

Vladimir Druskin

CONTACT INFO	Department of Mathematical Sciences Worcester Polytechnic Institute 100 Institute Road, WPI - Stratton Hall, Worcester, MA 01609	vdruskin@wpi.edu, vdruskin@gmail.com
EDUCATION	Lomonosov Moscow State University , Moscow, Russia Ph.D. equivalent in applied mathematics	1984
	Gubkin Moscow Oil and Gas Institute , Moscow, Russia M.S. equivalent in geophysics	1979
EMPLOYMENT HISTORY	Worcester Polytechnic Institute , MA US Research Professor	2018-present
	Schlumberger-Doll Research , Cambridge, US Technology Adviser, Mathematics and Modeling Responsibility: Technical lead of large scale simulation and imaging projects in borehole&surface electromagnetic&seismic exploration Principal Research Scientist Senior Research Scientist Research Scientist Visiting Scientist	1991-2018
	Central Geophysical Expedition (CGE) , Moscow, Russia, Mathematics and modeling program manager Principal Geophysicist Senior Geophysicist Geophysicist	1984-1991
AWARDS AND RECOGNITIONS	SIAM Fellow, Class 2014 Workshop honoring my contributions to inverse problems and scattering theory, Brown University, 2017, https://icerm.brown.edu/programs/sp-f17/w5/ Schlumberger grant 'Future of Schlumberger Research', 400 K\$, 2005-2010 Highlights of Inverse Problems, 2008 Honorable Mention, Geophysics, 2003 The Best Paper Award, Log Analyst, 1999 3686 citations, h-index = 34, i10-index=67 in Google Scholar as on 5/4/2018, see http://scholar.google.com/citations?user=sn0S7WsAAAAJ&hl=en .	

1. L. Borcea, V. Druskin, A.V. Mamonov, and M. Zaslavsky. Untangling the nonlinearity in inverse scattering with data-driven reduced order models. *Inverse Problems*, 34(6):065008, 2018.
2. V. Druskin, A. Mamonov, and M. Zaslavsky. A nonlinear method for imaging with acoustic waves via reduced order model backprojection. *SIAM Journal on Imaging Sciences*, 11(1):164–196, 2018
3. V. Druskin, A. Mamonov, and M. Zaslavsky. Multiscale s-fraction reduced-order models for massive wavefield simulations. *Multiscale Modeling & Simulation*, 15(1):445–475, 2017
4. J. Zimmerling, V. Druskin, M. Zaslavsky, and R. Remis. Model order reduction of electromagnetic wavefields in open domains. *Geophysics*, 83(2):1–38, 2017
5. M. Li, V. Druskin, A. Abubakar, and T. Habashy. A 2.5 d finite-difference algorithm for elastic wave modeling using near-optimal quadratures. *Geophysics*, 81(4):T155–T162, 2016
6. V. Druskin, A. Mamonov, A. Thaler, and M. Zaslavsky. Direct, nonlinear inversion algorithm for hyperbolic problems via projection-based model reduction. *SIAM Journal on Imaging Sciences*, 9(2):684–747, 2016
7. V. Druskin, S. Guttel, and L. Knizhnerman. Near-optimal perfectly matched layers for indefinite Helmholtz problems. *SIAM Review*, 58(1):90–116, 2016
8. V. Druskin, A. Mamonov, A. Thaler, and M. Zaslavsky. Direct, nonlinear inversion algorithm for hyperbolic problems via projection-based model reduction. *SIAM Journal on Imaging Sciences*, 9(2):684–747, 2016
9. V. Druskin, V. Simoncini, and M. Zaslavsky. Adaptive tangential interpolation in rational krylov subspaces for MIMO dynamical systems. *SIAM Journal on Matrix Analysis and Applications*, 35(2):476–498, 2014
10. V. Druskin, R. Remis, and M. Zaslavsky. An extended krylov subspace model order reduction technique to simulate wave propagation in unbounded domains. *Journal of Computational Physics*, 272:608–618, 2014
11. L. Borcea, V. Druskin, A. Mamonov, and M. Zaslavsky. A model reduction approach to numerical inversion for a parabolic partial differential equation. *Inverse Problems*, 30(12):125011, 2014.
12. V. Druskin and R. Remis. A krylov stability-corrected coordinate-stretching method to simulate wave propagation in unbounded domains. *SIAM Journal on Scientific Computing*, 35(2):B376–B400, 2013
13. M. Zaslavsky, V. Druskin, A. Abubakar, T. Habashy, and V. Simoncini. Largescale gauss-newton inversion of transient controlled-source electromagnetic measurement data using the model reduction framework. *Geophysics*, 78(4):E161–E171, 2013
14. V. Druskin, V. Simoncini, and M. Zaslavsky. Solution of the time-domain inverse resistivity problem in the model reduction framework. part i: One-dimensional problem with iso data. *SIAM Journal on Scientific Computing*, 2012
15. M. Zaslavsky, V. Druskin, and L. Knizhnerman. Solution of 3d time-domain electromagnetic problems using optimal subspace projection. *Geophysics*, 76(6):F339–F351, 2011

