

Ali Siahkoohi

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RESEARCH INTERESTS	<p>I conduct research that focuses on developing deep learning methods to reliably solve scientific computing problems pertaining to inverse problems, uncertainty quantification, and signal processing.</p> <p><i>Keywords:</i> generative models, variational inference, inverse problems, uncertainty quantification, signal processing</p>
EMPLOYMENT	<p>Simons Postdoctoral Fellow, August 2022–present Department of Computational Applied Mathematics & Operations Research Rice University, Houston, TX, USA</p> <p>Research Assistant, February 2018–July 2022 School of Computational Science and Engineering Georgia Institute of Technology, Atlanta, GA, USA</p> <p>Research Intern, August 2021–December 2021 Chrome Media Team Google, San Francisco, CA, USA</p> <p>Research Assistant, August 2016–January 2018 Department of Earth, Ocean and Atmospheric Sciences University of British Columbia, Vancouver, BC, Canada</p>
PROFESSIONAL PREPARATION	<p>Georgia Institute of Technology, Atlanta, GA, USA Ph.D., 2022, <i>Computational Science and Engineering</i></p> <p>University of Tehran, Tehran, Iran M.Sc., 2016, <i>Geophysics</i></p> <p>Sharif University of Technology, Tehran, Iran B.Sc., 2013, <i>Electrical Engineering</i></p>
PUBLICATION	<p>◇ Preprints</p> <p>A. Siahkoohi, R. Morel, R. Balestrieri, E. Allys, G. Sainton, T. Kawamura, and M. V. de Hoop, “Martian time-series unraveled: A multi-scale nested approach with factorial variational autoencoders,” 2023.</p> <p>D. LeJeune, L. Luzi, A. Siahkoohi, S. Alemohammad, V. Saragadam, H. Babaei, N. Liu, Z. Wang, and R. G. Baraniuk, “TITAN: Bringing the deep image prior to implicit representations,” 2023.</p> <p>S. Alemohammad, J. Casco-Rodriguez, L. Luzi, A. I. Humayun, H. Babaei, D. LeJeune, A. Siahkoohi, and R. G. Baraniuk, “Self-consuming generative models go MAD,” 2023.</p> <p>◇ Journal Publications</p> <p>L. Luzi, P. M. Mayer, J. Casco-Rodriguez, A. Siahkoohi, and R. G. Baraniuk, “Boomerang: Local sampling on image manifolds using diffusion models,” <i>Transactions on Machine Learning Research</i>, 2023.</p>

M. Louboutin, Z. Yin, R. Orozco, T. J. Grady II, A. Siahkoohi, G. Rizzuti, P. A. Witte, O. Møyner, G. J. Gorman, and F. J. Herrmann, “Learned multiphysics inversion with differentiable programming and machine learning,” *The Leading Edge*, vol. 42, no. 7, pp. 474–486, 2023.

A. Siahkoohi, G. Rizzuti, R. Orozco, and F. J. Herrmann, “Reliable amortized variational inference with physics-based latent distribution correction,” *Geophysics*, vol. 88, no. 3, R297–R322, 2023.

Y. Zhang, Z. Yin, O. López, A. Siahkoohi, M. Louboutin, R. Kumar, and F. J. Herrmann, “Optimized time-lapse acquisition design via spectral gap ratio minimization,” *Geophysics*, vol. 88, no. 4, A19–A23, 2023.

A. Siahkoohi, G. Rizzuti, and F. J. Herrmann, “Deep Bayesian inference for seismic imaging with tasks,” *Geophysics*, vol. 87, no. 5, S281–S302, 2022.

A. Siahkoohi, M. Louboutin, and F. J. Herrmann, “The importance of transfer learning in seismic modeling and imaging,” *Geophysics*, vol. 84, no. 6, A47–A52, 2019.

◇ **Conference Papers**

A. Siahkoohi, R. Morel, M. V. de Hoop, E. Allys, G. Sainton, and T. Kawamura, “Unearthing InSights into Mars: Unsupervised source separation with limited data,” in *Proceedings of the 40th International Conference on Machine Learning*, vol. 202, 2023, pp. 31 754–31 772.

L. Baldassari, A. Siahkoohi, J. Garnier, K. Sølna, and M. V. de Hoop, “Conditional score-based diffusion models for Bayesian inference in infinite dimensions,” in *Advances in Neural Information Processing Systems*, vol. 36, 2023.

M. Louboutin, R. Orozco, A. Siahkoohi, and F. J. Herrmann, “Learned one-shot imaging,” in *3rd International Meeting for Applied Geoscience & Energy*, 2023.

R. Orozco, A. Siahkoohi, G. Rizzuti, T. van Leeuwen, and F. J. Herrmann, “Adjoint operators enable fast and amortized machine learning based Bayesian uncertainty quantification,” in *Medical Imaging 2023: Image Processing*, vol. 12464, 2023, p. 124641L.

