

Shixu Meng

CONTACT INFORMATION Department of Mathematics 305 Data & Decisions Science
Virginia Tech 727 Prices Fork Road
Blacksburg VA, 24061 Email: sg122@vt.edu

EMPLOYMENT **Virginia Tech, Department of Mathematics**

Senior Research Associate, January 2024 –

Chinese Academy of Sciences, Academy of Mathematics and Systems Science

Associate Professor (tenured), March 2023 – January 2024

Associate Professor (tenure-track), January 2021 – March 2023

Assistant Professor (tenure-track), June 2020 – January 2021

University of Michigan, Department of Mathematics

Postdoctoral Assistant Professor, September 2017 – May 2020

Brown University, Institute for Computational and Experimental Research in Mathematics

Postdoctoral Fellow, September 2017 – December 2017

University of Minnesota, Institute for Mathematics and its Applications

Postdoctoral Fellow, September 2016 – August 2017

RESEARCH INTEREST

Applied and computational mathematics, inverse problems, data science
computational inverse scattering, low rank methods, dimension reduction, non-destructive testing and eigenvalues, homogenization for periodic media, kernel machine

EDUCATION

University of Delaware

Ph.D. in Applied Mathematics, May 2016

– Thesis: Inverse Scattering for a Penetrable Cavity and the Transmission Eigenvalue Problem

– Advisor: Prof. Fioralba Cakoni and Prof. David Colton

M.S. in Applied Mathematics, May 2013

Nankai University

B.S. in Mathematics, June 2011

RESEARCH GRANTS

AMS-Simons Travel Grant (\$4,000), July 2018 – June 2020

ACADEMIC VISITS

Ecole Polytechnique

Chateaubriand Fellowship, January 2015 – August 2015

Research Assistant, May 2013 – August 2013

Peer-reviewed journal articles

1. S Meng and B Zhang, *Kernel machine learning for inverse source and scattering problems*. SIAM J. Numer. Anal., in press.
2. S Meng, *Data-driven basis for reconstructing the contrast in inverse scattering: Picard criterion, regularity, regularization, and stability*. SIAM J. Appl. Math. 83 (2023), no. 5, pp. 2003–2026.
3. S Meng, *Single mode multi-frequency factorization method for the inverse source problem in acoustic waveguides*. SIAM J. Appl. Math. 83 (2023), no. 2, pp. 394–417.
4. X Liu and S Meng, *A multi-frequency sampling method for the inverse source problems with sparse measurements*. CSIAM Trans. Appl. Math. 4 (2023), no. 4, pp. 653–671.
5. F Dou, X Liu, S Meng, and B Zhang, *Data completion algorithms and their applications in inverse acoustic scattering with limited-aperture backscattering data*. J. Comput. Phys. 469 (2022), no. 11550, 17 pp.
6. B Guzina, O Oudghiri-Idrissi, and S Meng, *Asymptotic anatomy of the Berry phase for scalar waves in 2D periodic continua*. Proc. R. Soc. A. 478 (2022), no. 2262, 20220110.
7. X Liu, S Meng, and B Zhang, *Modified sampling method with near field measurements*. SIAM J. Appl. Math. 82 (2022), no. 1, pp. 244–266.
8. S Meng, O Oudghiri-Idrissi, and B Guzina, *A convergent low-wavenumber, high-frequency homogenization of the wave equation in periodic media with a source term*. Applicable Analysis 101 (2022), no. 18, pp. 6451–6484.
9. F Cakoni, S Meng, and J Xiao, *A note on transmission eigenvalues in electromagnetic scattering theory*. Inverse Probl. Imaging 15 (2021), no. 5, pp. 999–1014.
10. O Oudghiri-Idrissi, B Guzina, and S Meng, *On the spectral asymptotics of waves in periodic media with Dirichlet or Neumann exclusions*. Quart. J. Mech. Appl. Math. 74 (2021), no. 2, pp. 173–221.
11. F Zeng and S Meng, *The interior inverse electromagnetic scattering for an inhomogeneous cavity*. Inverse Problems 37 (2021), no. 2, 025007, 29 pp.
12. S Meng, *A Sampling type method in an electromagnetic waveguide*. Inverse Probl. Imaging 15 (2021), no. 4, pp. 745–762.
13. L Borcea and S Meng, *Factorization method versus migration imaging in a waveguide*. Inverse Problems 35 (2019), no. 12, 124006, 33 pp.
14. L Borcea, F Cakoni, and S Meng, *A direct approach to imaging in a waveguide with perturbed geometry*. J. Comput. Phys. 392 (2019), pp. 556–577.
15. C Lackner, S Meng, and P Monk, *Determination of electromagnetic Bloch variety in a medium with frequency-dependent coefficients*. J. Comput. Appl. Math. 358 (2019), pp. 359–373.
16. B Guzina, S Meng, and O Oudghiri-Idrissi, *A rational framework for dynamic homogenization at finite wavelengths and frequencies*. Proc. R. Soc. A. 475 (2019), no. 2223, 20180547, 30 pp.
17. Y-H Lin and S Meng, *Leading and second order homogenization of an elastic scattering problem for highly oscillating anisotropic medium*. J. Elasticity 137 (2019), no. 2, pp. 177–217.
18. H Haddar and S Meng, *Spectral analysis of the transmission eigenvalue problem for Maxwell's equations*. J. Math. Pures Appl. (9) 120 (2018), pp. 1–32.

