Inverse Problems and Imaging
Vol. 16, No. 6, December 2022, pp. i–iii
doi:10.3934/ipi.2022056

PREFACE

Our esteemed colleague Victor Isakov passed away on May 14, 2021 after a short illness. Victor was an editor of Inverse Problems and Imaging since its inception in 2007 and made many contributions to the success of the journal. He also made fundamental contributions to the field as indicated below in the several articles written by his colleagues and friends. This issue is a tribute to his memory. He will be sorely missed.

We shall now proceed to describe briefly the contents of each of the 11 articles comprising the special issue.

"On the scientific work of Victor Isakov" by the guest editors begins with brief biographical information and then proceeds to describe in more detail selected fundamental contributions of Victor Isakov to the field of inverse problems. The paper concludes with the full list of publications of Victor Isakov together with a list of his Ph.D. students.

"New notions and constructions of the boundary control method" by Mikhail Belishev presents a survey of the boundary control method, introduced by the author back in 1988, with applications to inverse problems. Among the specific applications discussed in the paper are inverse problems of the recovery of a manifold and a potential from the knowledge of the hyperbolic Dirichlet–to–Neumann map, analogous inverse problems in the setting of Maxwell's system, inverse problems of reconstructing a Riemann surface from the elliptic Dirichlet–to–Neumann map, some results dealing with eikonal algebras, the wave spectrum, and the so called s-points in inverse scattering.

"A spectral target signature for thin surfaces with higher order jump conditions" by Fioralba Cakoni, Heejin Lee, Peter Monk, and Yangwen Zhang studies the inverse problem of the recovery of structural properties of a thin anisotropic and dissipative inhomogeneity in the Euclidean space from the knowledge of the scattering data at a fixed frequency. In the limit as the thickness tends to zero, the thin inhomogeneity is modeled by a co-dimension one submanifold, called the screen, and the field inside degenerates to jump conditions along the screen involving a second order surface differential operator. The authors show that the three screen coefficients, of which one may be possibly matrix valued, can be determined uniquely by the fixed frequency scattering data. The inversion method is based on a target signature characterized by a novel eigenvalue problem such that the corresponding eigenvalues can be recovered from the measured scattering data. Some preliminary numerical results are presented as well.

"Two single–measurement uniqueness results for inverse scattering problems within polyhedral geometries" by Xinlin Cao, Diao Huai-An, Hongyu Liu, and Jun Zou deals with an inverse obstacle scattering problem in the case of an impenetrable obstacle with the impedance boundary condition. Specifically, in the setting of polyhedral geometries, the authors focus on the problem of the recovery of the

shape of the obstacle as well as of the impedance parameter using only a single far-field measurement rather than the far-field operator. An inverse diffraction grating problem with single measurement is also addressed in this paper.

In the paper *"Global unique continuation from the boundary for a system of viscoelasticity with analytic coefficients and a memory term"*, Matthias Eller, Naofumi Honda, Ching-Lung Lin, and Gen Nakamura establish a global unique continuation property from the boundary for solutions to a viscoelastic system with analytic coefficients and a memory term. The global unique continuation property is given in terms of the travel time of the slowest wave of the viscoelastic system.

"Microlocal analysis of borehole seismic data" by Raluca Felea, Romina Gaburro, Allan Greenleaf, and Clifford Nolan provides a general approach to the analysis of borehole seismic data, using techniques of microlocal analysis which have already proven to be extremely powerful for conventional seismic data. Borehole seismic data is collected by receivers located in a well with sources located on the surface or another well. The main focus of the paper is on possible approximate reconstruction via linearized, filtered backprojection of an isotropic sound speed in the subsurface for the following three types of data sets: (i) the sources form a dense array on the surface, (ii) the sources are located along a line on the surface (walkaway geometry), (ii) the sources are in another borehole (crosswell).

"A uniqueness theorem for inverse problems in quasilinear anisotropic media" by Md. Ibrahim Kholil and Ziqi Sun studies the Calderón problem of impedance tomography for quasilinear anisotropic conductivity equations with conductivities in the form of a scalar function, depending on the spatial variable and the solution, times a fixed metric that depends only on the spatial variable. The authors prove that the knowledge of the Dirichlet–to–Neumann map for quasilinear conductivities determines the scalar function uniquely in the 2D case, recovering the result of Sun–Uhlmann (1997), as well as in the 3D case, assuming that the following, still open conjecture in 3D, holds: two anisotropic conductivities for the linear impedance tomography problem with the same Dirichlet–to–Neumann map are pullbacks of each other via a diffeomorphism that fixes the boundary.

"Convexification-based globally convergent numerical method for a 1D coefficient inverse problem with experimental data" by Michael Klibanov, Thuy Le, Loc Nguyen, Anders Sullivan, and Lam Nguyen develops a new version of the convexification method for solving numerically coefficient inverse problems for 1D hyperbolic equations. In doing so the authors prove a new version of the Carleman estimates and use these estimates to construct a globally strictly convex cost functional. The desired numerical solution to the coefficient inverse problem is obtained by minimizing the constructed cost functional by the gradient descent method. The authors' convexification method provides a good approximation of the exact solution without requiring a good initial guess. Numerical study of both experimentally collected and computationally simulated data are given.

"Refined instability estimates for some inverse problems" by Pu-Zhao Kow and Jenn-Nan Wang establishes instability estimates for two inverse problems: (i) inverse inclusion problem in the electrical impedance tomography, (ii) inverse acoustic scattering problem. For the first inverse problem, the authors analyze how the instability depends on the depth of the hidden inclusion and the conductivity of the background medium, and show that the exponential instability becomes worse when the inclusion is hidden deeper inside the conductor or the conductivity is larger. For

the second inverse problem, the authors investigate how the exponential instability of recovering the near-field of a radiating solution to the Helmholtz equation from the far-field pattern is affected by the frequency and prove that the instability changes from an exponential type to a Hölder type when the frequency increases.

"Kantorovich-Rubinstein metric based level-set methods for inverting modulus of gravity-force data" by Wenbin Li and Jianliang Qian proposes to use the Kantorovich-Rubinstein metric as a novel misfit function for the level-set based approach to inverse gravity problems. The alternating direction method of multipliers (ADMM) algorithm is used for the resulting optimization problem. Numerical examples are given to demonstrate the effectiveness and performance of the proposed algorithms.

"Linearized inverse Schrödinger potential problem with partial data and its deep neural network inversion" by Sen Zou, Shuai Lu, and Boxi Xu studies the linearized inverse boundary problem for Schrödinger–Helmholtz equations with partial data. Specifically, it deals with the situation when the Dirichlet boundary data is supported in a subset of the boundary of the domain while the inaccessible part of the boundary is a part of a hyperplane. Hölder type increasing stability estimates are obtained for large frequencies, and a deep neural network approach is applied for numerically solving this linearized inverse problem.

We would like to express our sincere gratitude to all the authors for their contributions to this special issue. We would also like to thank Ziqi Sun for providing useful material related to the work of Victor Isakov.

Guest Editors:

Katya Krupchyk
University of California, Irvine, USA
katya.krupchyk@uci.edu

Mikko Salo
University of Jyväskylä, Finland
mikko.j.salo@jyu.fi

Gunther Uhlmann
University of Washington / HKUST, USA
gunther@math.washington.edu

Jenn-Nan Wang
National Taiwan University, Taiwan
jnwang@math.ntu.edu.tw