R. Orozco, A. Siahkoohi, M. Louboutin, and F. J. Herrmann, “Refining amortized posterior approximations using gradient-based summary statistics,” in *5th Symposium on Advances in Approximate Bayesian Inference*, 2023.

R. Orozco, M. Louboutin, A. Siahkoohi, G. Rizzuti, T. van Leeuwen, and F. J. Herrmann, “Amortized normalizing flows for transcranial ultrasound with uncertainty quantification,” in *Medical Imaging with Deep Learning (MIDL) Conference*, 2023.

Y. Zhang, Z. Yin, O. Lopez, A. Siahkoohi, M. Louboutin, and F. J. Herrmann, “3D seismic survey design by maximizing the spectral gap,” in *3rd International Meeting for Applied Geoscience & Energy*, 2023.

A. Siahkoohi, M. Chinen, T. Denton, W. B. Kleijn, and J. Skoglund, “Ultra-Low-Bitrate Speech Coding with Pretrained Transformers,” in *Proceedings of Interspeech 2022*, 2022, pp. 4421–4425.

M. Louboutin, P. Witte, A. Siahkoohi, G. Rizzuti, Z. Yin, R. Orozco, and F. J. Herrmann, “Accelerating innovation with software abstractions for scalable computational geophysics,” in *2nd International Meeting for Applied Geoscience & Energy*, 2022, pp. 1482–1486.

Y. Zhang, M. Louboutin, A. Siahkoohi, Z. Yin, R. Kumar, and F. J. Herrmann, “A simulation-free seismic survey design by maximizing the spectral gap,” in *2nd International Meeting for Applied Geoscience & Energy*, 2022, pp. 15–20.

A. Siahkoohi, M. Louboutin, and F. J. Herrmann, “Velocity continuation with Fourier neural operators for accelerated uncertainty quantification,” in *2nd International Meeting for Applied Geoscience & Energy*, 2022, pp. 1765–1769.

- A. Siahkoohi, R. Orozco, G. Rizzuti, and F. J. Herrmann, “Wave-equation based inversion with amortized variational Bayesian inference,” in *EAGE Deep learning for seismic processing: Investigating the foundations workshop*, 2022.
- Z. Yin, A. Siahkoohi, M. Louboutin, and F. J. Herrmann, “Learned coupled inversion for carbon sequestration monitoring and forecasting with Fourier neural operators,” in *2nd International Meeting for Applied Geoscience & Energy*, 2022, pp. 467–472.
- A. Siahkoohi, G. Rizzuti, M. Louboutin, P. Witte, and F. J. Herrmann, “Preconditioned training of normalizing flows for variational inference in inverse problems,” in *3rd Symposium on Advances in Approximate Bayesian Inference*, 2021.
- R. Orozco, A. Siahkoohi, G. Rizzuti, T. van Leeuwen, and F. J. Herrmann, “Photoacoustic imaging with conditional priors from normalizing flows,” in *NeurIPS 2021 Workshop on Deep Learning and Inverse Problems*, 2021.
- A. Siahkoohi and F. J. Herrmann, “Learning by example: Fast reliability-aware seismic imaging with normalizing flows,” in *First International Meeting for Applied Geoscience & Energy*, 2021, pp. 1580–1585.
- R. Kumar, M. Kotsi, A. Siahkoohi, and A. Malcolm, “Enabling uncertainty quantification for seismic data preprocessing using normalizing flows (NF)—An interpolation example,” in *First International Meeting for Applied Geoscience & Energy*, 2021, pp. 1515–1519.
- G. Rizzuti, A. Siahkoohi, P. A. Witte, and F. J. Herrmann, “Parameterizing uncertainty by deep invertible networks, an application to reservoir characterization,” in *90th Annual International Meeting*, 2020, pp. 1541–1545.
- A. Siahkoohi, G. Rizzuti, and F. J. Herrmann, “A deep-learning based Bayesian approach to seismic imaging and uncertainty quantification,” in *82nd EAGE Conference and Exhibition*, 2020.
- A. Siahkoohi, G. Rizzuti, and F. J. Herrmann, “Uncertainty quantification in imaging and automatic horizon tracking—A Bayesian deep-prior based approach,” in *90th Annual International Meeting*, 2020, pp. 1636–1640.
- A. Siahkoohi, G. Rizzuti, and F. J. Herrmann, “Weak deep priors for seismic imaging,” in *90th Annual International Meeting*, 2020, pp. 2998–3002.
- M. Zhang, A. Siahkoohi, and F. J. Herrmann, “Transfer learning in large-scale ocean bottom seismic wavefield reconstruction,” in *90th Annual International Meeting*, 2020, pp. 1666–1670.
- A. Siahkoohi, D. J. Verschuur, and F. J. Herrmann, “Surface-related multiple elimination with deep learning,” in *89th Annual International Meeting*, 2019, pp. 4629–4634.
- A. Siahkoohi, R. Kumar, and F. J. Herrmann, “Deep-learning based ocean bottom seismic wavefield recovery,” in *89th Annual International Meeting*, 2019, pp. 2232–2237.
- F. J. Herrmann, A. Siahkoohi, and G. Rizzuti, “Learned imaging with constraints and uncertainty quantification,” in *Neural Information Processing Systems (NeurIPS) 2019 Deep Inverse Workshop*, 2019.
- G. Rizzuti, A. Siahkoohi, and F. J. Herrmann, “Learned iterative solvers for the helmholtz equation,” in *81st EAGE Conference and Exhibition*, 2019.
- A. Siahkoohi, M. Louboutin, R. Kumar, and F. J. Herrmann, “Deep convolutional neural networks in prestack seismic—two exploratory examples,” in *88th Annual International Meeting*, 2018, pp. 2196–2200.
- A. Siahkoohi, R. Kumar, and F. J. Herrmann, “Seismic Data Reconstruction with Generative Adversarial Networks,” in *80th EAGE Conference and Exhibition*, 2018.