19. S Meng and B Guzina, *On the dynamic homogenization of periodic media: Willis' approach versus two-scale paradigm*. Proc. R. Soc. A. 474 (2018), no. 2213, 20170638, 27 pp.
20. S Cogar, D Colton, S Meng, and P Monk, *Modified transmission eigenvalues in inverse scattering theory*. Inverse Problems 33 (2017), no. 12, 125002, 31 pp.
21. F Cakoni, D Colton, S Meng, and P Monk, *Stekloff eigenvalues in inverse scattering*. SIAM J. Appl. Math. 76 (2016), no. 4, pp. 1737–1763.
22. F Cakoni, H Haddar, and S Meng, *Boundary integral equations for the transmission eigenvalue problem for Maxwell's equations*. J. Integral Equations Appl. 27 (2015), no. 3, pp. 375–406.
23. D Colton, Y-J Leung, and S Meng, *Distribution of complex transmission eigenvalues for spherically stratified media*. Inverse Problems 31 (2015), no. 3, 035006, 19 pp.
24. D Colton, Y-J Leung, and S Meng, *The inverse spectral problem for exterior transmission eigenvalues*. Inverse Problems 30 (2014), no. 5, 055010, 11 pp.
25. D Colton and S Meng, *Spectral properties of the exterior transmission eigenvalue problem*. Inverse Problems 30 (2014), no. 10, 105010, 16 pp.
26. S Meng, H Haddar, and F Cakoni, *The factorization method for a cavity in an inhomogeneous medium*. Inverse Problems 30 (2014), no. 4, 045008, 20 pp.
27. F Cakoni, D Colton, and S Meng, *The inverse scattering problem for a penetrable cavity with internal measurements*. Inverse problems and applications, pp. 71–88, Contemp. Math. 615, Amer. Math. Soc., Providence, RI, 2014.

Submitted journal articles

1. L Audibert and S Meng, *Shape and parameter identification by the linear sampling method for a restricted Fourier integral operator*. arXiv preprint.

STUDENTS
MENTORING

- 2022 – Yuyuan, Zhou. Graduate student (co-advise with Bo Zhang), University of Chinese Academy of Sciences.
- 2021 – Jialu, Tian. Graduate student (co-advise with Bo Zhang), University of Chinese Academy of Sciences.

