteo, Pavia*)
Luigi Pugliese (*Policlinico San Matteo, Pavia*)

MS71 NONLINEAR AND ADAPTIVE REGULARIZATION FOR IMAGE RESTORATION

Friday, 08 at 09:30
Main room - aula magna - SP.I.S.A. (SP.I.S.A., floor 0)

Image restoration can be considered the basic model of inverse problems. Recent regularization approaches involve the minimization of special Tikhonov functionals, with nonlinear data fitting and/or penalty terms aimed at reducing oversmoothness and ringing effects, promoting sparsity, or dealing with specific model-dependent noise filtering. The minisymposium will focus on nonlinear regularization methods, with special emphasis to adaptive strategies such as trust region techniques, unsupervised choice of the regularization level, automatic selection of the domain where enforcing the sparsity. Ill-posed imaging problems, with Poisson and Gauss models arising in different application fields such as medical imaging and geophysics, will be discussed.

Organizers:
Claudio Estatico (*University of Genoa*)
Giuseppe Rodriguez (*University of Cagliari*)

09:30 Adaptive image restoration in variable exponent Lebesgue spaces

Claudio Estatico (*University of Genoa*)

10:00 On an elliptical trust-region procedure for ill-posed nonlinear least squares problems

Stefania Bellavia (*University of Florence*)
Elisa Riccietti (*University of Florence*)

10:30 Poisson imaging reconstruction by means of a consistent adaptive regularization method promoting (grouped) sparsity

Federico Benvenuto (*University of Genoa*)
Sabrina Guastavino (*University of Genoa*)

11:00 An infimal-convolution modelling for mixed image denoising problems

Luca Calatroni (*CMAP, École Polytechnique CNRS*)
Juan Carlos De Los Reyes (*Escuela Politécnica Nacional*)
Carola-Bibiane Schönlieb (*University of Cambridge*)

MT3 AUTOMATED 3D RECONSTRUCTION FROM SATELLITE IMAGES

Friday, 08 at 09:30
Room B (Palazzina A - Building A, floor 1)

Commercial spaceborne imaging is experiencing an unprecedented growth both in size of the constellations and resolution of the images. This is driven by applications ranging from geographic mapping to measuring glacier evolution, or rescue assistance for natural disasters. For all these applications it is critical to automatically extract and update elevation data from arbitrary collections of multi-date satellite images. This multi-date satellite stereo problem is a challenging application of 3D computer vision: images are taken at very different dates, from very different points of view, and under different lighting conditions. The case of urban scenes adds further difficulties because of occlusions and reflections. This tutorial is a hands-on introduction to the manipulation of optical satellite images, using complete examples with python code. The objective is to provide all the tools needed to process and exploit the images for 3D reconstruction. We will present the essential modeling elements needed for building a stereo pipeline for satellite images. This includes the specifics of satellite imaging such as pushbroom sensor modeling, coordinate systems, and localization functions. Next we will review the main concepts and algorithms for stereovision and tailor them to the case of satellite images. Finally, we will bring together these elements to build a 3D reconstruction pipeline for multi-date satellite images.

Chairs:
Carola-Bibiane Schönlieb (*University of Cambridge*)

Gabriele Facciolo (*Centre de mathématiques et de leurs applications [CMLA] - École Normale Supérieure Paris-Saclay*)

CP9 CONTRIBUTED SESSION 9

Friday, 08 at 09:30
Room 1 (Redenti, floor 0)

Chairs:
Patrizio Frosini (*University of Bologna*)

09:30 Partially Coherent Ptychography

Huibin Chang (*School of Math. Sci., Tianjin Normal University*)
Pablo Enfedaque (*Lawrence Berkeley Lab*)
Hari Krishnan (*Lawrence Berkeley Lab*)
Stefano Marchesini (*Lawrence Berkeley Nat'l Lab*)

09:50 Imaging with Photonic Integrated Circuits

Katherine Badham (*Lockheed Martin Advanced Technology Center*)
Guy Chriqui (*Lockheed Martin Advanced Technology Center*)
Alan Duncan (*Lockheed Martin Advanced Technology Center*)
Richard Kendrick (*Lockheed Martin Advanced Technology Center*)
Chad Ogden (*Lockheed Martin Advanced Technology Center*)
Tiehui Su (*University of California Davis*)
Samuel Thurman (*Lockheed Martin Coherent Technologies*)
Danielle Wuchenich (*Lockheed Martin Advanced Technology Center*)
S. J. B. Yoo (*University of California Davis*)

10:10 On the application of frame decompositions to 3D reconstruction

Anastasia Zakharova (*National Institute of Applied Sciences, Rouen*)

10:30 Shape Registration With Normal Cycles

Roussillon Pierre (*Ecole Normale Supérieure Paris-Saclay*)

10:50 The cone-beam transform and spherical convolution operators

Michael Quellmalz (*Technische Universität Chemnitz*)

11:10 Fast and stable lagrangian method for image segmentation

Karol Mikula (*Slovak University of Technology*)
Jozef Urbán (*Slovak University of Technology*)

MS33-4 ADVANCES IN RECONSTRUCTION ALGORITHMS FOR COMPUTED TOMOGRAPHY

Friday, 08 at 14:00
Room A (Palazzina A - Building A, floor 0)

Computed tomography (CT), which uses x-rays to image object interiors from the outside, is an established imaging modality in medicine, invaluable for diagnosis and treatment. In recent years, CT has found applications in other fields as well, e.g. nondestructive testing of components in manufacturing, analysis of material microstructures using micro-CT. Such a diverse set of applications and reconstruction scenarios require specialized algorithms that can handle different conditions and configurations, such as, limited data or low dose reconstruction, high resolution from large-scale data, unconventional source-detector geometries. This mini-symposium will showcase novel reconstruction approaches to address such challenges in CT. Examples will include iterative reconstruction algorithms, discrete tomography, customized regularization approaches.

Organizers:
Gunay Dogan (*Theiss Research, NIST*)
Harbir Antil (*George Mason University*)
Elena Loli Piccolomini (*Dept. Computer Science and Engineering, University of Bologna*)
Samuli Siltanen (*University of Helsinki*)

14:00 On CT forward operator approximation and applications to limited data CT

Tatiana Bubba (*University of Helsinki*)
Gaetano Zanghirati (*University of Ferrara*)

14:30 Preconditioning for spectral tomography

Martin Andersen (*Technical University of Denmark*)
Yunyi Hu (*Emory University*)
James Nagy (*Emory University*)

15:00 Quasi-3D iterative reconstruction

Joost Batenburg (*CWI, Amsterdam*)
Jan-Willem Buurlage (*Centrum Wiskunde & Informatica*)
Holger Kohr (*Thermo Fisher Scientific*)
Willem Jan Palenstijn (*Centrum Wiskunde & Informatica, Amsterdam*)

15:30 AIR Tools II – a MATLAB toolbox of algebraic iterative reconstruction methods for CT

Per Christian Hansen (*Technical University of Denmark*)
Jakob Jorgensen (*University of Manchester*)

MS49-3 IMAGE RESTORATION, ENHANCEMENT AND RELATED ALGORITHMS

Friday, 08 at 14:00
Room E (Palazzina A - Building A, floor 2)

High quality images are important for both visualization and analysis purpose. Image reconstruction, the process to compute high quality images from raw hardware measurements and image enhancement, the process to obtain higher quality images from different low quality images (e.g., noisy, blurred, low resolution) of the same scene/object are important imaging problems. Appropriate modeling and efficient algorithms are substantial in both problems. This 4-session mini-symposium gathers together the latest theoretical and practical development in this broad topic. Three sessions focus on (depending on titles) while one session focuses on enhancing resolution of multi-spectral and high-spectral images.

Organizers:
Weihong Guo (*Case Western Reserve University*)
Ke Chen (*University of Liverpool*)
Xue-Cheng Tai (*Hong Kong Baptist University*)
Guohui Song (*Clarkson University*)

14:00 Super-Resolution of Multispectral Multiresolution Images

Jose Bioucas-Dias (*Universidade de Lisboa, Instituto Superior Técnico (IST), Instituto de Telecomunicações (IT)*)
Mário Figueiredo (*Instituto de Telecomunicações and IST, University of Lisboa*)

14:30 The SparseFI Algorithms for Resolution Enhancement of Optical Remote Sensing Images

Claas Grohnfeldt (*Technical University of Munich (TUM)*)
Xiaoxiang Zhu (*Technical University of Munich (TUM) & German Aerospace Center (DLR)*)

15:00 Fusion of Multispectral and Panchromatic Image: a Review of Classical Approaches and New Developments

Luciano Alparone (*University of Florence*)
Jocelyn Chanussot (*Grenoble Institute of Technology*)
Andrea Garzelli (*University of Siena*)
Gemine Vivone (*University of Salemo*)

15:30 Producible Kernel Hilbert Space and Heaviside Functions in Image Enhancement

Liang-Jian Deng (*University of Electronic Science and Technology of China*)

MS54-3 HYBRID APPROACHES THAT COMBINE DETERMINISTIC AND STATISTICAL REGULARIZATION FOR APPLIED INVERSE PROBLEMS

Friday, 08 at 14:00
Room L (Palazzina B - Building B, floor 0)

Techniques that combine deterministic and statistical methods to solve inverse problems will be the focus of the minisymposium. The speakers and audience may range from practitioners in medical imaging to more specialized mathematicians/statisticians working on applied inverse problems. This type of blended expertise is relevant to solving applied problems in imaging, particularly ones that are ill-posed in nature including electrical impedance tomography and optical tomography. In recent years, there has been a tremendous growth in devising new techniques both deterministic and statistical, such as model reduction using reduced basis method, sparsity, Bayesian inversion, Markov Chain Monte Carlo (MCMC) methods etc. The statistical approaches are becoming more popular due to the growth of computational power in the last several decades.

