Workshop on

Theoretical and Applied Computational Inverse Problems

organized by

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May 5 - 15, 2014

Erwin Schrödinger International Institute for Mathematical Physics

universität wien

Overview

Week 1

	Monday, May 5
09:00	**Opening & Registration**
09:30 – 10:30	**Lenya Ryzhik** *Waves in weakly random media*
10:30 – 11:00	*coffee break*
11:00 – 12:00	**Lenya Ryzhik** *Waves in weakly random media*
12:00 – 14:00	*lunch break*
15:00 – 16:00	**Lauri Oksanen** *Computational approaches to the Boundary Control method*
16:00 – 16:30	**Peter Elbau** *A Model for Photoacoustic Sectional Imaging*

	Tuesday, May 6
09:30 – 10:30	**Lenya Ryzhik** *Waves in weakly random media*
10:30 – 11:00	*coffee break*
11:00 – 12:00	**Lenya Ryzhik** *Waves in weakly random media*
12:00 – 14:00	*lunch break*
15:00 – 16:00	**Josselin Garnier** *Correlation-based imaging with moving sensors*
16:00 – 16:30	**Thomas Widlak** *Stability in linearized elastography*

Wednesday, May 7

09:30 – 10:30	**Chrysoula Tsogka** *Signal to Noise Ratio analysis in passive correlation based imaging*
10:30 – 11:00	*coffee break*
11:00 – 12:00	**Panel discussion**
12:00 – 15:15	*lunch break*
16:00 – 16:30	**Lenya Ryzhik** *Kinetic models for waves in random media*
16:45 – 17:15	**Simon Arridge** *Diffuse Optical and PhotoAcoustic Tomography*

Math.-Colloquium, OMP1 lounge 12th floor

Thursday, May 8

09:30 – 10:30	**Simon Arridge** *Reconstruction in PhotoAcoustic Tomography*
10:30 – 11:00	*coffee break*
11:00 – 12:00	**Simon Arridge** *Reconstruction in Quantitative PhotoAcoustic Tomography*
12:00 – 14:00	*lunch break*
15:00 – 16:00	**Alexander Mamonov** *Krein-Gelfand-Levitan algorithm for inverse hyperbolic problems via spectrally matched finite-difference grids*
16:00 – 17:00	**Maarten de Hoop** *Inverse problem of electroseismic conversion*

	Friday, May 9
09:30 – 10:00	**Wolf Naetar** *Quantitative photoacoustic tomography with piecewise constant material parameters*
10:00 – 10:30	*coffee break*
10:30 – 11:00	**Stefan Rotter** *Controlling waves in complex scattering systems*

Overview

Week 2

	Monday, May 12
09:30 – 10:30	**Martin Hanke** *Multi frequency MUSIC for impedance imaging*
10:30 – 11:00	*coffee break*
11:00 – 12:00	**Plamen Stefanov** *Traveltime tomography with partial data*
12:00 – 14:00	*lunch break*
14:00 – 15:00	**Habib Ammari** *Emerging imaging approaches in medicine*
15:00 – 15:30	**Roman Andreev** *On simultaneous flux/source identification*

	Tuesday, May 13
09:30 – 10:30	**Miguel Moscoso** *Imaging with sparsity promoting optimization*
10:30 – 11:00	*coffee break*
11:00 – 12:00	**Liliana Borcea** *Imaging in complex environments*
12:00 – 14:00	*lunch break*
14:00 – 15:00	**Alexander Novikov** *Imaging of sparse scatterers*
15:00 – 15:30	**Konstantinos Kalimeris** *Attenuating models and reconstruction methods in Photoacoustic Imaging*