TEACHING
EXPERIENCE

- 2020W **Introduction to Numerical Methods (MATH 471)**, undergraduate course, two sections, University of Michigan, Department of Mathematics.
- 2019W **Fourier Analysis and its Applications (MATH 354)**, undergraduate course, University of Michigan, Department of Mathematics.
- 2018F **Advanced Engineering Mathematics (MATH 450)**, undergraduate and graduate course, University of Michigan, Department of Mathematics.
- 2018W **Advanced Engineering Mathematics (MATH 450)**, undergraduate and graduate course, University of Michigan, Department of Mathematics.
- 2016S **Analytic Geometry and Calculus B (MATH 242)**, undergraduate course, University of Delaware, Department of Mathematical Sciences.
- 2016W **Analytic Geometry and Calculus B (MATH 242)**, undergraduate course, University of Delaware, Department of Mathematical Sciences.
- 2014S **Teaching Assistant** for Analytic Geometry and Calculus C (MATH 243), University of Delaware, Department of Mathematical Sciences.
- 2014W **Analytic Geometry and Calculus B (MATH 242)**, undergraduate course, University of Delaware, Department of Mathematical Sciences.

2013S **Teaching Assistant** for Analytic Geometry and Calculus B (MATH 242), University of Delaware, Department of Mathematical Sciences.

PRESENTATIONS
AND POSTERS

2024 *Learning Theory and Algorithm for Inverse Scattering*. Applied Numerical Analysis Seminar, Department of Mathematics, Virginia Tech. Blacksburg VA, USA. (February 2024).

2023 *Prolate Eigensystem and its Application in Born Inverse Scattering*. The 11th Applied Inverse Problems. Göttingen, Germany. (Minisymposium talk, September 2023)

Single Mode Multi-frequency Factorization Method for the Inverse Source Problem in Acoustic Waveguides. The 11th Applied Inverse Problems. Göttingen, Germany. (Minisymposium talk, September 2023)

Convergence Study on Prolate-Galerkin Linear Sampling Method for Shape and Parameter Identification. Workshop on Numerical Methods for Spectral Problems: Theory and Applications. Kushiro, Hokkaido, Japan. (Invited talk, August 2023)

Application of Prolate Eigensystem to Born Inverse Scattering. International Congress on Industrial and Applied Mathematics. Tokyo, Japan. (Minisymposium talk, August 2023)

Modified Sampling Method with Near Field Measurements. The 4th Workshop on Theoretical Analysis and Numerical Methods for Applied Inverse Problems. Shanghai, China. (Invited online talk, February 2023)

2022 *Single Mode Multi-frequency Factorization Method for the Inverse Source Problem in Acoustic Waveguides*. School of Mathematics (Zhuhai), Sun Yat-sen University. Zhuhai, China. (Invited online talk, September 2022)

Single Mode Multi-frequency Factorization Method for the Inverse Source Problem in Acoustic Waveguides. The 10th International Conference “Inverse Problems: Modeling & Simulation”. Malta. (Minisymposium talk via Zoom, May 2022)

2021 *Modified sampling method with near field measurements*. School of Mathematics and Information Sciences, Yantai University. Yantai, China. (Invited online talk, December 2021)

Sampling Methods in Acoustic and Electromagnetic Waveguides. Beijing Computational Science Research Center. Beijing, China. (Invited online talk, December 2021)

A Dynamic Model at Finite Frequency and Wavenumber in Periodic Media. CSIAM Annual Conference 2021. Hefei, China. (Minisymposium talk, October 2021)

A Dynamic Model at Finite Frequency and Wavenumber in Periodic Media. Workshop on Inverse Problems and Related Topics. Chengdu, China. (Invited talk, May 2021)

Sampling Type Methods in Acoustic and Electromagnetic Waveguide. Workshop on Analysis and Computation of Inverse Problems. Harbin Institute of Technology. China. (Invited talk, April 2021)

2020 *Wave Propagation and Inverse Problems*. Colloquium, University of Dayton. Dayton, Ohio. (Colloquium talk, February 2020)

Wave Propagation and Inverse Problems. Colloquium, University of Tennessee at Chattanooga. Chattanooga, Tennessee. (Colloquium talk, February 2020)

Wave Propagation and Inverse Problems. Webinar, Academy of Mathematics

and Systems Science, Chinese Academy of Sciences. Beijing, China. (Webinar talk, January 2020)