A. Siahkoohi and A. Gholami, “Sparsity Promoting Least Squares Migration for Laterally Inhomogeneous Media,” in *7th EAGE Saint Petersburg International Conference and Exhibition*, 2016.

M. S. Ebrahimi, M. H. Daraei, J. Rezaei, and A. Siahkoohi, “A Novel Utilization of Wireless Sensor Networks as Data Acquisition System in Smart Grids,” in *Materials Science and Information Technology*, vol. 433-440, 2012, pp. 6725–6730.

A. Najafi, A. Siahkoohi, and M. B. Shamsollahi, “A content-based digital image watermarking algorithm robust against JPEG compression,” in *IEEE International Symposium on Signal Processing and Information Technology*, 2011, pp. 432–437.

◇ **Thesis**

A. Siahkoohi, “Deep generative models for solving geophysical inverse problems,” PhD Thesis, Georgia Institute of Technology, 2022.

◇ **Technical Reports**

M. Louboutin, A. Siahkoohi, R. Wang, and F. J. Herrmann, “Low-memory stochastic backpropagation with multi-channel randomized trace estimation,” Georgia Institute of Technology, Tech. Rep., 2021.

A. Siahkoohi, G. Rizzuti, P. A. Witte, and F. J. Herrmann, “Faster uncertainty quantification for inverse problems with conditional normalizing flows,” Georgia Institute of Technology, Tech. Rep., 2020.

A. Siahkoohi, M. Louboutin, and F. J. Herrmann, “Neural network augmented wave-equation simulation,” Georgia Institute of Technology, Tech. Rep., 2019.

SERVICE

◇ **Journal Review**

Geophysical Prospecting
Geophysics
Geosciences
Entropy
IEEE Transactions on Geoscience and Remote Sensing
IEEE Transactions on Neural Networks and Learning Systems
IEEE Geoscience and Remote Sensing Letters
Remote Sensing
Journal of Geophysical Research – Solid Earth
Notices of the American Mathematical Society (AMS)

◇ **Conference/Workshop Review**

International Speech Communication Association (Interspeech ’23)
Structured Probabilistic Inference & Generative Modeling (ICML ’23 workshop)
Advances in Approximate Bayesian Inference (AABI ’23)
Neural Information Processing Systems (NeurIPS ’23)
Deep Generative Models for Health (NeurIPS ’23 workshop)
International Meeting for Applied Geoscience & Energy (IMAGE ’23)
International Conference on Learning Representations (ICLR ’24)
Artificial Intelligence and Statistics Conference (AISTATS ’24)

◇ **Conference Session Chairing**

International Meeting for Applied Geoscience & Energy (IMAGE ’22)

◇ **Editorial Roles**

Applied Mathematics in Inverse Problems and Uncertainty Quantification
(Mathematics journal special issue)

TEACHING
EXPERIENCE

Numerical Analysis I, Fall 2022
Rice University, Houston, TX, USA
Instructor for 18 lectures

Computational Foundations of Machine Learning, Spring 2022

Georgia Institute of Technology, Atlanta, GA, USA

Teaching Assistant

Imaging with Data-Driven Models, Fall 2019

Georgia Institute of Technology, Atlanta, GA, USA

Teaching Assistant

Numerical Analysis I, Fall 2018

Georgia Institute of Technology, Atlanta, GA, USA

Teaching Assistant

Digital Signal Processing, Spring 2011

Sharif University of Technology, Tehran, Iran

Teaching Assistant

Signals and Systems, Spring 2011

Sharif University of Technology, Tehran, Iran

Teaching Assistant

Linear Algebra, Spring 2010

Sharif University of Technology, Tehran, Iran

Teaching Assistant