Mathias Thibaut Louboutin

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Experience

July 2020–July 2023

Postdoctoral Fellow: Georgia Institute of Technology, Atlanta, GA

High performance/low memory randomized linear algebra for backpropagation based inverse problems

Cloud HPC for separable problems (task parallel)

Supervising the PhD and MSc students

*Managing and developping the software stack for the Lab (**slimgroup**)*

Machine learning for geophysical and medical wave-equation based inverse problems

HPC for machine learning

Geological Carbon Storage seismic monitoring

Computational experience

Open Source

Devito: A symbolic domain specific language (DSL) for stencil computation with just-in-time compilation and code generation. Achieves state of the art performance while providing a high-level mathematical interface to the users for the development of stencil based applications.

JUDI: Linear algebra high level API for wave-equation based inversion. This pacage is built on top of Devito to have high performance wave-equation solvers. A new additional Azure batch extension was developped for scalability **JUDI4Cloud**.

XConv: High performance low memory convolutional layer. This repository implements both in julia (for Flux.jl) and in python (for pytorch) a convolutional layer that has virtually a zero memory imprnt for training using randomized linear algebra to compute an unbiased estimate of the gradient with respect to the weights. Additionaly, a byte only implementation of the ReLU layer leads to memry reduction by a factor of X2 for full networks.

dfno: Model parallel (MPI model decomposition) implementation of Fourier Neural Operators for PyTorch. Extension of distdl, a model parallel extension of PyTorch.

InvertibleNetworks.jl: Native Julia implementation of invertible networks for variational inference, generative models and normalizing flows.

Programming Languages

Python: Main programming language for the development of **Devito** and machine learning applications.

Julia: Heavy development of research software at Georgia Tech (**slimgroup**) in Julia

docker Developped and automatized the deployement of **Devito** and **JUDI** images through CI (github actions).

Knowledge of **C**, **Linux**, **Bash**, **PyTorch**, **Azure**, **Latex**, **Markdown**, **Matlab**, **MPI**, **OPenMP**, **OpenACC**

HPC

Devito: Weak and strong scaling benchmarks of **Devito** on on-premise (Imperical college) and Cloud (Azure) hardware.

JUDI: Implementation and deployment at scale of **JUDI** on clusters and Azure Batch (up 300 nodes).

Optimum (2015-2018): Early PhD 50 nodes cluster. Development of parallel Matlab seismic inverse problem algorithms (FWI/RTM).

YEMOJA (2017-2018): Part of a collaboration with SENAI-CIMANTEC. Scaling of our Matlab and Julia framework to hundred of nodes.

Cloud (2018-): Serverless and clusterless framework for task parallel inverse problems on AWS and Azure.

Perlmutter (2022-): Scaling of MPI-parallel Fourier Neural Operator on Perlmutter (and previously Summit).

Education

2018–2020

PhD, Computer Science; Georgia Institute of Technology, Atlanta, GA

Thesis title: Modeling for inversion in exploration geophysics **Link**

Numerical and computational methods for large scale simulation based inverse problems and machine learning

2013–2018

PhD, Earth Science; University of British Columbia, Canada

Transfered to Georgia Institute of Technology in January 2018 following my supervior new position there.

2016 Feb-Aug

Visiting PhD, Computer Science; Impertial College London, UK

Automatic code generation for geophysical exploration applications with finite differences

2011–2013 **MSc, Applied Mathematics**; Universite de Rennes 1, Rennes, France

Valedictorian

Required coursework: Calculus, Numerical Methods, PDE Resolution, Opti- mization, C/C++ Computing, Mathematics Modeling and Simulation, Finite Element Method*

Elective coursework: Fluid Mechanics, Continuum Mechanics and Thermo- mechanics, Bio-mechanics, Geophysics Modeling*

2008–2011 **BSc, Aeronautical Engineering,** ENSICA-ISAE, Toulouse, France

Leading French Aeronautical Engineering School.