Organizers:
Cristiana Sebu (*University of Malta*)
Taufiquar Khan (*Clemson University*)

14:00 Recovery from model errors in magnetic particle imaging - approximation error modeling approach

Christina Brandt (*University of Hamburg*)

14:30 Deterministic methods for conductivity imaging for breast and skin cancer detection

Cristiana Sebu (*University of Malta*)

15:00 Total variation regularized Acousto-Electric Tomography with Neumann conditions

Bjørn Christian Skov Jensen (*Technical University of Denmark*)

15:30 Combining iterative and statistical inversion algorithms in imaging

Erkki Somersalo (*Case Western Reserve University*)

MS60-2 COMPUTATIONAL AND COMPRESSIVE IMAGING TECHNOLOGIES AND APPLICATIONS

Friday, 08 at 14:00
Room B (Palazzina A - Building A, floor 1)

Compressive and computational imaging offers the potential for radical new sensor designs coupled with a new way to envision the collection of image information. New theories in sparse Image models, sensor architectures, and reconstruction algorithms all play an integrated role in the design of the next generation imaging sensors. This minisymposium will explore some of the latest theoretical developments, application areas that could benefit from a different sensing paradigm, and current results from prototype compressive and computational imaging devices.

Organizers:
Robert Muise (*Lockheed Martin*)
Richard Baraniuk (*Rice University*)

14:00 Efficient Signal Reconstruction for Optically Multiplexed Imagers

Yaron Rachlin (*MIT Lincoln Laboratory*)

14:30 Fast Detection of Compressively-Sensed IR Targets Using Stochastically Trained Least Squares and Compressed Quadratic Correlation Filters

Brian Millikan (*University of Central Florida*)

15:00 DiffuserCam: Lensless Single-exposure 3D Imaging

Nicholas Antipa (*UC Berkeley*)
Reinhard Heckel (*UC Berkeley*)
Grace Kuo (*UC Berkeley*)
Fanglin Liu (*UC Berkeley*)
Ren Ng (*UC Berkeley*)
Laura Waller (*University of California, Berkeley*)
Kyrollos Yanny (*UC Berkeley*)

15:30 Phase Retrieval: Tradeoffs and New Algorithms

Richard Baraniuk (*Rice University*)
Christopher Metzler (*Rice University*)
Ashok Veeraraghavan (*Rice University*)

MS61-2 IMAGING WITH LIGHT AND SOUND

Friday, 08 at 14:00
Room H (Palazzina B - Building B, floor 0)

Recent years have seen increasing interest in imaging with photons in the visible and near-infrared spectrum. The physiological nature of chromophores in tissue gives rise to a rich set of contrasts but at the cost of complex models of light propagation and usually poor resolution resulting from the strongly ill-posed and non-linear nature of the corresponding inverse problem. Combining optical and other modalities in "Coupled Physics Imaging" can overcome these limitations, e.g., light-plus-sound modalities such as photo-acoustics and ultrasound modulated optical tomography. In this minisymposium we bring together leading researchers in the fields of optical, acoustic and coupled imaging.

Organizers:
Felix Lucka (*CWI & UCL*)
Tanja Tarvainen (*University of Eastern Finland*)

14:00 Image reconstruction in hybrid optical imaging modalities using Monte-Carlo solutions to the transport equation

Samuel Powell (*University College London*)

14:30 Coherent acousto-optic imaging

John C Schotland (*University of Michigan*)

15:00 Time-resolved optical tomography of biological tissue by means of structured illumination and single pixel camera detection

Simon Arridge (*University College London*)
Andrea Bassi (*Dept. Physics - Politecnico di Milano*)
Marta Betcke (*University College London*)
Cosimo D'Andrea (*Politecnico di Milano*)
Andrea Farina (*Consiglio Nazionale delle Ricerche (CNR), Istituto di Fotonica e Nanotecnologie (IFN)*)
Gianluca Valentini (*Dept. Physics - Politecnico di Milano*)

15:30 Location of sensors in thermo-acoustic tomography

Maïtine Bergounioux (*CNRS - Université d'Orléans UMR 7013*)
Elie Bretin (*University of Lyon*)
Yannick Privat (*University of Paris*)

MS62-2 IMAGING MODELS WITH NON-LINEAR CONSTRAINTS

Friday, 08 at 14:00
Room M (Palazzina B - Building B, floor 0)

The talks in our minisymposium discuss numerical methods and practise of imaging problems that are linked to measurements in a non-linear fashion. This linkage take, for instance, the form of a control constraint on the solution of an optimisation problem. As an example, the constraint can arise through a PDE modelling the relationship of boundary measurements to desired interior data; such imaging modalities include various forms of electrical, optical, and acoustic tomography. The linkage can also arise from the desire to optimise, to train, an inner imaging model to available true data or fitness functions. The inner model can take the form of a non-linear neural network, or an optimisation problem itself. While the former needs to mention, the latter methodology has also gained significant popularity as an approach to optimise conventional, more analytically justified imaging models to expected data.

Organizers:
Tuomo Valkonen (*University of Liverpool*)
Juan Carlos De Los Reyes (*Escuela Politécnica Nacional*)

14:00 Accelerated primal-dual methods for nonlinear inverse problems

Stanislav Mazurenko (*University of Liverpool*)
Tuomo Valkonen (*University of Liverpool*)

14:30 A two-point gradient method for nonlinear ill-posed problems

Simon Hubmer (*Johannes Kepler University Linz*)
Ronny Ramlau (*Kepler University Linz and Johann Radon Institute*)

15:00 A fast non regularized numerical algorithm for solving bilevel denoising problems

David Villacis (*Escuela Politécnica Nacional*)

15:30 Preconditioners for PDE-constrained optimization problems, with application to image metamorphosis

John Pearson (*University of Edinburgh*)

MS67-2 ADVANCES AND NEW DIRECTIONS IN SEISMIC IMAGING AND INVERSION

Friday, 08 at 14:00
Room G (Palazzina A - Building A, floor 0)

Seismic data are inverted to estimate subsurface model parameters. We would like to address current challenges and directions in seismic data inversion and parameter estimation. Questions to address include inversion of non-ideal data, the influence of parametrization on the retrieval of velocity models, inversion of data in the absence of frequencies, and estimation methods for models with sharp discontinuities. Issues to discuss in this mini-symposium are of current importance. With the advent of algorithms for seismic full-waveform inversion, new problems have arisen, and a definite necessity for formulating new directions in seismic inversion and geophysical estimation theory.

Organizers:
Mauricio Sacchi (*University of Alberta*)
Sergey Fomel (*University of Texas, Austin*)
Laurent Demanet (*MIT*)

14:00 Efficient estimates of uncertainty in time-lapse seismic imaging

Maria Kotsi (*Memorial University of Newfoundland*)
Alison Malcolm (*Memorial University of Newfoundland*)

14:30 Experiments in bandwidth extension

Laurent Demanet (*MIT*)

15:00 Imaging complex near surface using noisy and narrow band surface wave data

Valentina Socco (*Politecnico di Torino*)

15:30 Multi-domain target-oriented imaging using extreme-scale matrix factorization

Marie Graff-Kray (*Dr.*)
Felix J. Herrmann (*Georgia Institute of Technology*)
Rajiv Kumar (*Georgia Institute of Technology*)
Ivan Vasconcelos (*Dept. of Earth Sciences, Utrecht University*)

MS70-2 INNOVATIVE CHALLENGING APPLICATIONS IN IMAGING SCIENCES

Friday, 08 at 14:00
Room D (Palazzina A - Building A, floor 1)

Computing reliable solutions to ill-posed inverse problems is one of the most important tasks in imaging science. The aim of this minisymposium is to present new trends in computer vision, numerical analysis, optimization, shape analysis with their applications in the real world. The presentations will

promote interactions of these new challenging methods in many fields of imaging science, such as science, medicine, engineering with particular focus on 3D reconstructions, medical imaging, fingerprints and barcode problems. The speakers span from industrial to academic mathematical community to highlight interdisciplinary aspects of imaging science and to share the latest developments in this field.

Organizers:
Roberto Mecca (*University of Bologna and University of Cambridge*)
Giulia Scalet (*Dept. Civil Engineering and Architecture, University of Pavia*)
Federica Sciacchitano (*Dept. Mathematics, University of Genoa*)

14:00 How flexible is your scanner?

