# Ali Siahkoohi

CURRICULUM VITAE


CONTACT INFORMATION

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Houston, TX 77005

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RESEARCH INTERESTS

I conduct research that focuses on developing scalable deep learning methods to reliably solve computational problems in the physical and data sciences. This includes high-dimensional Bayesian inference for solving large-scale medical and geophysical inverse problems and unsupervised time series analysis with limited data.

*Keywords*: generative models, variational inference, inverse problems, uncertainty quantification, signal processing

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EMPLOYMENT

**Simons Postdoctoral Fellow** August 2022 – present
Department of Computational Applied Mathematics & Operations Research
Rice University, Houston, TX, USA

**Research Assistant** February 2018 – July 2022
School of Computational Science and Engineering
Georgia Institute of Technology, Atlanta, GA, USA

**Research Intern** August 2021 – December 2021
Chrome Media Team
Google, San Francisco, CA, USA

**Research Assistant** August 2016 – January 2018
Department of Earth, Ocean and Atmospheric Sciences
University of British Columbia, Vancouver, BC, Canada

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PROFESSIONAL PREPARATION

**Georgia Institute of Technology**, Atlanta, GA, USA August 2022
Ph.D., *Computational Science and Engineering*

**University of Tehran**, Tehran, Iran March 2016
M.Sc., *Geophysics*

**Sharif University of Technology**, Tehran, Iran August 2013
B.Sc., *Electrical Engineering*

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PUBLICATION

◇ **Preprints**

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

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

A. Siahkoohi, R. Morel, R. Balestriero, E. Allys, G. Sainton, T. Kawamura, and M. V. de Hoop. Martian time-series unraveled: A multi-scale nested approach with factorial variational autoencoders. Preprint: arXiv:2305.16189, 2023

◇ **Journal Publications**

L. Luzi, P. M. Mayer, J. Casco-Rodriguez, A. Siahkoohi, and R. G. Baraniuk. Boomerang: Local sampling on image manifolds using diffusion models. *Transactions on Machine Learning Research*, 2023

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*, 42(7):474–486, 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*, 88(4):A19–A23, 2023

A. Siahkoohi, G. Rizzuti, R. Orozco, and F. J. Herrmann. Reliable amortized variational inference with physics-based latent distribution correction. *Geophysics*, 88(3):R297–R322, 2023

A. Siahkoohi, G. Rizzuti, and F. J. Herrmann. Deep Bayesian inference for seismic imaging with tasks. *Geophysics*, 87(5):S281–S302, 2022

A. Siahkoohi, M. Louboutin, and F. J. Herrmann. The importance of transfer learning in seismic modeling and imaging. *Geophysics*, 84(6):A47–A52, 2019

◇ **Conference Papers**

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*, volume 36, 2023

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*, volume 202, pages 31754–31772, 2023

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 Conference*, 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*, volume 12464, page 124641L, 2023

M. Louboutin, R. Orozco, A. Siahkoohi, and F. J. Herrmann. Learned one-shot imaging. In *Third International Meeting for Applied Geoscience & Energy*, 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 *Third 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*, pages 4421–4425, 2022

A. Siahkoohi, M. Louboutin, and F. J. Herrmann. Velocity continuation with Fourier neural operators for accelerated uncertainty quantification. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 1765–1769, 2022

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 *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 1482–1486, 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 *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 467–472, 2022

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 *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 15–20, 2022

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

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, 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

A. Siahkoohi and F. J. Herrmann. Learning by example: Fast reliability-aware seismic imaging with normalizing flows. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 1580–1585, 2021

R. Kumar, M. Kotsi, A. Siahkoohi, and A. Malcolm. Enabling uncertainty quantification for seismic data preprocessing using normalizing flows (NF)—An interpolation example. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 1515–1519, 2021

G. Rizzuti, A. Siahkoohi, P. A. Witte, and F. J. Herrmann. Parameterizing uncertainty by deep invertible networks, an application to reservoir characterization. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 1541–1545, 2020

M. Zhang, A. Siahkoohi, and F. J. Herrmann. Transfer learning in large-scale ocean bottom seismic wavefield reconstruction. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 1666–1670, 2020

A. Siahkoohi, G. Rizzuti, and F. J. Herrmann. Weak deep priors for seismic imaging. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 2998–3002, 2020

A. Siahkoohi, G. Rizzuti, and F. J. Herrmann. Uncertainty quantification in imaging and automatic horizon tracking—A Bayesian deep-prior based approach. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 1636–1640, 2020

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

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

A. Siahkoohi, R. Kumar, and F. J. Herrmann. Deep-learning based ocean bottom seismic wavefield recovery. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 2232–2237, 2019

A. Siahkoohi, D. J. Verschuur, and F. J. Herrmann. Surface-related multiple elimination with deep learning. In *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 4629–4634, 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 *Society of Exploration Geophysicists Technical Program Expanded Abstracts*, pages 2196–2200, 2018

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*, volume 433-440, pages 6725–6730, 2012

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*, pages 432–437, 2011

◇ **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. Technical Report arXiv:2106.06998, 2021

A. Siahkoohi, G. Rizzuti, P. A. Witte, and F. J. Herrmann. Faster uncertainty quantification for inverse problems with conditional normalizing flows. Technical Report arXiv:2007.07985, 2020

A. Siahkoohi, M. Louboutin, and F. J. Herrmann. Neural network augmented wave-equation simulation. Technical Report arXiv:1910.00925, 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