16. V. Druskin and V. Simoncini. Adaptive rational krylov subspaces for large-scale dynamical systems. *Systems & Control Letters*, 60(8):546–560, 2011
17. M. Zaslavsky, V. Druskin, S. Davydycheva, L. Knizhnerman, A. Abubakar, and T. Habashy. Hybrid FInite-diFFerence integral equation solver for 3d frequency domain anisotropic electromagnetic problems. *Geophysics*, 76(2):F123–F137, 2011
18. V. Druskin and V. Knizhnerman, L.and Simoncini. Analysis of the rational krylov subspace and adi methods for solving the lyapunov equation. *SIAM Journal on Numerical Analysis*, 49(5):1875–1898, 2011
19. L. Borcea, V. Druskin, F Guevara Vasquez, and A. Mamonov. Resistor network approaches to electrical impedance tomography. *Inverse Problems and Applications: Inside Out II*, Math. Sci. Res. Inst. Publ, 60:55118, 2011
20. L Borcea, V Druskin, A. Mamonov, and F. Guevara Vasquez. Pyramidal resistor networks for electrical impedance tomography with partial boundary measurements. *Inverse Problems*, 26(10):105009, 2010
21. V. Druskin, Ch. Lieberman, and M. Zaslavsky. On adaptive choice of shifts in rational krylov subspace reduction of evolutionary problems. *SIAM Journal on Scientific Computing*, 32(5):2485–2496, 2010
22. V. Simoncini and V. Druskin. Convergence analysis of projection methods for the numerical solution of large lyapunov equations. *SIAM Journal on Numerical Analysis*, 47(2):828–843, 2009
23. L. Knizhnerman, V. Druskin, and M. Zaslavsky. On optimal convergence rate of the rational krylov subspace reduction for electromagnetic problems in unbounded domains. *SIAM Journal on Numerical Analysis*, 47(2):953–971, 2009
24. V. Druskin, L. Knizhnerman, and M. Zaslavsky. Solution of large scale evolutionary problems using rational krylov subspaces with optimized shifts. *SIAM Journal on Scientific Computing*, 31(5):3760–3780, 2009
25. L. Borcea, V. Druskin, and F. Guevara-Vasquez. Electrical impedance tomography with resistor networks. *Inverse Problems*, 24(3):035013, 2008
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27. A. Abubakar, T. Habashy, V. Druskin, L. Knizhnerman, and D. Alumbaugh. 2.5-d forward and inverse modeling for interpreting low-frequency electromagnetic measurements. *Geophysics*, 73(4):F165–F177, 2008
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29. A. Abubakar, T. Habashy, V. Druskin, and L. Knizhnerman. An enhanced Gauss-Newton inversion algorithm using a dual-optimal grid approach. *Geoscience and Remote Sensing, IEEE Transactions on*, 44(6):1419–1427, 2006
30. V. Druskin, L. Borcea, and L. Knizhnerman. On the sensitivity of lanczos recursions to the spectrum. *Linear algebra and its applications*, 396:103–125, 2005
31. L. Borcea, V. Druskin, and Leonid Knizhnerman. On the continuum limit of a discrete inverse spectral problem on optimal finite difference grids. *Communications on pure and applied mathematics*, 58(9):1231–1279, 2005