Sophia Bethany Coban (*Centrum Wiskunde & Informatica, University of Manchester*)

14:30 Classifying stroke using electrical impedance tomography

Samuli Siltanen (*University of Helsinki*)

15:00 Evolution of barcode technology: mathematical models for advanced decoding algorithms

Francesco Deppieri (*DATALOGIC*)

15:30 Image analysis and biometrics @ Fingerprints

Sara Soltani (*Fingerprint Cards, R&D Algorithm Development*)

MS73-1 MATHEMATICAL METHODS FOR SPATIOTEMPORAL IMAGING

Friday, 08 at 14:00
Room P (Palazzina B - Building B, floor 0)

Spatiotemporal imaging arises in many applications and the minisymposium aims to bring together leading experts and young researchers in the processing of such imaging data. The field is undergoing rapid development where a variety of mathematical methods (shape theory, regularization method, local analysis, algorithm) play a pivotal role in improving the reconstruction and analysis of spatiotemporal images, e.g. motion estimation in reconstruction (4D CBCT, pulmonary PET-CT, cardiac SPECT-CT, electron microscopy), predicting the evolution of a disease. The high diversity in mathematical techniques makes it very challenging for a single researcher to embrace the full spectrum of this rapidly evolving field.

Organizers:
Chong Chen (*LSEC, ICMSEC, Academy of Mathematics and Systems Science, Chinese Academy of Sciences*)
Barbara Gris (*Laboratoire Jacques-Louis Lions*)
Ozan Öktem (*KTH - Royal Institute of Technology*)

14:00 Large diffeomorphic deformation based image reconstruction method for spatiotemporal imaging

Chong Chen (*LSEC, ICMSEC, Academy of Mathematics and Systems Science, Chinese Academy of Sciences*)
Barbara Gris (*Laboratoire Jacques-Louis Lions*)
Ozan Öktem (*KTH - Royal Institute of Technology*)

14:30 Optical flow constrained joint motion estimation and reconstruction for dynamic inverse problems

Andreas Hauptmann (*University College London*)

15:00 4D Reconstruction of motion corrected dynamic MR PET list mode data with regularization in the time domain

Fjedor Gaede (*Institute for Computational and Applied Mathematics, University of Münster*)

15:30 Generalized Sinkhorn Iterations for Regularizing Inverse Problems Using Optimal Mass Transport

Johan Karlsson (*KTH - Royal Institute of Technology*)
Axel Ringh (*KTH - Royal Institute of Technology*)

MS74 SEQUENTIAL MONTE CARLO METHODS FOR INVERSE ESTIMATION IN IMAGING SCIENCE

Friday, 08 at 14:00
Matemates (Matemates, floor 0)

Sequential Monte Carlo (SMC) methods provide an attractive way to estimate unknown quantities from noisy observations, as they are flexible, easy-to-implement and have reduced computational burden compared to Markov Chain Mote Carlo methods. Last decade has witnessed an explosion of scientific articles on SMC methods and their applications to inverse problems and image reconstruction, thanks to the ever-increasing computing power. The aim of this minisymposium is to bring together experts working in this field and introduce the latest algorithmic developments and applications of SMC methods pertaining to multiple target tracking, brain connectivity estimation and multimodal sensor analysis, among others.

Organizers:
Narayan Puthanmadam Subramaniyam (*Aalto University*)
Sara Sommariva (*Aalto University*)

14:00 Expectation–maximization algorithm with a Rao-Blackwellized particle smoother for joint estimation of neural sources and connectivity from MEG data

Xi Chen (*Cavendish Laboratory, University of Cambridge*)
Lauri Parkkonen (*Aalto University*)
Narayan Puthanmadam Subramaniyam (*Aalto University*)
Simo Särkkä (*Aalto University, Department of Electrical Engineering and Automation*)
Sara Sommariva (*Aalto University*)
Filip Tronarp (*Aalto University, Department of Electrical Engineering and Automation*)

14:30 Tracking of cyclists in the velodrome using IMU and timing sensors

Simon Godsill (*University of Cambridge*)
Jiaming Liang (*University of Cambridge*)

15:00 Rao-Blackwellized particle filtering in multiple target tracking

Simo Särkkä (*Aalto University, Department of Electrical Engineering and Automation*)

15:30 Bayesan sequential Monte Carlo approaches to simulated EEG-fMRI and EEG-fNIRS data

Filippo Zappasodi (*"G.d'Annunzio" University, Chieti*)

MS75-1 GEOMETRIC METHODS FOR SHAPE ANALYSIS WITH APPLICATIONS TO BIOMEDICAL IMAGING AND COMPUTATIONAL ANATOMY, PART II

Friday, 08 at 14:00
Room I (Palazzina B - Building B, floor 0)

This minisymposium will focus on the fundamental and applied aspects of shape analysis. Shape analysis remains one of the key problems to many recent applications ranging from automatic object recognition in computer vision to the field of biomedical imaging in which datasets typically involve multiple geometric structures with important morphological variability. Modern methods are at the intersection of several fields in mathematics that span finite and inifinite dimensional geometry, optimal control, optimal transport and statistical data analysis. The objective of the mininisymposium is to bring together researchers covering those multiple aspects to present most recent ideas in the field, discuss new directions of interest for the community and foster future collaborations across different groups.

Organizers:
Joan Alexis Glaunès (*MAP5, Université Paris Descartes*)
Sergey Kushnarev (*Singapore University of Technology and Design*)
Mario Micheli (*Harvey Mudd College*)

14:00 Shape analysis through geometric distributions.

Nicolas Charon (*Johns Hopkins University*)

14:30 Constant and linear kernels on normal cycles for shape analysis

Joan Alexis Glaunès (*MAP5, Université Paris Descartes*)
Pierre Roussillon (*Centre de Mathématiques et de Leurs Applications, Ecole Normale Supérieure Paris-Saclay*)

15:00 Bridge Simulation and Metric Estimation on Lie Groups and Orbit Spaces

Sarang Joshi (*Scientific Computing and Imaging (SCI) Institute, the University of Utah*)

15:30 Development of the cortical surface via landmarks: labeling and trajectories of sulcal pits.

Irène Kaltenmark (*Neurosciences Institut of La Timone (INT), Aix-Marseille University*)

MS76-1 SOLVING INVERSE PROBLEMS IN MINUTES: SOFTWARE FOR IMAGING

Friday, 08 at 14:00
Room F (Palazzina A - Building A, floor 2)

Within the research community, there is a growing need to test and evaluate reconstruction methods on various problems. Likewise, implementations based on re-usable components foster collaborations. Hence, software frameworks that can handle large data and complex mathematical constructions is becoming increasingly important in research. Over time, a number of software packages for inverse problems has emerged, including efficient implementations of forward models and state-of-the-art solution methods. The aim of this minisymposium is to pick up current trends and highlight software packages for inverse problems, to encourage collaboration and to make promising mathematical and numerical approaches better known in the community.

Organizers:
Ozan Öktem (*KTH - Royal Institute of Technology*)
Holger Kohr (*Thermo Fisher Scientific*)
Jonas Adler (*KTH Royal Institute of Technology*)

14:00 Software for prototyping inverse problems with real data

Jonas Adler (*KTH Royal Institute of Technology*)
Holger Kohr (*Thermo Fisher Scientific*)
Ozan Öktem (*KTH - Royal Institute of Technology*)

14:30 STIR: an Open Source library for PET and SPECT image reconstruction

Nikolaos Efthymiou (*University of Hull*)
Kris Thielemans (*Institute of Nuclear Medicine, University of College London*)
Charalampos Tsoumpas (*University of Leeds*)

15:00 Solving inverse problems in imaging with Shearlab.jl

Héctor Andrade Loarca (*TU Berlin*)

15:30 Iterative tomography within minutes using RTK

Cyril Mory (*CREATIS, Lyon*)

MS77-1 ADVANCES IN ULTRASOUND TOMOGRAPHY

Friday, 08 at 14:00
Room C (Palazzina A - Building A, floor 1)

In ultrasound tomography, acoustic properties of the medium are reconstructed from data collected on transducers placed around the boundary of the region of interest. One application of this technique is noninvasive detection of breast cancer, with the advantages over mammography of being non-ionizing and more comfortable for the patient. Pulmonary imaging is an emerging application, with new challenges including modeling and design of low-frequency transducers and optimal sensor placement. The reconstruction problem is computationally challenging, and the problem may be posed in the time or the frequency domain. This minisymposium will include approaches to transducer modeling, sensor placement, and reconstruction algorithms in two and three dimensions.