	Wednesday, May 14
09:30 – 10:30	**Barbara Kaltenbacher** *Regularization by discretization: recent convergence results and multilevel strategies*
10:30 – 11:00	*coffee break*
11:00 – 12:00	**Vladimir Druskin** *Finite-difference Gaussian quadrature rules for Dirichlet-to-Neumann Operators and inverse problems*
12:00 – 14:00	*lunch break*
14:00 – 15:00	**Ricardo Alonso** *Electromagnetic wave propagation in random waveguides*
15:00 – 16:00	**Ronny Ramlau** *Inverse Problems in Adaptive Optics*

	Thursday, May 15
09:30 – 10:30	**Alexandru C. Tamasan** *Uniqueness and nonuniqueness in Current Density Impedance Imaging with one current density information*
10:30 – 11:00	*coffee break*
11:00 – 12:00	**Shari Moskow** *Inverse Born series for the Calderon problem and related inverse problems*
12:00 – 14:00	*lunch break*
14:00 – 15:00	**John C. Schotland** *Acousto-Optic Imaging*
15:00 – 16:00	**Discussion**

Abstracts

Week 1

Waves in weakly random media

Lenya Ryzhik
Monday, May 5, 09:30 – 10:30, 11:00 – 12:00 Tuesday, May 6, 09:30 – 10:30, 11:00 – 12:00

I will review the very basic results on wave propagation in weakly scattering random media. In particular, I will describe some of the kinetic models that can be used in modeling, and sketch some of their derivations from the first principles. I will also describe the connection between the kinetic models and the super-resolution in the wave time-reversal experiments, and to imaging using passive noise sources. I will try my best to be accessible to graduate students, requiring as little background as possible.

Multiwave Imaging

Gunther Uhlmann
– cancelled –

Multi-wave imaging methods, also called hybrid methods, attempt to combine the high resolution of one imaging method with the high contrast capabilities of another through a physical principle. One important medical imaging application is breast cancer detection. Ultrasound provides a high (sub-millimeter) resolution, but suffers from low contrast. On the other hand, many tumors absorb much more energy of electromagnetic waves (in some specific energy bands) than healthy cells. Photoacoustic tomography (PAT) consists of sending relatively harmless optical radiation into tissues that causes heating which results in the generation of propagating ultrasound waves (the photo-acoustic effect). Such ultrasonic waves are readily measurable. The inverse problem then consists of reconstructing the optical properties of the tissue from these measurements. In Thermoacoustic tomography (TAT) low frequency microwaves, with wavelengths on the order of $1m$, are sent into the medium. The rationale for using the latter frequencies is that they are less absorbed than optical frequencies. Transient Elastography (TE) images the propagation of shear waves using ultrasound.

We will discuss the mathematics of some of the inverse problems arising in these imaging techniques with emphasis on PAT.

Computational approaches to the Boundary Control method

Lauri Oksanen
Monday, May 5, 15:00 – 16:00

The Boundary Control method is a powerful technique to prove uniqueness results for hyperbolic inverse boundary value problems. In this talk we present a computational approach for an obstacle detection problem that is based on the Boundary Control method. Moreover, we talk about stability properties of a reconstruction formula for a spatially varying smooth sound speed that is closely related to this computational method. We present numerical examples in the obstacle detection case.

A Model for Photoacoustic Sectional Imaging

Peter Elbau
Monday, May 5, 16:00 – 16:30

The main idea to obtain sectional images with photoacoustic imaging is to focus the laser illumination onto a single slice of the object so that ideally the photoacoustic effect generates a pressure in this slice only. Then, measurements on a curve around the object are enough to reconstruct the generated pressure in this slice.

However, since the laser light is always scattered inside the object, even for a weakly scattering medium such a focusing of the illumination is not possible. To compensate for this, focusing detectors are used to measure the acoustic signals.

We want to present a model for this measurement setup and show that for a weakly scattering medium a reconstruction of the initial pressure in the vicinity of the focus point can be achieved.