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34. S. Asvadurov, V. Druskin, and L. Knizhnerman. Application of the difference Gaussian rules to solution of hyperbolic problems: Ii. global expansion. *Journal of Computational Physics*, 175(1):24–49, 2002
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36. L. Borcea and V. Druskin. Optimal finite difference grids for direct and inverse Sturm–Liouville problems. *Inverse Problems*, 18(4):979, 2002
37. V. Druskin, P. Lee, and L. Knizhnerman. Method, apparatus, and article of manufacture for solving 3d maxwell equations in inductive logging applications, September 5 2000. US Patent 6,115,670 5 of 10
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44. B. Anderson, T. Barber, V. Druskin, P. Lee, E. Dussan, L. Knizhnerman, and S. Davydycheva. The response of multiarray induction tools in highly dipping formations with invasion and in arbitrary 3d geometries. *LOG ANALYST*, 40:327–344, 1999
45. V. Druskin, L. Knizhnerman, and P. Lee. New spectral lanczos decomposition method for induction modeling in arbitrary 3-d geometry. *Geophysics*, 64(3):701–706, 1999
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51. V. Druskin, A. Greenbaum, and L. Knizhnerman. Using nonorthogonal Lanczos vectors in the computation of matrix functions. *SIAM Journal on Scientific Computing*, 19(1):38–54, 1998
52. V. Druskin. On the uniqueness of inverse problems from incomplete boundary data. *SIAM Journal on Applied Mathematics*, 58(5):1591–1603, 1998 6 of 10
53. V. Druskin, L. Knizhnerman, T. Tamarchenko, and S. Kostek. Krylov subspace reduction and its extensions for option pricing. *J. Comput. Finance*, 1(1):63–79, 1997
54. V. Druskin and L. Knizhnerman. Krylov subspace approximation of eigenpairs and matrix functions in exact and computer arithmetic. *Numerical linear algebra with applications*, 2(3):205–217, 1995
55. V. Druskin and L. Knizhnerman. Spectral approach to solving three-dimensional Maxwell’s diffusion equations in the time and frequency domains. *Radio Science*, 29(4):937–953, 1994
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57. V. Druskin and L. Knizhnerman. On application of the Lanczos method to solution of some partial differential equations. *Journal of Computational and Applied Mathematics*, 50(1):255–262, 1994
58. T. Tamarchenko and V. Druskin. Fast modeling of induction and resistivity logging in the model with mixed boundaries. *SPWLA 34th Annual Logging Symposium*. Houston: Well Log Analysts, 1993
59. V. Druskin and Leonid Knizhnerman. The lanczos optimization of a splitting-up method to solve homogeneous evolutionary equations. *Journal of computational and applied mathematics*, 42(2):221–231, 1992
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64. V. Druskin and L. Knizhnerman. A spectral semi-discrete method for the numerical solution of 3-d nonstationary problems in electrical prospecting. *Phys. Solid Earth*, 24:63–74, 1988
65. V. Druskin. Two-dimensional data inversion for near field buildup sounding. *Izvestiya of the Academy of Sciences, USSR.: Physics of the solid earth*, 24:901, 1988
66. V. Druskin and L. Knizhnerman. A method of solution of forward problems of electric well logging and electric exploration with direct current. *Izvestiya of the Academy of Sciences, USSR.: Physics of the solid earth*, 23(4):317–323, 1987
67. V. Druskin. On uniqueness of the determination of the three-dimensional underground structures from surface measurements with variously positioned steady-state or monochromatic field sources. *Izvestiya of the Academy of Sciences, USSR.: Physics of the solid earth*, 21:210–4, 1985
68. V. Druskin. The unique solution of the inverse problem of electrical surveying and electrical well-logging for piecewise-constant conductivity, *Izvestiya of the Academy of Sciences, USSR.: Physics of the solid earth*, 18(1), 1982