Organizers:
Jennifer Mueller (*Colorado State University*)
Raul Gonzalez Lima (*Universidade de São Paulo*)

14:00 Low frequency Ultrasound Tomography Transducer for bedside lung monitoring

Luis Henrique Camargo Quiroz (*Universidade de São Paulo*)
Raul Gonzalez Lima (*Universidade de São Paulo*)
Ely Lopes (*Universidade de São Paulo*)

14:30 Full-wave form inversion for breast cancer detection

Koen W. A. van Dongen (*TU Delft*)

15:00 Modeling and direct reconstruction in ultrasound tomography

Jennifer Mueller (*Colorado State University*)

15:30 Qualitative ultrasound imaging from real and synthetic data through fast non-iterative schemes

Wagner Muniz (*Federal University of Santa Catarina, Brazil*)

CP10 CONTRIBUTED SESSION 10

Friday, 08 at 14:00
Room 1 (Redenti, floor 0)

Chairs:
Carolina Beccari (*Dept. Mathematics, University of Bologna*)

14:00 Bluebild: accurate and efficient radio-astronomy imaging on the sphere

Paul Hurley (*IBM Research, Zurich*)
Matthieu Simeoni (*EPFL / IBM Research*)

14:20 Approximation of Functions Over Manifolds by Moving Least Squares

Yariv Aizenbud (*Tel Aviv University*)
Barak Sober (*Tel-Aviv University*)

14:40 Three dimensional shape reconstruction from liquid displacement using parametric level set methods

Andrei Sharf (*Ben Gurion University of the Negev*)
Eran Treister (*Ben Gurion University of the Negev*)

15:00 Detection of cardiac ischemic regions from non-invasive electrical measurements

Elena Beretta (*Politecnico di Milano*)
Luca Ratti (*Politecnico di Milano*)
Marco Verani (*Politecnico di Milano*)

15:20 Three-dimensional volume reconstruction using two-dimensional parallel slices

Junwoo Kim (*KAIST*)
Chang-Ock Lee (*KAIST*)

15:40 Reconstruction of a compactly supported sound profile in the presence of a random background medium

George Biros (*Institute for Computational Engineering and Sciences, University of Texas at Austin*)
Carlos Borges (*ICES - UT Austin*)

MS49-4 IMAGE RESTORATION, ENHANCEMENT AND RELATED ALGORITHMS

Friday, 08 at 16:30
Room E (Palazzina A - Building A, floor 2)

High quality images are important for both visualization and analysis purpose. Image reconstruction, the process to compute high quality images from raw hardware measurements and image enhancement, the process to obtain higher quality images from different low quality images (e.g., noisy, blurred, low resolution) of the same scene/object are important imaging problems. Appropriate modeling and efficient algorithms are substantial in both problems. This 4-session mini-symposium gathers together the latest theoretical and practical development in this broad topic. Three sessions focus on (depending on titles) while one session focuses on enhancing resolution of multi-spectral and high-spectral images.

Organizers:
Weihong Guo (*Case Western Reserve University*)
Ke Chen (*University of Liverpool*)
Xue-Cheng Tai (*Hong Kong Baptist University*)
Guohui Song (*Clarkson University*)

16:30 Second Order Approximation of the MRI Signal for Single Shot Parameter Assessment

Rodrigo Platte (*Arizona State University*)

17:00 Convex Blind Image Deconvolution with Inverse Filtering

Tieyong Zeng (*Department of Mathematics, The Chinese University of Hong Kong, Shatin, N.T.*)

17:30 Half-quadratic Adaptive TV^p to the Image Restoration Problem

Ke Chen (*University of Liverpool*)
Hui Li (*Henan University*)
Zhi-Feng Pang (*Hunan University*)

18:00 Phase Retrieval from Local Measurements: Deterministic Measurement Constructions and Efficient Recovery Algorithms

Mark Iwen (*Department of Mathematics, Michigan State University*)
Brian Preskitt (*University of California, San Diego*)
Rayan Saab (*University of California, San Diego*)
Aditya Viswanathan (*University of Michigan - Dearborn*)

MS54-4 HYBRID APPROACHES THAT COMBINE DETERMINISTIC AND STATISTICAL REGULARIZATION FOR APPLIED INVERSE PROBLEMS

Friday, 08 at 16:30
Room L (Palazzina B - Building B, floor 0)

Techniques that combine deterministic and statistical methods to solve inverse problems will be the focus of the mini-symposium. The speakers and audience may range from practitioners in medical imaging to more specialized mathematicians/statisticians working on applied inverse problems. This type of blended expertise is relevant to solving applied problems in imaging, particularly ones that are ill-posed in nature including electrical impedance tomography and optical tomography. In recent years, there has been a tremendous growth in devising new techniques both deterministic and statistical, such as model reduction using reduced basis method, sparsity, Bayesian inversion, Markov Chain Monte Carlo (MCMC) methods etc. The statistical approaches are becoming more popular due to the growth of computational power in the last several decades.

Organizers:
Cristiana Sebu (*University of Malta*)
Taufiquar Khan (*Clemson University*)

16:30 Simulation of changes on optical coherence tomography data in healthy and in disease conditions

Aderito Araujo (*University of Coimbra*)

17:00 Gap Safe Screening Rules for Sparsity Enforcing Penalties

Ndiaye Eugene (*Telecom ParisTech*)
Olivier Fercoq (*Telecom ParisTech*)

Alexandre Gramfort (*University Paris Saclay*)
Joseph Salmon (*Telecom ParisTech*)

17:30 On the electro-sensing of weakly electric fish

Faouzi Triki (*University of Grenoble Alpes*)

18:00 Regularization for Bayesian inverse problems using domain truncation and uncertainty quantification

Tan Bui-Thanh (*The University of Texas at Austin*)
Ellen Le (*The University of Texas at Austin*)
Vishwas Rao (*The University of Texas at Austin*)

MS59-3 APPROACHES FOR FAST OPTIMISATION IN IMAGING AND INVERSE PROBLEMS

Friday, 08 at 16:30
Room A (Palazzina A - Building A, floor 0)

Over the past decades, first-order operator splitting methods have become ubiquitous for many fields including signal/image processing and inverse problems owing to their simplicity and efficiency. In recent years, with the increasing of model complexity and data size, the needs for fast optimisation methods is becoming increasingly stronger. The aim of this mini-symposium is to highlight the recent advances in the acceleration of optimisation methods. The main topics of the mini-symposium will cover: inertial and acceleration schemes, preconditioning techniques, half quadratic regularisation, Krylov subspace, quasi-Newton method and other related ones.

Organizers:
Jingwei Liang (*University of Cambridge*)
Carola-Bibiane Schönlieb (*University of Cambridge*)
Mila Nikolova (*CMLA - CNRS ENS Cachan, University Paris-Saclay*)

16:30 FSI Schemes: Fast Semi-Iterative Solvers for PDEs and Optimisation Methods

Joachim Weickert (*Saarland University*)

17:00 Imaging by Krylov Methods

Silvia Gazzola (*University of Bath*)

17:30 Inexact Half-Quadratic Optimization for Inverse Problems in Imaging

Marc Robini (*INSA de Lyon*)

18:00 Make FISTA Faster Again

Jalal Fadili (*Université Caen*)
Jingwei Liang (*University of Cambridge*)
Gabriel Peyré (*ENS Paris*)

MS60-3 COMPUTATIONAL AND COMPRESSIVE IMAGING TECHNOLOGIES AND APPLICATIONS

Friday, 08 at 16:30
Room B (Palazzina A - Building A, floor 1)

Compressive and computational imaging offers the potential for radical new sensor designs coupled with a new way to envision the collection of image information. New theories in sparse Image models, sensor architectures, and reconstruction algorithms all play an integrated role in the design of the next generation imaging sensors. This minisymposium will explore some of the latest theoretical developments, application areas that could benefit from a different sensing paradigm, and current results from prototype compressive and computational imaging devices.

Organizers:
Robert Muise (*Lockheed Martin*)
Richard Baraniuk (*Rice University*)

16:30 Imaging and Sensing Around the Corner: An Information-theoretic Approach

Amit Ashok (*University of Arizona*)

17:00 Computer graphics meets estimation theory: Computing parameter estimation lower bounds for non-line-of-sight plenoptic imaging systems

Jarvis Haupt (*University of Minnesota*)
Richard Paxman (*MDA Information Systems, LLC*)
Abhinav V. Sambasivan (*University of Minnesota*)

17:30 UNCOVER: Unconstrained Natural-light Coherency Vector-field-imaging by Exploiting Randomness

Aristide Dogariu (*University of Central Florida*)

18:00 Computational memory effect imaging

Michael Gehm (*Duke University*)

MS61-3 IMAGING WITH LIGHT AND SOUND

Friday, 08 at 16:30
Room H (Palazzina B - Building B, floor 0)

Recent years have seen increasing interest in imaging with photons in the visible and near-infrared spectrum. The physiological nature of chromophores in tissue gives rise to a rich set of contrasts but at the cost of complex models of light propagation and usually poor resolution resulting from the strongly ill-posed and non-linear nature of the corresponding inverse problem. Combining optical and other modalities in "Coupled Physics Imaging" can overcome these limitations, e.g., light-plus-sound modalities such as photo-acoustics and ultrasound modulated optical tomography. In this minisymposium we bring together leading researchers in the fields of optical, acoustic and coupled imaging.