Waves in weakly random media

Lenya Ryzhik
Tuesday, May 6, 09:30 – 10:30, 11:00 – 12:00

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Correlation-based imaging with moving sensors

Josselin Garnier
Tuesday, May 6, 15:00 – 16:00

In the first part of this tutorial we will review a few results about correlation-based imaging with ambient noise sources. We will show that the Green's function between two receivers can be estimated from the cross correlation of the signals emitted by ambient noise sources and recorded by the receivers. We will also show that a reflector can be imaged by migration of the cross correlation matrix of the signals emitted by ambient noise sources and recorded by a passive receiver array.

In the second part of the tutorial we will extend these results to situations in which the sensors are moving. We will show that it is possible to use moving sensors to generate large synthetic apertures. We will also exhibit a surprising super-resolution phenomenon when the sensor velocities become of the order of the speed of propagation.

Stability in linearized elastography

Thomas Widlak

Tuesday, May 6, 16:00 – 16:30

The goal of quantitative elastography is to identify biomechanical parameters from interior displacement data, which are provided by other modalities, such as ultrasound or magnetic resonance imaging. In this paper, we analyze the stability of the linearized problem in quantitative elastography. Our method is based on the theory of redundant systems of linear partial differential equations. We analyze the ellipticity properties of the PDE system augmented with the interior displacement data. Stability criteria can then be deduced. Our results indicate that it is more stable to recover pressure and the shear modulus rather than the Lamé parameters, that singular strain fields should be avoided, and that additional measurements can help in ensuring stability.

Signal to Noise Ratio analysis in passive correlation based imaging

Chrysoula Tsogka
Wednesday, May 7, 09:30 – 10:30

We consider the problem of imaging a reflector using passive noise recordings. Imaging is performed by back-propagating (migrating) the cross correlations of the data recorded on a passive array. We will present an analysis of the signal to noise ratio of the obtained image.

Math.-Colloquium: How to build Harry Potter's Cloak

Gunter Uhlmann
– cancelled –

We describe theoretical and experimental progress on making objects invisible to detection by electromagnetic waves, acoustic waves and quantum waves. We emphasize the method of transformation optics. For the case of electromagnetic waves, Maxwell's equations have transformation laws that allow for design of electromagnetic materials that steer light around a hidden region, returning it to its original path on the far side. Not only would observers be unaware of the contents of the hidden region, they would not even be aware that something was being hidden. The object, which would have no shadow, is said to be cloaked. We recount some of the history of the subject and discuss some of the mathematical issues involved.

Math.-Colloquium: Kinetic models for waves in random media

Lenya Ryzhik
Wednesday, May 7, 16:00 – 16:30
At OMP-1 Lounge

In many physical problems, waves propagate in media whose fine details are inaccessible. Fortunately, often their precise structure is also irrelevant for the macroscopic features of the wave. That is, while the microstructure modifies the wave profile in a highly non-trivial way, we may infer the macroscopic information about the wave simply from the statistics of the medium inhomogeneities without the need for their detailed nature. In such situations, kinetic models are an effective way to model the energy evolution. I will describe some old and recent results in this direction.

Math.-Colloquium: Diffuse Optical and PhotoAcoustic Tomography

Simon Arridge
Wednesday, May 7, 16:45 – 17:00
At OMP-1 Lounge

Tomographic imaging using light remains a topic of increasing interest. One method is Diffuse Optical Tomography(DOT) in which light is detected after transmission through a highly scattering medium which is described by either a transport or a diffusion type forward model. Since the light is detected on the boundary this methodology is usually formulated as an inverse boundary value problem and is exponetially ill-posed. By contrast, PhotoAcoustic Tomography (PAT) uses light to create sound sources (by heat generated on optical absorption) and image reconstruction consists of an inverse acoustic source reconstruction, which can be done using conventional ultrasound methods. In order to quantify the optical properties underlying the sound generation it is necessary to couple models for optical and acoustic propagation. In this talk I present some of our recent work on these problems, utilising a non-linear algorithm for recovering optical absorption coefficient.