PREPRINTS

1. Liliana Borcea, Vladimir Druskin, Alexander V Mamonov, and Mikhail Zaslavsky. Robust nonlinear processing of active array data in inverse scattering via truncated reduced order models. *arXiv preprint arXiv:1805.03747*, 2018
2. V. Druskin, R. Remis, M. Zaslavsky, and journal=arXiv preprint arXiv:1711.00942 year=2017 Zimmerling, J. Compressing large-scale wave propagation models via phase-preconditioned rational Krylov subspaces
3. V. Druskin, S. Güttel, and L. Knizhnerman. Compressing variable-coefficient exterior Helmholtz problems via RKFIT. *Manchester Institute for Mathematical Sciences, University of Manchester*, 2016

PATENTS

1. P. Childs, I. Graham, J. Shanks, V. Druskin, L. Knizhnerman, Wave equation processing, Application WO2014057440A1 Geco Technology B.V. Priority 2012-10-10, Filing 2013-10-09, Publication 2014-04-17.
2. A. Abubakar, A. Belani, V. Druskin, T. Habashy, M. Zaslavsky, Data set inversion using source-receiver compression Application GB2486854A Schlumberger Holdings, Priority 2010-03-31, Filing 2011-03-30, Publication 2012-06-27
3. V. Druskin, M. Zaslavsky, Constructing a reduced order model of an electromagnetic response in a subterranean structure, Application WO2009146041A1 Geco Technology B.V., Priority 2008-03-31, Filing 2009-03-31, Publication 2009-12-03
4. B. Couet, M. Prange, W. Bailey, H. Djikpesse, V. Druskin, Method for optimal gridding in reservoir simulation, Application GB2451977A, Logined Bv, Priority 2006-05-15, Filing 2008-11-11, Publication 2009-02-18

5. A. Abubakar, T. Habashy, V. Druskin, D. Alumbaugh, Pixel based inversion method for surface electromagnetic measurement, Grant US7640110B2, Schlumberger Technology Corporation, Priority 2007-04-27, Filing 2007-04-27, Grant 2009-12-29, Publication 2009-12-29
6. V. Druskin, P. Lee, L. Knizhnerman, Method and apparatus for solving 3D Maxwell equations for inductive logging applications, Grant GB2324158B, Schlumberger Ltd, Priority 1996-12-04, Filing 1997-12-04, Grant 2001-03-14, Publication 2001-03-14
7. C. Torres-Verdin, S. Fang, V. Druskin I. Bryant, M. Karakas, Method for sensing and estimating the shape and location of oil-water interfaces in a well, Grant GB2328024B, Schlumberger Ltd, Priority 1996-06-11, Filing 1997-08-08, Grant 1999-10-13, Publication 1999-10-13
8. A. Sezginer, V. Druskin, Method for measuring the resistivity of the formations in the tubes holes device, Grant FR2719386B1, Schlumberger Services Petrol, Priority 1994-05-02, Filing 1995-05-02, Grant 1997-10-31, Publication 1997-10-31

SELECTED
RECENT INVITED
LECTURES

Reduced order models, networks and applications to modeling and imaging with waves, Plenary Lecture at FACM meeting, NJIT, August 2018.

Clustering of a subset of big data problems via reduced order graph-Laplacians, Workshop on Model Order Reduction, Delft University, Holland, July 2018.

Reduced order models, networks and applications to modeling electromagnetic waves, Workshop on Computational Aspects of Time-Dependent Electromagnetic Wave Problems in Complex Materials, ICERM, Brown University, June 2018.

Reduced order models, networks and applications to modeling and imaging with waves, Mechanical Engineering, Boston University, April 2018.

Reduced order models, networks and applications to modeling and imaging with waves, Applied Math. Colloquium, University of Michigan, Ann Arbor, April 2018.