Organizers:
Felix Lucka (*CWI & UCL*)
Tanja Tarvainen (*University of Eastern Finland*)

16:30 Anisotropic and higher-order regularisation for photoacoustic tomography reconstruction

Yoeri Boink (*University of Twente*)

17:00 Improving photoacoustic mammography by using intrinsic a priori information

Anabela Da Silva (*Aix-Marseille Université, CNRS, Centrale Marseille, Institut Fresnel UMR 7249*)
Gasteau Damien (*Aix-Marseille Université, CNRS, Centrale Marseille, Institut Fresnel UMR 7249*)
Metwally Khaled (*Aix-Marseille Université, CNRS, Centrale Marseille, Institut Fresnel UMR 7249, Marseille*)
Mensah Serge (*Aix-Marseille Université, CNRS, CNRS, Centrale Marseille, LMA UPR 7051*)

17:30 A one-step reconstruction method for photoacoustics with multispectral data

Kui Ren (*University of Texas at Austin*)
Yimin Zhong (*University of California at Irvine*)

18:00 3D Quantitative photoacoustic tomography (qPAT) using an adjoint Monte Carlo inversion scheme: application to recovering blood oxygenation

Bernhard Kaplan (*Zuse Institute Berlin*)
Jan Laufer (*Martin-Luther-Univ Halle-Wittenberg*)

MS65-2 MACHINE LEARNING TECHNIQUES FOR IMAGE RECONSTRUCTION

Friday, 08 at 16:30
Room M (Palazzina B - Building B, floor 0)

The development of fast and accurate reconstruction algorithms is a central mathematical aspect of imaging. Most traditional image reconstruction methods can basically be classified in either analytical or iterative methods. Recently, a new class of image reconstruction methods appeared which use methods from machine learning, especially from deep learning. Initial results using deep learning techniques for image reconstruction demonstrate great promise, for example, for improving image quality, reducing computation time, or reducing radiation exposure. In this minisymposium leading experts will report on recent progress towards using machine learning for image reconstruction.

Organizers:
Markus Haltmeier (*University Innsbruck*)
Linh Nguyen (*University of Idaho*)

16:30 Deep learning in computational microscopy

Yair Rivenson (*University of California Los Angeles*)

17:00 Task Based Reconstruction using Deep Learning

Jonas Adler (*KTH Royal Institute of Technology*)
Ozan Öktem (*KTH - Royal Institute of Technology*)

17:30 Machine learning in compressed sensing

Stephan Antholzer (*University of Innsbruck*)

18:00 Finding best approximation pairs with Douglas-Rachford

Irene Waldspurger (*CEREMADE (Université Paris-Dauphine)*)

MS67-3 ADVANCES AND NEW DIRECTIONS IN SEISMIC IMAGING AND INVERSION

Friday, 08 at 16:30
Room G (Palazzina A - Building A, floor 0)

Seismic data are inverted to estimate subsurface model parameters. We would like to address current challenges and directions in seismic data inversion and parameter estimation. Questions to address include inversion of non-ideal data, the influence of parametrization on the retrieval of velocity models, inversion of data in the absence of frequencies, and estimation methods for models with sharp discontinuities. Issues to discuss in this mini-symposium are of current importance. With the advent of algorithms for seismic full-waveform inversion, new problems have arisen, and a definite necessity for formulating new directions in seismic inversion and geophysical estimation theory.

Organizers:
Mauricio Sacchi (*University of Alberta*)
Sergey Fomel (*University of Texas, Austin*)
Laurent Demanet (*MIT*)

16:30 Multi-parameter full-waveform inversion: the influence of the parameterization

Ettore Biondi (*Stanford University*)

17:00 Retrieving full-wavefields within the medium from incomplete, one-sided data

Joeri Brackenhoff (*TU Delft*)
Matteo Ravasi (*Statoil*)
Christian Reinicke (*TU Delft*)
Tristan van Leeuwen (*Utrecht University*)
Ivan Vasconcelos (*Dept. of Earth Sciences, Utrecht University*)

17:30 Salt Geometry Reconstruction in Seismic Imaging

Ajinkya Kadu (*Mathematics Department, Utrecht University*)
Wim Mulder (*Shell Global Solutions*)
Tristan van Leeuwen (*Utrecht University*)

18:00 Edge preserving filter for full waveform inversion

Amsalu Anagaw (*University of Alberta*)
Mauricio Sacchi (*University of Alberta*)

MS73-2 MATHEMATICAL METHODS FOR SPATIOTEMPORAL IMAGING

Friday, 08 at 16:30
Room P (Palazzina B - Building B, floor 0)

Spatiotemporal imaging arises in many applications and the minisymposium aims to bring together leading experts and young researchers in the processing of such imaging data. The field is undergoing rapid development where a variety of mathematical methods (shape theory, regularization method, local analysis, algorithm) play a pivotal role in improving the reconstruction and analysis of spatiotemporal images, e.g. motion estimation in reconstruction (4D CBCT, pulmonary PET-CT, cardiac SPECT-CT, electron microscopy), predicting the evolution of a disease. The high diversity in mathematical techniques makes it very challenging for a single researcher to embrace the full spectrum of this rapidly evolving field.

Organizers:
Chong Chen (*LSEC, ICMSEC, Academy of Mathematics and Systems Science, Chinese Academy of Sciences*)
Barbara Gris (*Laboratoire Jacques-Louis Lions*)
Ozan Öktem (*KTH - Royal Institute of Technology*)

16:30 Joint Motion Estimation and Source Identification with an Application to the Analysis of Cell Membranes

Nilankur Dutta (*LIPHY, Université Grenoble Alpes*)
Jocelyn Étienne (*LIPHY, Université Grenoble Alpes*)
Lukas F. Lang (*University of Cambridge*)
Carola-Bibiane Schönlieb (*University of Cambridge*)

17:00 Respiratory motion correction in PET/CT and PET/MR

Alexandre Bousse (*Institute of Nuclear Medicine, University of College London*)

Elise Emond (*University College London*)

17:30 Learning digital models of Alzheimer's Disease progression

Igor Koval (*Brain and Spine Institute, INRIA*)

MS75-2 GEOMETRIC METHODS FOR SHAPE ANALYSIS WITH APPLICATIONS TO BIOMEDICAL IMAGING AND COMPUTATIONAL ANATOMY, PART II

Friday, 08 at 16:30
Room I (Palazzina B - Building B, floor 0)

This minisymposium will focus on the fundamental and applied aspects of shape analysis. Shape analysis remains one of the key problems to many recent applications ranging from automatic object recognition in computer vision to the field of biomedical imaging in which datasets typically involve multiple geometric structures with important morphological variability. Modern methods are at the intersection of several fields in mathematics that span finite and inifinite dimensional geometry, optimal control, optimal transport and statistical data analysis. The objective of the mininisymposium is to bring together researchers covering those multiple aspects to present most recent ideas in the field, discuss new directions of interest for the community and foster future collaborations across different groups.

Organizers:
Joan Alexis Glaunès (*MAP5, Université Paris Descartes*)
Sergey Kushnarev (*Singapore University of Technology and Design*)
Mario Micheli (*Harvey Mudd College*)

16:30 Estimating and using deformation constraints

Barbara Gris (*Laboratoire Jacques-Louis Lions*)

17:00 Normalized Hamiltonians for measure transport

Jean Feydy (*Centre de Mathématiques et de Leurs Applications, Ecole Normale Supérieure Paris-Saclay*)

17:30 Computation of crowded geodesics on the universal Teichmüller space

Sergey Kushnarev (*Singapore University of Technology and Design*)
Akil Narayan (*Scientific Computing and Imaging (SCI) Institute, the University of Utah*)

18:00 TEMPO: Feature-endowed Teichmüller extremal mappings of point clouds for geometry processing and shape classification

Ronald Lui (*Chinese University of Hong Kong*)

MS76-2 SOLVING INVERSE PROBLEMS IN MINUTES: SOFTWARE FOR IMAGING

Friday, 08 at 16:30
Room F (Palazzina A - Building A, floor 2)

Within the research community, there is a growing need to test and evaluate reconstruction methods on various problems. Likewise, implementations based on re-usable components foster collaborations. Hence, software frameworks that can handle large data and complex mathematical constructions is becoming increasingly important in research. Over time, a number of software packages for inverse problems has emerged, including efficient implementations of forward models and state-of-the-art solution methods. The aim of this minisymposium is to pick up current trends and highlight software packages for inverse problems, to encourage collaboration and to make promising mathematical and numerical approaches better known in the community.

Organizers:
Ozan Öktem (*KTH - Royal Institute of Technology*)
Holger Kohr (*Thermo Fisher Scientific*)
Jonas Adler (*KTH Royal Institute of Technology*)

16:30 Learning to Solve Inverse Problems with ODL

Jonas Adler (*KTH Royal Institute of Technology*)

17:00 Efficient Image Optimization with Domain Specific Languages

Steven Diamond (*Stanford University*)

17:30 Using the ASTRA Toolbox for implementing tomographic reconstruction algorithms

Willem Jan Palenstijn (*Centrum Wiskunde & Informatica, Amsterdam*)

18:00 The RVL Framework Applied to Full Waveform Inversion

Mario Bencomo (*Department of Computational and Applied Mathematics (CAAM), Rice University*)
William Symes (*Rice University*)

MS77-2 ADVANCES IN ULTRASOUND TOMOGRAPHY

Friday, 08 at 16:30
Room C (Palazzina A - Building A, floor 1)

In ultrasound tomography, acoustic properties of the medium are reconstructed from data collected on transducers placed around the boundary of the region of interest. One application of this technique is noninvasive detection of breast cancer, with the advantages over mammography of being non-ionizing and more comfortable for the patient. Pulmonary imaging is an emerging application, with new challenges including modeling and design of low-frequency transducers and optimal sensor placement. The reconstruction problem is computationally challenging, and the problem may be posed in the time or the frequency domain. This minisymposium will include approaches to transducer modeling, sensor placement, and reconstruction algorithms in two and three dimensions.