Reconstruction in PhotoAcoustic Tomography

Simon Arridge
Thursday, May 8, 09:30 – 10:30

PhotoAcoustic Tomography (PAT) uses light to create sound sources (by heat generated on optical absorption) and image reconstruction consists of an inverse acoustic source reconstruction. In this talk I review some of the method for this problem, including those based on the spherical mean Radon transform, Fourier methods, and time-reversal. I will discuss the development of numerical methods based on pseudo-spectral time-domain techniques. The problem of heterogeneous sound speed, and limited data will be discussed.

Reconstruction in Quantitative PhotoAcoustic Tomography

Simon Arridge
Thursday, May 8, 11:00 – 12:00

Quantitative PhotoAcoustic Tomography (QPAT) is the name given to the "second inverse problem" in photoacoustics, viz. the reconstruction of optical parameters (absorption and scattering) from internal measurements of acoustic initial pressure, as recovered from a photoacoustic tomography inversion. This problem presents some theoretical and computational challenges which I will review. The possibility of spectral QPAT will be discussed.

Krein-Gelfand-Levitan algorithm for inverse hyperbolic problems via spectrally matched finite-difference grids

Alexander Mamonov
joint with V. Druskin and M. Zaslavsky
Thursday, May 8, 15:00 – 16:00

We present a method for the numerical solution of inverse problems for coefficients of hyperbolic PDEs based on the spectrally matched finite-difference grids (a.k.a. Gaussian quadrature rules or optimal grids). The method is built around an algorithm for interpolation of the measured time domain data. Once an interpolant is obtained, it can be expressed in terms of Stieltjes continued fraction or its matrix generalization. The use of S-fraction coefficients in inversion is twofold. First, they can be used to reformulate the traditional optimization-based approaches to drastically improve the objective functional, which addresses issues such as local minima and slow convergence. Second, the coefficients provide a way to obtain direct, non-iterative reconstructions on the spectrally matched grids. We supplement the theoretical considerations with numerical results.

Inverse problem of electroseismic conversion

Maarten de Hoop
joint with Jie Chen
Thursday, May 8, 16:00 – 17:00

In fluid-saturated porous media, an electrical double layer (EDL) is formed at the interface (the pore boundaries) of the fluid and solid matrix. The fluid side of the EDL is charged with positive ions and the solid side with negative electrons. When electric or magnetic fields impinge on the EDL, the electrokinetic phenomenon will cause relative movement of the fluid and rock matrix and generate seismic waves, which can propagate to the surface. This effect is named electroseismic conversion. We study the hybrid inverse problem of this conversion. In hybrid inverse problem we distinguish two steps.

In the first ('high-resolution') step we study an interior inverse source problem for Biot's equations. To this end, subject to a low-frequency assumption, we establish an error estimate for Gassmann's approximation which reduces Biot's equations to an elastic wave equation with effective Lamé parameters and density. We recover ('low-energy') internal data from boundary measurement of seismic waves and obtain a Lipschitz stability estimate.

In the second ('low-resolution') step we encounter an inverse problem for Maxwell's equations to reconstruct the electrokinetic coupling coefficient, and conductivity and permittivity (of sufficient regularity) from internal data obtained in the first step, while allowing the magnetic permeability to be a known variable function. The contrast in conductivity is in general 'high' and its recovery is the key objective. In view of the low-frequency nature of the experiment (noting the skin depth), the electromagnetic field is essentially diffuse. We show that knowledge of two internal data sets generated by well-chosen boundary conditions for the electric field uniquely determines these parameters. Moreover, a Lipschitz-type stability is obtained. The methodology relies on converting Maxwell's equations to a transport equation; the associated vector field is controlled by the internal data. With a properly chosen electric field, we prove the unique solvability of the transport equation. Complex Geometrical Optics solutions play a central role in the analysis.