- 2019 *Qualitative Method, Eigenvalue, and Dynamic Homogenization in Wave Propagation and Inverse Problem*. Spectral and Scattering Seminar, Purdue University. West Lafayette, Indiana. (Seminar talk, October 2019)
- Factorization Method versus Migration Imaging in a Waveguide*. SIAM Great Lakes Section Meeting. Ann Arbor, Michigan. (Invited talk, April 2019)
- Qualitative Imaging Methods and Wave Motion in Complex Media*. Colloquium, Oakland University. Rochester, Michigan. (Colloquium talk, March 2019)
- Qualitative Imaging Methods and Wave Motion in Complex Media*. Applied Mathematics Seminar, Central Michigan University. Mt Pleasant, Michigan. (Seminar talk, March 2019)
- Determination of Electromagnetic Bloch Modes in a Medium with Frequency-dependent Coefficients*. SIAM CSE 2019. Spokane, Washington. (Minisymposium talk, February 2019)
- 2018 *Qualitative Methods in Terminating Waveguide Imaging*. Conference on Mathematics of Wave Phenomena 2018. Karlsruhe, Germany. (Minisymposium talk, July 2018)
- Dynamic Homogenization of Periodic Media at Finite Frequency and Finite Wavenumber*. Conference on Mathematics of Wave Phenomena 2018. Karlsruhe, Germany. (Minisymposium talk, July 2018)
- Imaging in an Unknown Terminating Waveguide*. 2018 Inverse Problems Symposium, Michigan State University. East Lansing, MI. (Minisymposium talk, June 2018)
- Spectral Analysis of the Modified Transmission Eigenvalue Problem*. The 9th International Conference “Inverse Problems: Modeling & Simulation”. Malta. (Minisymposium talk, May 2018)
- 2017 *On the Dynamic Homogenization of Periodic Media: Willis’ Approach versus Two-scale Paradigm*. Postdoc/Graduate Seminar, ICERM, Brown University. Providence, Rhode Island. (Seminar talk, November 2017)
- The Spectral Analysis of Interior Transmission Problem for Maxwell’s Equations*. Institute of Applied Mathematics, Chinese Academy of Sciences. Beijing, China. (Seminar talk, June 2017)
- The Spectral Analysis of Interior Transmission Problem for Maxwell’s Equations*. Applied Inverse Problems 2017. Hangzhou, China. (Minisymposium talk, June 2017)
- Stekloff Eigenvalues in Inverse Scattering*. Computational Inverse Problems for PDE. Oberwolfach, Germany. (Contributed talk, May 2017)
- Inverse scattering for cavities and the associated eigenvalue problems*. Department of Mathematics, The University of Texas at Arlington. Arlington, Texas. (Colloquium talk, May 2017)
- The Spectral Analysis of the Transmission Eigenvalue Problem for Maxwell’s Equations*. SIAM CSE 2017. Atlanta, Georgia. (Minisymposium talk, March 2017)
- 2016 *The Spectral Analysis of the Transmission Eigenvalue Problem for Maxwell’s Equations*. Postdoc Seminar, Institute for Mathematics and its Applications, University of Minnesota. Minneapolis, Minnesota. (Seminar talk, October 2016)
- The Spectral Analysis of the Transmission Eigenvalue Problem for Maxwell’s Equations*. International Conference on Comp. Math. and Inverse Problems,

Michigan Technological University. Houghton, Michigan. (Invited talk, August 2016)

Stekloff Eigenvalues in Inverse Scattering. SIAM Annual Conference 2016. Boston, Massachusetts. (Minisymposium talk, July 2016)

The Interior Transmission Eigenvalue Problem for Maxwell's Equations in Inverse Scattering. SIAM Southeastern Atlantic Section Conference. Athens, Georgia. (Minisymposium talk, March 2016)

The transmission eigenvalue problem for Maxwell's equations. Winter Research Symposium, Department of Mathematical Sciences, University of Delaware. Newark, Delaware. (Wenbo Li Award talk, February 2016)

2015 *Boundary Integral Equations for the Transmission Eigenvalue Problem for Maxwell's Equations*. International Congress for Industrial and Applied Mathematics. Beijing, China. (Minisymposium talk, August 2015)