Organizers:
Jennifer Mueller (*Colorado State University*)
Raul Gonzalez Lima (*Universidade de São Paulo*)

16:30 Breast Imaging with 3D Ultrasound Computer Tomography

Torsten Hopp (*Karlsruhe Institute of Technology*)

17:00 Three-dimensional time-domain waveform inversion for breast ultrasound tomography

Mark Anastasio (*Washington University in St. Louis*)
Luca Forte (*Washington University in St. Louis*)

17:30 Ultrasound computed tomography using a wave equation with fractional Laplacian absorption

Ben Cox (*Department of Medical Physics, University College London*)

18:00 The use of standard CT-Scans for the development of an anatomical atlas for Ultrasound Tomography

Tayran Mila Mendes Olegario (*Department of Mechanical Engineering, University of Sao Paulo*)

MS78 RECENT DEVELOPMENTS IN VARIATIONAL IMAGE MODELING

Friday, 08 at 16:30
Matemates (Matemates, floor 0)

Variational modeling is a powerful framework to address inverse imaging problems that enables to incorporate prior knowledge and to make use of efficient optimization tools, while offering theoretical guaranties. Regularized models based on gradient penalizations are very successful in image processing, such as the popular total variation formulations that have been proposed in the last decades. This symposium aims at giving a representative sample of such recent developments for applications to image and point-cloud restoration and segmentation, with new definitions of the total variation relying on original discrete formulations and adaptive non-local schemes, or combined with local regularity estimation.

Organizers:
Sonia Tabti (*Université de Caen, CNRS*)
Rabin Julien (*CNRS, Normandie Univ.*)

16:30 Symmetric upwind scheme for discrete Non-Local Total Variation. Applications in image and point-cloud processing.

Abderrahim Elmoataz (*University of Caen Normandie, CNRS*)
Rabin Julien (*CNRS, Normandie Univ.*)
Sonia Tabti (*Université de Caen, CNRS*)

17:00 Regularized non-local Total Variation and application in image restoration

Zhi Li (*Department of Computational Mathematics, Science and Engineering (CMSE) Michigan State University*)
Francois Malgouyres (*Institut de Mathématiques de Toulouse, Université Paul Sabatier*)
Tieyong Zeng (*Department of Mathematics, The Chinese University of Hong Kong, Shatin, N.T.*)

17:30 Combining Local Regularity Estimation and Total Variation Optimization for Scale-Free Texture Segmentation

Patrice Abry (*CNRS, Laboratoire de Physique de l'ENS de Lyon*)
Pascal Barbara (*Laboratoire de Physique de l'ENS de Lyon*)
Nelly Pustelnik (*CNRS, Laboratoire de Physique de l'ENS de Lyon*)

18:00 Image restoration and segmentation using the Ambrosio-Tortorelli functional and discrete calculus

Marion Foare (*Laboratoire de Physique, ENS Lyon*)
Jacques-Olivier Lachaud (*Laboratoire de Mathématiques, Université Savoie Mont-Blanc*)
Hugues Talbot (*Laboratoire d'Informatique Gaspard-Monge, Université Paris-Est, ESIEE*)

MS79 FROM OPTIMIZATION TO REGULARIZATION IN INVERSE PROBLEMS AND MACHINE LEARNING

Friday, 08 at 16:30
Room D (Palazzina A - Building A, floor 1)

Classical approaches to process and classify data often reduce to designing and minimizing empirical objective functions. The challenge is on the one hand to incorporate the structural information that might be available on the problem at hand. On the other hand to develop optimization schemes that can encompass and exploit such a structure. In this minisymposium we will present state of the art approaches in this sense both in machine learning and inverse problems. The goal is to discuss the interplay between estimation and optimization principles.

Organizers:
Silvia Villa (*Politecnico di Milano*)
Lorenzo Rosasco (*University of Genoa, Istituto Italiano di Tecnologia; Massachusetts Institute of Technology*)

16:30 Parameter learning for total variation type regularisation schemes

Luca Calatroni (*CMAP, École Polytechnique CNRS*)
Juan Carlos De Los Reyes (*Escuela Politécnica Nacional*)
Carola-Bibiane Schönlieb (*University of Cambridge*)
Tuomo Valkonen (*University of Liverpool*)

17:00 Inexact variable metric forward-backward methods for convex and nonconvex optimization

Silvia Bonettini (*University of Modena and Reggio Emilia*)

17:30 A Random Block-Coordinate Douglas-Rachford Splitting Method with Low Computational Complexity for Binary Logistic Regression

Luis M. Bricenio-Arias (*Departamento de Matemática, Universidad Técnica Federico Santa María, Valparaíso*)
Giovanni Chierchia (*Université Paris Est, LIGM UMR 8049, CNRS, ENPC, ESIEE Paris, UPEM, Noisy-le-Grand.*)
Emilie Chouzenoux (*Université Paris-Est Marne-la-Vallée*)
Jean-Christophe Pesquet (*Université Paris-Saclay*)

18:00 Iterative optimization and regularization: convergence and stability

Lorenzo Rosasco (*University of Genoa, Istituto Italiano di Tecnologia; Massachusetts Institute of Technology*)

CP11 CONTRIBUTED SESSION 11

Friday, 08 at 16:30
Room 1 (Redenti, floor 0)

Chairs:

Germana Landi (*University of Bologna*)

16:30 Fixed-lag smoother for reduced state space model

Pascal Eun Sig Cheon (*University of Auckland*)

16:50 Mesh refinement in FEM based imaging with hierarchical Bayesian methods

Daniela Calvetti (*Case Western Reserve University*)
Anna Cosmo (*Politecnico di Milano*)
Simona Perotto (*MOX, Politecnico di Milano*)
Erkki Somersalo (*Case Western Reserve University*)

17:30 Extended Pseudo-Morphological Processing for Blob Detection

Jue Wang (*Union College*)
Yongjian Yu (*Axon Connected LLC*)

17:50 A Parallel Integro-Differential Approach to the Solution of a 3D Subsurface Imaging Problem.

Ronald Gonzales (*Idaho State University*)
Yury Gryazin (*Idaho State University*)
Yun Teck Lee (*Idaho State University*)

18:10 A more efficient method for solving the Radiative Trasport Equation (RTE)

Sean Horan (*University of California, Irvine*)
Vasan Venugopalan (*University of California, Irvine*)

18:30 Composite surrogate solution of the stochastic planar elasticity problem using sparse grids and measurements

Harri Hakula (*Aalto University*)
Vesa Kaarnioja (*University of Helsinki*)

Poster Sessions

The poster sessions are scheduled:

Tuesday, June 5
from 18:30 onwards
in Building A (first and second floor) and B (ground floor)

Wednesday, June 6
from 11:30 to 13:00
in Building A (first and second floor) and B (ground floor)

The map with the exact position of each poster will be available in each participant folder.

1 Efficient splitting strategies for structured illumination microscopy

Emmanuel Soubies (*EPFL, Biomedical Imaging Group, Lausanne VD*)
Michael Unser (*EPFL, Lausanne*)

2 Identification and Analysis of Intranuclear Protein Patterns in Fluorescence Microscopy Cell Images

Laura Antonelli (*Institute for High-Performance Computing and Networking ICAR-CNR, Naples*)
Francesco Gregoretti (*Institute for High-Performance Computing and Networking ICAR-CNR, Napoli*)
Chiara Lanzuolo (*Institute of Cellular Biology and Neurobiology, Milano; Istituto Nazionale di Genetica Molecolare "Romeo ed Enrica Invernizzi", INGM, Milano*)
Federica Lucini (*Istituto Nazionale di Genetica Molecolare "Romeo ed Enrica Invernizzi", INGM, Milano*)
Gennaro Oliva (*Institute for High-Performance Computing and Networking ICAR-CNR, Napoli*)

3 Restoration of multispectral images based on the anisotropic diffusion

Savita Nandal (*Department of Mathematics Indian Institute of Technology Roorkee, *)
Kumar Sanjeev (*Department of Mathematics, Indian institute of Technology Roorkee, *)

4 A Neuromathematical Model for Geometrical Optical Illusions

Giovanna Citti (*Dept. Mathematics, University of Bologna*)
Benedetta Franceschiello (*Fondation Asile des Aveugles, Centre hospitalier universitaire vaudois (LINE) *)
Alessandro Sarti (*CNRS - EHESS*)

5 Accurate discontinuous Galerkin schemes for seismic traveltimes and amplitudes in heterogeneous anisotropic media

Philippe Le Bouteiller (*Univ. Grenoble Alpes*)
Ludovic Métivier (*Univ. Grenoble Alpes*)
Jean Virieux (*Univ. Grenoble Alpes*)