Quantitative photoacoustic tomography with piecewise constant material parameters

Wolf Naetar
Friday, May 9, 09:30 – 10:00

The goal of quantitative photoacoustic tomography is to determine optical and acoustic material properties from initial pressure maps as obtained in photoacoustic imaging. The most relevant parameters are absorption, diffusion and Grüneisen coefficients, all of which can be heterogeneous. Recent work by Bal and Ren shows that in general, unique reconstruction of all three parameters is impossible, even if multiple measurements of the initial pressure (corresponding to different laser excitation directions at a single wavelength) are available.

To overcome this problem, we propose a restriction to piecewise constant material parameters. We show that in the diffusion approximation of light transfer, piecewise constant absorption, diffusion and Grüneisen coefficients can be recovered uniquely from photoacoustic measurements at a single wavelength.

Controlling waves in complex scattering systems

Stefan Rotter
Friday, May 9, 10:30 – 11:00

In my talk I will speak about the control of wave scattering in complex systems like resonators, surface-disordered waveguides or random media. For each of these different situations we have recently developed customized theoretical concepts for how to manipulate the propagation of waves such as to achieve a certain desired functionality. For scattering through resonators we addressed the problem of how to inject a wave into the system such that it scatters solely along classical paths, forming so-called "particle-like scattering states" [1]. For surface-disordered waveguides we could recently obtain quantitative agreement between numerical results and analytical predictions for the attenuation of modes in the waveguide as a function of the surface boundary profile [2]. This allows us to design waveguides with boundaries that transmit waves at certain predetermined frequencies but not at others [3]. Finally, I will show how one can trick a so-called "random laser" into emitting in a desired direction by pumping the laser with a suitably chosen illumination profile [4].

[1] S. Rotter, P. Ambichl, and F. Libisch, Phys. Rev. Lett. 106, 120602 (2011), selected for Phys. Rev. Focus.

[2] J. Doppler, J. A. Méndez-Bermúdez, J. Feist, O. Dietz, D. O. Krimer, N. M. Makarov, F. M. Izrailev, and S. Rotter, arXiv:1312.7458 (New J. of Physics, in press)

[3] O. Dietz, H.-J. Stöckmann, U. Kuhl, F. M. Izrailev, N. M. Makarov, J. Doppler, F. Libisch, S. Rotter, Phys. Rev. B 86, 201106(R) (2012).

[4] T. Hisch, M. Liertzer, D. Pogany, F. Mintert, and S. Rotter, Phys. Rev. Lett. 111, 023902 (2013), selected for PRL Editors' suggestion.

Abstracts

Week 2

Multi frequency MUSIC for impedance imaging

Martin Hanke
Monday, May 12, 09:30 – 10:30

While for the classical MUSIC algorithm (in the impedance imaging context) different input currents with fixed frequency are used to generate data, the multi frequency MUSIC scheme is restricted to one single current pattern with different driving frequencies. In either case the goal is to determine the locations of small irritating obstacles within a homogeneous background and, if possible, their shape, from measured voltages. In this talk we will outline limitations and potentials of the multi frequency MUSIC technique.

This is joint work with Roland Griesmaier (University of Leipzig)

Traveltime tomography with partial data

Plamen Stefanov
Monday, May 12, 11:00 – 12:00

We will review the recent progress of recovery a sound speed from localized travel times in dimensions 3 and higher. Under a certain foliation condition, one can recover the speed globally and in a stable way. This allows speeds with possible conjugate points. Applications to the inverse problem for the hyperbolic Dirichlet to Neumann map will be discussed as well. The talk is based on a joint work with Gunther Uhlmann and Andras Vasy.