Boundary Integral Equations for the Transmission Eigenvalue Problem for Maxwell's Equations. 12th International Conference on Mathematical and Numerical Aspects of Waves. Karlsruhe, Germany. (Invited talk, July 2015)

2014 *The Factorization Method for a Cavity in an Inhomogeneous Medium*. SIAM Annual Conference 2014. Chicago, Illinois. (Minisymposium talk, July 2014)

The Factorization Method for a Cavity in an Inhomogeneous Medium. REUSI-NSF Meeting, Colorado State University. Fort Collins, Colorado. (Contributed talk, June 2014)

The Inverse Scattering Problem for a Penetrable Cavity. Winter Research Symposium, Department of Mathematical Sciences, University of Delaware. Newark, Delaware. (Poster, February 2014)

The factorization method for a cavity in an inhomogeneous medium. Progress in Harmonic Analysis and Geometric Measure Theory, Temple University. Philadelphia, Pennsylvania. (Poster, April 2014)

2013 *The Inverse Scattering Problem for a Penetrable Cavity*. Graduate Student Seminar, University of Delaware. Newark, Delaware. (Seminar talk, April 2013)

The factorization method for a cavity in an inhomogeneous medium. International Conference on Novel Directions in Inverse Scattering Honoring David Colton. Newark, Delaware. (Poster, August 2013)

PROFESSIONAL
SERVICE

Reviewer for:

2D Materials, Acta Mathematica Scientia, Applicable Analysis, Computers and Mathematics with Application, Communications in Mathematical Sciences, Computer Methods in Applied Mechanics and Engineering, Communications on Pure & Applied Analysis, European Journal of Applied Mathematics, IMA Journal of Numerical Analysis, Inverse Problems, Inverse Problems and Imaging, Inverse Problems in Science & Engineering, Journal of Computational and Applied Mathematics, Journal of Computational Physics, Journal of Inverse and Ill-posed Problems, Mathematical Methods in the Applied Sciences, Proceedings of The Royal Society A, Research in the Mathematical Sciences, Scientific Reports Nature, SIAM Journal on Applied Mathematics, SIAM Journal on Mathematical Analysis, SIAM Journal on Scientific Computing.

Minisymposium (Co-)Organized for:

Recent Advances in Inverse Scattering Theory and Applications, 11th International Conference "Inverse Problems: Modeling and Simulation". Malta. (Minisymposium co-organizer, May 26–June 01, 2024)

Recent Advances in Inverse Problems of Time-Harmonic Wave Propagation, 10th International Conference “Inverse Problems: Modeling and Simulation”. Malta. (Minisymposium co-organizer, May 22–28, 2022)

Recent Developments in the Mathematics of Tomography and Scattering, AMS Sectional Meeting. Ann Arbor, Michigan. (Minisymposium co-organizer, October 2018)

Seminar (Co-)Organized for:

Inverse Problems and Imaging Seminar, Academy of Mathematics and Systems Science, Chinese Academy of Sciences. Beijing. (Seminar co-organizer, June 2020 – present)

Postdoc/Graduate student Seminar 2017, ICERM, Brown University. Providence, Rhode Island. (Seminar organizer, Fall 2017)

Postdoc Seminar, IMA, University of Minnesota. Minneapolis, Minnesota. (Seminar co-organizer, September 2016 – August 2017)

HONORS AND AWARDS	2016	SIAM Student Travel Award for the SIAM Annual Conference.
	2016	Wenbo Li Award, University of Delaware (Mathematical Department).
	2015–2016	University Dissertation Award, University of Delaware.
	2014–2015	Chateaubriand Fellowship (Mathematics).
	2013	Winter Research Symposium Travel Award, University of Delaware (Mathematical Department).
COMPUTER SKILLS	Operating system:	Linux, Windows, Macintosh.
	Programming language:	Python, C++, Matlab.
	Software:	MicroSoft, L ^A T _E X, Mathematica, FreeFem++, NGSolve, TensorFlow, Scikit-learn.