6 Anisotropic image osmosis filtering for visual computing

Luca Calatroni (*CMAP, École Polytechnique CNRS*)
Simone Parisotto (*University of Cambridge*)

7 Distances between Tensor Subspaces for Image Analysis

Atsushi Imiya (*IMIT, Chiba University*)

8 Morphing of Manifold-Valued Images inspired by Discrete Geodesics in Image Spaces

Sebastian Neumayer (*TU Kaiserslautern*)

9 Partial difference equations and stochastic games for graph signal processing

Pierre Buyssens (-)
Abderrahim Elmoataz (*University of Caen Normandie, CNRS*)

10 4D computed tomography of foot and ankle using spatio-temporal regularization

Marta Betcke (*University College London*)
Nargiza Djurabekova (*University College London*)
Andrew Goldberg (*University College London*)
David Hawkes (*University College London*)
Guy Long (*CurveBeam Europe LTD*)

11 A model of a dynamic system for predicting neurological disease progression through longitudinal imaging

Poay Hoon Lim (*University of Calgary*)
Wee Keong Lim (*Marianopolis College*)

12 A graph-based framework for analysing temporal brain network connectivity on longitudinal imaging

Poay Hoon Lim (*University of Calgary*)
Wee Keong Lim (*Marianopolis College*)

13 Nonlinear diffraction tomography of predominantly forward-scattering objects

Gregory Samelsohn (*Center for Advanced Imaging Systems, SCE*)

14 Phase-constrained Magnetic Resonance Imaging as a Nonlinear Inverse Problem with a Rank Penalty

H. Christian M. Holme (*University Medical Center Göttingen*)
Sebastian Rosenzweig (*University Medical Center Göttingen*)
Martin Uecker (*University Medical Center Göttingen*)

15 Reconstruction algorithms for sub-second X-ray tomographic microscopy of liquid water dynamics in polymer electrolyte fuel cells

Felix Buechi (*Paul Scherrer Institute*)
Minna Bührer (*Paul Scherrer Institute*)
Jens Eller (*Paul Scherrer Institute*)
Federica Marone (*Paul Scherrer Institute*)
Marco Stampanoni (*Paul Scherrer Institute and Institute of Biomedical Engineering, ETH Zürich*)
Hong Xu (*Paul Scherrer Institute*)

16 Simultaneous reconstruction and separation in a spectral CT framework

Sandrine Anthoine (*Aix Marseille Univ, CNRS, Centrale Marseille, I2M*)
Yannick Boursier (*Aix-Marseille University, Computer Science & Engineering*)
Christian Morel (*Aix Marseille Univ, CNRS/IN2P3, CPPM*)
Souhil Tairi (*Aix Marseille Univ, CNRS/IN2P3, CPPM*)

17 Super-resolution image reconstruction for inexpensive MRI

Merel de Leeuw den Bouter (*Delft University of Technology*)
Rob Remis (*Delft University of Technology*)
Martin van Gijzen (*Delft University of Technology*)
Andrew Webb (*Leiden University Medical Center*)

18 The nonlinear diffusion filtering methods for geodetic measurements

Róbert Čunderlík (*Slovak University of Technology*)
Michal Kollár (*Slovak University of Technology*)
Karol Mikula (*Slovak University of Technology*)

19 Variational image reconstruction from X-ray micro-tomography data with mixed noise

Pearl Agyakwa (*Faculty of Engineering, University of Nottingham*)
George Papanikos (*University of Nottingham*)
Yves van Gennip (*University of Nottingham*)

20 Learning and Dimension Reduction in Medical Image Analysis

Anna Breger (*University of Vienna*)

21 A fast minorization-maximization algorithm for the mixture-of-normals logit model: value of time estimates under crowding conditions in the NYC subway

Prateek Bansal (*Cornell University*)
Ricardo Daziano (*Cornell University*)
Ricardo Hurtubia (*Pontificia Universidad Catolica de Chile*)

22 A rank-adaptive Riemannian optimization technique for hyperspectral image recovery

Jan Pablo Burgard (*Trier University, Department of Statistics*)
Gennadij Heidel (*Trier University*)
Volke Schulz (*Trier University, Department of Mathematics*)

23 An Accelerated Newton's Method for Projections onto the l1-Ball

Paul Rodriguez (*Pontificia Universidad Catolica del Peru*)

24 Anisotropic Space Variant regularizer in image restoration

Monica Pragliola (*University of Bologna*)

25 Convex Formulation for Discrete Tomography

Ajinkya Kadu (*Mathematics Department, Utrecht University*)
Tristan van Leeuwen (*Utrecht University*)

26 Edge detection with prior shapes based on Mumford-Shah model

Yilin Li (*North China Electric Power University*)
Yuying Shi (*North China Electric Power University*)
Juan Zhang (*North China Electric Power University*)

27 Fractional Order Total Variational Based Model for Multiplicative Noise Removal

Noor Badshah (*University of Engineering and Technology Peshawar*)
Rizwan Rizwan (*University of Peshawar*)
Akbar Zada (*University of Peshawar*)

28 L1 Patch-Based Image Partitioning Into Homogeneous Textured Regions

Coloma Ballester (*Universitat Pompeu Fabra*)
Vadim Fedorov (*Universitat Pompeu Fabra*)
Gloria Haro (*Universitat Pompeu Fabra*)
Maria Oliver (*Universitat Pompeu Fabra*)

29 Mathematical morphology on tensor images for fiber enhancement

Jesús Angulo (*Center for Mathematical Morphology, Départ. de Mathématiques et Systèmes, MINES ParisTech*)
Isabelle Bloch (*LTCI, Télécom ParisTech, Université Paris-Saclay*)
Yann Gousseau (*Telecom ParisTech*)
Blusseau Samy (*Centre for Mathematical Morphology, MINES ParisTech, PSL* Research University*)
Santiago Velasco-Forero (*Centre for Mathematical Morphology, MINES ParisTech, PSL* Research University*)

30 Space-variant model for image segmentation over surfaces

Martin Huska (*University of Bologna*)

31 Total Variation Reconstruction from Quadratic Measurements

Anastasia Zakharova (*National Institute of Applied Sciences, Rouen*)

32 Two Fast Nonoverlapping Domain Decomposition Methods for the Dual ROF Model

Chang-Ock Lee (*KAIST*)
Jongho Park (*KAIST*)

33 A new probabilistic interpretation of the expected patch loglikelihood

Alexandre Saint-Dizier (*Universite Paris Descartes*)

34 A sequential Monte Carlo for astronomic imaging

Anna Maria Massone (*CNR - SPIN*)
Michele Piana (*Dept. Mathematics, University of Genoa*)
Federica Sciacchitano (*Dept. Mathematics, University of Genoa*)
Alberto Sorrentino (*University of Genoa*)

35 Bayesian full-waveform tomography of Ground Penetrating Radar data

Jürg Hunziker (*Université de Lausanne*)
Eric Laloy (*Belgian Nuclear Research Center*)
Niklas Linde (*Université de Lausanne*)

36 Maximum Likelihood Imaging for Sensor Arrays

Paul Hurley (*IBM Research, Zurich*)
Matthieu Simeoni (*EPFL / IBM Research*)

37 **Spot the difference for computers**

Vincent Vidal (*MAP, Université Paris Descartes, Paris*)

38 **Texture synthesis via Gaussian Mixture Models in a Deep Learning Framework**

Andrés Almansa (*MAP5 - CNRS - Université Paris Descartes*)
Antoine Houdard (*Télécom ParisTech*)
Alasdair Newson (*Télécom ParisTech*)

39 **Wavelength and polarization multiplexed pinhole array for variable coded aperture**

Ariel Schwarz (*Bar Ilan university and JCE*)
Amir Shemer (*Bar Ilan university and JCE*)
Prof. Zeev Zalevsky (*Bar Ilan university*)

40 **The 3D X-Ray CT as new way of the Scientific Dissemination concerning Cultural Heritage**

Fauzia Albertin (*Study and Research Center Enrico Fermi (Rome)*)
Maria Giovanna Belcastro (*University of Bologna, Department of Biological, Geological and Environmental Sciences (BiGeA)*)
Matteo Bettuzzi (*Study and Research Center Enrico Fermi (Rome), University of Bologna, Department of Physics and Astronomy (DIFA)*)
Rossella Brancaccio (*Study and Research Center Enrico Fermi (Rome), University of Bologna, Department of Physics and Astronomy (DIFA)*)
Franco Casali (*Study and Research Center Enrico Fermi (Rome)*)
Luisa Leonardi (*University of Bologna, The Bologna University Museum Network (SMA), University of Bologna, Department of Biomedical and Neuromotor Science (DIBINEM)*)
Maria Pia Morigi (*Study and Research Center Enrico Fermi (Rome), University of Bologna, Department of Physics and Astronomy (DIFA)*)
Eva Peccenini (*Study and Research Center Enrico Fermi (Rome)*)
Elios Sequi (*University of Bologna, Department of Biomedical and Neuromotor Science (DIBINEM)*)