Emerging imaging approaches in medicine

Habib Ammari
Monday, May 12, 14:00 – 15:00

Imaging techniques in medicine are for visualizing contrast information on the electrical, acoustic, optical, mechanical properties of tissues. They can be formulated as nonlinear inverse problems. The goal is to achieve good resolution, good stability, and high specificity. A standard approach for solving imaging problems is nonlinear optimization. In this talk, I will discuss emerging alternative approaches which include differential imaging, physics-based classification and identification approaches, and hybrid imaging. I will show resolution, stability, and specificity enhancements for a few modalities. These include spectroscopic admittivity imaging, conductivity imaging by Lorentz force, ultrasound modulated electromagnetic tomography, and optical cohence elastography.

On simultaneous flux/source identification.

Roman Andreev
Monday, May 12, 15:00 – 15:30

Motivated primarily by tagged cell motion on the surface of zebrafish embryo, we discuss well-posedness and numerical implementation of a simple model for simultaneous flux and source identification of given measurements of a transported quantity.

Imaging with sparsity promoting optimization

Miguel Moscoso
Tuesday, May 13, 09:30 – 10:30

In imaging the images are often sparse, which means that, in a suitable basis, the solution vector of the underlying linear inverse problem has many components which are zero. Hence, it is desirable to seek approximate solutions to linear systems in which the unknown has few nonzero entries relative to its dimensions. This approach is referred to as sparsity promoting optimization. These problems arise in many areas including statistics, biology, medicine, geophysics, etc. In this talk, I will discuss sparse approximation techniques and their use in a few applications such as array imaging of localized scatterers and mesoscopic imaging of biological tissue.

Imaging in complex environments

Liliana Borcea
Tuesday, May 13, 11:00 – 12:00

The talk is concerned with the application of sensor array imaging in complex environments. The goal of imaging is to estimate the support of remote sources or strong reflectors using time resolved measurements of waves at a collection of sensors (the array). This is a challenging problem when the imaging environment is complex, due to numerous small scale inhomogeneities and/or rough boundaries that scatter the waves. Mathematically we model such complexity (which is necessarily uncertain in applications) using random processes, and thus study imaging in random media. I will focus attention on the application of imaging in random waveguides, which exhibits all the challenges of imaging in random media. I will present a quantitative study of cumulative scattering effects in such waveguides and then explain how we can use such a study to design high fidelity imaging methods.

Imaging of sparse scatterers.

Alexander Novikov
Tuesday, May 13, 14:00 – 15:00

I present an ordinary differential equations approach to the analysis of algorithms for constructing l1 minimizing solutions to underdetermined linear systems of full rank. It involves a relaxed minimization problem whose minimum is independent of the relaxation parameter. An advantage of using the ordinary differential equations is that energy methods can be used to prove convergence. The connection to the discrete algorithms is provided by the Crandall-Liggett theory of monotone nonlinear semigroups. We illustrate the effectiveness of the discrete optimization algorithm in some sparse array imaging problems.

Attenuating models and reconstruction methods in Photoacoustic Imaging

Konstantinos Kalimeris
Tuesday, May 13, 15:00 – 15:30

The common underlying mathematical equation of Photoacoustic Imaging is the wave equation for the pressure. In this talk some of the existing models are presented, taking into account acoustic attenuation under the different physical properties of the biological tissue and a strong causality property. That is, the solutions of these equations are zero before the initialization and satisfy a finite front wave propagation speed. A family of time reversal imaging functionals for strongly causal acoustic attenuation models is presented. The time reversal techniques are based on recently proposed ideas of Ammari et al for the thermo-viscous wave equation. In particular, an asymptotic analysis provides reconstruction functionals from first order corrections for the attenuating effect. Finally, a novel approach for higher order corrections is described.

Regularization by discretization: recent convergence results and multilevel strategies

Barbara Kaltenbacher
Wednesday, May 14, 09:30 – 10:30

On one hand in practice very often inverse problems are just discretized and then solved, on the other hand discretization itself can be expected to have a regularizing effect (which is often referred to as self-regularization). In this talk we will give an overview on the principles and some recent results on convergence for nonlinear problems as well as in a Banach space setting. Moreover, we will dwell on multilevel strategies for enhancing computational efficiency and global convergence.