Reduced order models, networks and applications to modeling and imaging with waves, Worcester Institute of Technology, April 2018.

Reduced order models, networks and applications to modeling and imaging with waves, Numerical Analysis Seminar, University of Geneva, March 2018.

Reduced order models, networks and applications to modeling and imaging with waves, CSE Industry Lecture, MIT, October 2017.

Untangling nonlinearity of multiple scattering via reduced order models, Student SIAM Chapter Colloquium, Delft University (Netherlands), May, 2017.

Geometrical interpretation of reduced order models, Applied Math Seminar, Columbia University, April, 2017.

Sparse realization of reduced order models, Centre International de Rencontres Mathématiques, Luminy, October, 2016.

Direct nonlinear imaging via data-driven reduced order models, TU Delft, October 2016.

Direct nonlinear imaging via data-driven reduced order models, Utrecht University, October 2016.

Reduced order models for large scale wave problems, Department of Mathematics, University of Houston, Scientific Computing Seminar, October 2015.

Model Reduction Approaches to Forward and Inverse Elastic Wave Problems with Active Sources in Fractured Reservoirs, IMA Hot Topic Workshop Hydraulic Fracturing: From Modeling and Simulation to Reconstruction and Characterization, May 2015.

Reduced Order Models for Large Scale Wave Problems, University of Utah Applied Math Colloquium, March 2015

Finite-difference Gaussian Rules for Dirichlet-to-Neumann Operators, Perfectly Matched Layers and Inverse Problems Courant Institute of Mathematical Sciences, NYU, April 2014.

Finite-difference Gaussian Quadrature Rules for Dirichlet-to-Neumann Operators and Inverse Problems, Theoretical and Applied Computational Inverse Problems - ESI, Vienna, May 2014.

Electromagnetic Computations via Optimal Rational Krylov Subspace projection, TU Vienna, May 2014.

Rational Approximations of NtD Type Markov-Stieltjes Matrix Functions Via Finite-Difference Schemes, Advances in Matrix Functions and Matrix Equations, University of Manchester, April 2013.

Solution of inverse problems in model reduction framework, Computational Inverse Problems Workshop, Mathematisches Forschungsinstitut Oberwolfach, October 2012.

SERVICE (RECENT)

SIAM Fellows Canvassing Committee, 2017-2018.

Organization committee SIAM-ALA18, Hong Kong

Associate editor of Electronic Transactions on Numerical Analysis, 2010-current.

Organizational committee for ICERM Semester Program on "Mathematical and Computational Challenges in Radar and Seismic Reconstruction", Fall 2017

Organizational committee for ICERM Workshop on Computational and Analytical Aspects of Image Reconstruction, July 2015

Co-organizing Schlumberger-Tufts Computational and Applied Math Seminar series 2006-2018

MENTORING

I co-advised and mentored the following researchers who now have successful careers in academia and industry:

Tanya Tamarchenko, Ph.D. student (co-advising), defended 1998, currently Head of Market Risk Modeling, Director, BNY Mellon

Shari Moskow, IMA-Schlumberger postdoc, 1996-1997 currently Professor, Drexel University

Sergey Asvadurov, research mentoring 1998-2000, currently Partner, McKinsey&Company

Fernando Guevara Vasquez, research mentoring 2005-2006, currently Associate (tenured) Professor, University of Utah

Vadim Lisitsa, research mentoring 2005-2006,

currently Principal Researcher at Trofimuk Geology Institute, Russia

Rob Remis, research mentoring 1998-1999,
currently Associate (tenured) professor, TU Delft

Alexander Mamonov, research mentoring 2006-2011,
currently (tenure track) Assistant Professor, UH

Jorn Zimmerling, research mentoring 2014-2018,
Van Loo Assistant Professor, University of Michigan, starting in Fall 2018,

Mikhail Zaslavsky, research mentoring, 2005-2010,
currently Principal Research Scientist, Schlumberger,

Andy Thaler, IMA-Schlumberger Postdoc 2014-2015,
currently Software Engineer at MathWorks.