41 **A New Feature Coherence-Penalized Dynamic Minimal Path Model for Tubularity Centerline Delineation**

Da Chen (*University Paris Dauphine, PSL Research University; Centre Hospitalier National d'Ophtalmologie des Quinze-Vingts, Paris, France*)
Laurent D. Cohen (*University Paris Dauphine, PSL Research University*)

42 **A new Monte Carlo software for simulating light transport in biological tissue**

Aleksi Leino (*University of Eastern Finland*)
Aki Pulkkinen (*University of Eastern Finland*)
Tanja Tarvainen (*University of Eastern Finland*)

43 **A novel generative model to synthesize realistic training images**

Luigi Di Stefano (*Dept. Computer Science and Engineering, University of Bologna*)
Alessio Tonioni (*Dept. Computer Science and Engineering, University of Bologna*)
Pierluigi Zama Ramirez (*Dept. Computer Science and Engineering, University of Bologna*)

44 **A second order free discontinuity model for bituminous surfacing crack recovery, analysis of a nonlocal version of it and MPI implementation**

Patrick Bousquet-Melou (*CRIANN*)
Noémie Debroux (*University of Cambridge*)
Carole Le Guyader (*INSA Rouen*)
Emeric Quesnel (*INSA Rouen*)
Nathan Rouxelin (*INSA Rouen*)
Timothée Schmoderer (*INSA Rouen*)

45 **Acoustic interface contrast imaging with a constant velocity assumption**

Jacob Fokkema (*Delft University of Technology*)
Peter van den Berg (*Delft University of Technology*)
Joost van der Neut (*Delft University of Technology*)

46 **Covering the Space of Tilts: Application to affine invariant image comparison**

Mariano Rodríguez Guerra (*CMLA, École Normale Supérieure Paris-Saclay*)

47 **Determinantal pixel processes and texture synthesis**

Claire Launay (*Université de Paris Descartes*)

48 **Heterogeneous geobodies retrieval in seismic images**

Jean Charléty (*IFP Energies Nouvelles*)
Florence Delprat-Jannaud (*IFP Energies Nouvelles*)

Christian Gorini (*Université Pierre et Marie Curie*)
Didier Granjeon (*IFP Energies Nouvelles*)
Pauline Le Bouteiller (*Université Pierre et Marie Curie*)

49 High Resolution DEM Building with SAR Interferometry and High Resolution optical Image

Hadj Sahraoui Omar (*Algerian Space Agency*)

50 How to use mixture models on patches for solving image inverse problems

Julie Delon (*Université Paris Descartes*)
Antoine Houdard (*Télécom ParisTech*)

51 Image Quality Control for Legacy JPEG Standard According to Importance of Target Regions

Shun Aoki (*Meiji University*)
Jean-Philippe Heng (*Meiji University*)
Makoto Iguchi (*CMerTV*)
Ryusuke Miyamoto (*Meiji University*)
Takuro Oki (*Meiji University*)

52 Imaging for High-Throughput Screening of Pluripotent Stem Cells

Laura Casalino (*National Research Council, Institute of Genetics and Biophysics*)
Mario Rosario Guarracino (*National Research Council, Institute for High-Performance Computing and Networking*)
Lucia Maddalena (*National Research Council, Institute for High-Performance Computing and Networking*)

53 Joint denoising and decompression

Andrés Almansa (*MAP5 - CNRS - Université Paris Descartes*)
Mario Gonzalez (*Universidad de la República (Uruguay), Université Paris Descartes*)
Pablo Musé (*Facultad de Ingeniería, Universidad de la República*)

54 Learning an optimization solver for a class of inverse problems

Jonas Adler (*KTH Royal Institute of Technology*)
Sebastian Banert (*KTH - Royal Institute of Technology*)
Johan Karlsson (*KTH - Royal Institute of Technology*)
Ozan Öktem (*KTH - Royal Institute of Technology*)
Axel Ringh (*KTH - Royal Institute of Technology*)

55 Learning to solve inverse problems using Wasserstein loss

Jonas Adler (*KTH Royal Institute of Technology*)
Johan Karlsson (*KTH - Royal Institute of Technology*)
Ozan Öktem (*KTH - Royal Institute of Technology*)
Axel Ringh (*KTH - Royal Institute of Technology*)

56 Learned Primal-Dual Reconstruction

Jonas Adler (*KTH Royal Institute of Technology*)
Ozan Öktem (*KTH - Royal Institute of Technology*)

57 Milano Retinex Paths as Local Minima of an Energy Functional with Tunable Color and Spatial information

Michela Lecca (*Fondazione Bruno Kessler - Center for Information and Communication Technology*)
Alessandro Rizzi (*Universita' degli Studi di Milano, Dip. di Informatica*)
Gabriele Simone (*Universita' degli Studi di Milano, Dip. di Informatica*)

58 Motion Modeling of Solutions on the TLC Plate for Analyzing Carbohydrates by Using Image Capturing and Analysis

Hiroshi Ijima (*Wakayama University*)
Hayato Nakasuji (*Wakayama University*)
Masanori Yamaguchi (*Wakayama University*)
Akio Yamano (*Wakayama University*)

59 Multiscale denoising of RAW images with precise estimation of noise in all scales

Julie Delon (*Université Paris Descartes*)
Matias Tassano (*Université Paris Descartes*)

60 Multispectral Image Registration of Historical Artefacts

Adam Gibson (*UCL Medical Physics and Biomedical Engineering*)
Cerys Jones (*UCL*)
Melissa Terras (*College of Arts, Humanities and Social Sciences, The University of Edinburgh*)
Michael Toth (*R.B.Toth Associates*)

61 Neighborhood filters and functional rearrangements

Gonzalo Galiano (*University of Oviedo*)

Julián Velasco (*University of Oviedo*)

62 Patch based spatial redundancy analysis using a contrario methods

Valentin De Bortoli (*ENS Paris Saclay*)

63 Raman spectroscopy hyper-resolution - Resolving nanomaterial properties at better than 50nm resolution in Raman spectroscopy

Dominik J. Winterauer (*Renishaw plc, University of Nantes*)

64 Satellite Imagery Reconstructions from Starfire Optical Range

Lee Kann (*Air Force Research Laboratory*)

65 Scikit-Shape: Python toolbox for shape analysis and segmentation

Gunay Dogan (*Theiss Research, NIST*)

66 Source Localization by Spatially Variant Blind Deconvolution

Pol del Aguila Pla (*KTH Royal Institute of Technology*)

67 Sparse Recovery Algorithms for 3D Imaging using Point Spread Function Engineering

Raymond H. Chan (*Department of Mathematics, The Chinese University of Hong Kong*)
Mila Nikolova (*CMLA - CNRS ENS Cachan, University Paris-Saclay*)
Robert Plemmons (*Wake Forest University*)
Sudhakar Prasad (*Department of Physics and Astronomy, The University of New Mexico*)
Chao Wang (*The Chinese University of Hong Kong*)

IV Speakers and Organizers Index

Speakers and Organizers Index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z

SIAM IS18 Program

Bologna, June 5-8, 2018

STARTING TIME	MONDAY 4	TUESDAY 5	WEDNESDAY 6	THURSDAY 7	FRIDAY 8
08:15			IP3 Clarisse Mandridake Rooms A-B Building A	IP4 Yonina Eldar Rooms A-B Building A	IP6 Francis Bach Rooms A-B Building A
08:30					
08:45					
09:00			Coffee break	Coffee break	Coffee break
09:15		OPENING & WELCOME Aula Magna Santa Lucia			
09:30					
09:45		IP1 Raymond Chan Aula Magna Santa Lucia	CONCURRENT SESSIONS 3	CONCURRENT SESSIONS 6	CONCURRENT SESSIONS 9
10:00					
10:15			and	and	and
10:30			MT1 John Bardsley	MT2 Otmar Scherzer	MT3 Gabriele Facciolo
10:45		IP2 Anna Michalak Aula Magna Santa Lucia			
11:00					
11:15					
11:30					
11:45		Welcome lunch	Lunch	Lunch	Lunch
12:00		(included with	(on your own)	(on your own)	(on your own)
12:15		the program)	POSTER SESSION 2		
12:30		courtyard	Buildings A and B		
12:45		via B. Andreatta 8			
13:00				IP5 Christoph Schnörr Rooms A-B Building A	AWARDS Rooms A-B Building A
13:15			CONCURRENT SESSIONS 4		
13:30					
13:45		CONCURRENT SESSION 1			
14:00					
14:15				CONCURRENT SESSIONS 7	CONCURRENT SESSIONS 10
14:30					
14:45					
15:00			Coffee break		
15:15					
15:30		Coffee break			
15:45					
16:00			CONCURRENT SESSIONS 5	Coffee break	Coffee break
16:15					
16:30		CONCURRENT SESSIONS 2			
16:45					
17:00				CONCURRENT SESSIONS 8	CONCURRENT SESSIONS 11
17:15					
17:30					
17:45			BUSINESS MEETING		
18:00					
18:15					
18:30		POSTER SESSION 1			
18:45		Buildings A and B			
19:00					
19:15		Welcome cocktail			
19:30			Social dinner		