Finite-difference Gaussian quadrature rules for Dirichlet-to-Neumann Operators and inverse problems

Vladimir Druskin
Wednesday, May 14, 11:00 – 12:00

The finite-difference Gaussian quadrature rules (FDGQR), a.k.a. spectrally-matched or optimal grids, were originally invented to obtain high accuracy approximations of Dirichlet-to-Newman maps for truncation of unbounded computational domains. Their construction is mainly based on Stieltjes-Krein continued fraction technique. It yields spectral superconvergence at a priori chosen boundaries using simple standard staggered second order finite-difference schemes. I will talk about application of the FDGQR to the solution of the inverse elliptic (EIT), parabolic and hyperbolic problems. Contributors: Liliana Borcea, Alexander Mamonov, Fernando Guevara Vasquez, Mikhail Zaslavsky

Electromagnetic wave propagation in random waveguides

Ricardo Alonso
Wednesday, May 14, 14:00 – 15:00

A long range propagation of electromagnetic waves in random waveguides with rectangular cross-section and perfectly conducting boundaries is presented. The waveguide is filled with an isotropic linear dielectric material, with randomly fluctuating electric permittivity. The fluctuations are weak, but they cause significant cumulative scattering over long distances of propagation of the waves. We analyze Maxwell's equations in this configuration with the diffusion approximation theory. The result is a detailed characterization of the transport of energy in the waveguide, the loss of coherence of the modes and the depolarization of the waves due to cumulative scattering.

Inverse Problems in Adaptive Optics

Ronny Ramlau
Friday, May 16, 15:00 – 16:00

In order to correct for the image degradation of ground based telescopes caused by turbulences in the atmosphere, modern telescopes use Adaptive Optics technology. Based on the measurements of incoming wavefronts from guide stars, the surface of deformable mirrors is determined in such a way that the image is corrected after reflection on the deformable mirror. The computation of the mirror shape from the measurements is an Inverse Problem, which has a different structure depending on the considered Adaptive Optics System. We introduce AO systems like Single Conjugate Adaptive Optics (SCAO), Multi Conjugate Adaptive Optics (MCAO) and Multi Object Adaptive Optics (MOAO) and describe the underlying Inverse Problems. In particular for MCAO and MOAO, an atmospheric tomography problem has to be solved. We present algorithms that guarantee a fast and high quality reconstruction from wavefront data. The results are verified within the Octopus environment used by the European Southern Observatory (ESO). Tests are presented for the European Extremely Large Telescope (E-ELT), a 40 meter telescope which is currently under development.

Uniqueness and nonuniqueness in Current Density Impedance Imaging with one current density information

Alexandru C. Tamasan
Thursday, May 15, 09:30 – 10:30

In this talk I will survey recent results in Current Density Impedance Imaging (CDII) from knowledge of one interior current density field. Of particular focus I will describe the so-called Complete Electrode model, which most accurately describe electrical measurements at the boundary as occurring in practice. Within this model the solution to the CDII problem is non-unique. I will present the characterization of the non-uniqueness class (up to a one dimensional scaling), and explain which additional boundary measurements fixes such non-uniqueness.

Inverse Born series for the Calderon problem and related inverse problems*

Shari Moskow
Thursday, May 15, 11:00 – 12:00

We propose a direct reconstruction method for the Calderon problem and other related inverse problems based on inversion of the Born series. We characterize the convergence, stability and approximation error of the method and illustrate its use in numerical reconstructions.

*joint work with S. Arridge, K. Kilgore and J. C. Schotland

Acousto-Optic Imaging

John C. Schotland

Thursday, May 15, 14:00 – 15:00

A method to reconstruct the optical properties of a highly-scattering medium from acousto-optic measurements is proposed. The method is based on the solution to an inverse problem for the radiative transport equation with internal data.

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