Required coursework: Mathematics, Mechanics, Continuum Mechanics, Structures Mechanics, Signal Processing, Thermodynamics, Fluid Mechanics, Java progamming*

Elective coursework: Estimation Methods, Earth Observation Satellites, Microwaves Processing*

2006–2008 **Classe Preparatoires**; Lycee Chateaubriand, Rennes, France

Advanced undergraduate preparatory program for national ranking entry exam.

Internships

Summer 2013 **Research internship**; ONERA, Toulouse, France

Scattering patterns of atmospheric dust clouds analysis with the Discrete Dipole Approximation (DDA) method.

Summer 2012 **Research internship**; INRIA, Grenoble, France

Intern in NANO-D department at INRIA-Grenoble. L2-SVM for protein interactions. Runtime and accuracy improvement of the C implementation and algorithmic development.

Summer 2011 **Internship, Aeroconseil**, Toulouse, France

Developed an interface for aerodynamics calculus in JAVA. Reading and implementation of Excel and Scilab scripts through the interface.

Additonal skills

- Languages:
  - French (native speaker)
  - English (Advanced, PhD in USA)

- Miscelanous CS:
  - Linux, Shell script, Latex, Markdown, Github, Unix, Matlab

Publications

Aguiar, M. de, Gorman, G., Herrmann, F. J., Kukreja, N., Lange, M., Louboutin, M., & Zacarias, F. V. (2016, November). DeVito: Fast finite difference computation. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SC/2016/deaguiar2016SCdff/deaguiar2016SCdff_poster.pdf

Bisbas, G., Luporini, F., Louboutin, M., Nelson, R., Gorman, G., & Kelly, P. H. J. (2021, May). Temporal blocking of finite-difference stencil operators with sparse "off-the-grid" sources. doi:**10.1109/IPDPS49936.2**

Erdinc, H. T., Gahlot, A. P., Louboutin, M., & Herrmann, F. J. (2023, March). *Enhancing CO2 leakage detectability via dataset augmentation*. Retrieved from https://slimgroup.github.io/IMAGE2023/DetectabilityWithVision/abstract.html

Erdinc, H. T., Gahlot, A. P., Yin, Z., Louboutin, M., & Herrmann, F. J. (2022a, November). De-risking carbon capture and sequestration with explainable CO_2 leakage detection in time-lapse seismic monitoring images. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/AAAI/2022/erdinc2022AAAIdcc/erdinc2022AAAIdcc.pdf

Erdinc, H. T., Gahlot, A. P., Yin, Z., Louboutin, M., & Herrmann, F. J. (2022b, November). De-risking GCS projects with explainable CO_2 leakage detection in time-lapse seismic images. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/erdinc2022ML4SEISMICdgp/index.html

Gahlot, A. P., Louboutin, M., & Herrmann, F. J. (2023, March). *Time-lapse seismic monitoring of geological carbon storage with the nonlinear joint recovery model*. Retrieved from https://slimgroup.github.io/IMAGE2023/NonLinear-JRM/abstract.html

Gorman, G., Aguiar, M. de, Ham, D., Herrmann, F. J., Kelly, P. H. J., Kukreja, N., … Zacarias, F. V. (2016). Open performance portablE SeismiC imaging-OPESCI. SINBAD. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2016/Fall/gorman2016SINBADFopp/gorman2016SINBADFopp.pdf

Herrmann, F. J., Gorman, G. J., Hückelheim, J., Lensink, K., Kelly, P. H. J., Kukreja, N., … Witte, P. A. (2018, August). The power of abstraction in computational exploration seismology.

Herrmann, F. J., Jones, C., Gorman, G., Hückelheim, J., Lensink, K., Kelly, P. H. J., … Witte, P. A. (2019, October). Accelerating ideation and innovation cheaply in the cloud the power of abstraction, collaboration and reproducibility.

Herrmann, F. J., Louboutin, M., II, T. J. G., Yin, Z., & Khan, R. (2023, February). The next step: Interoperable domain-specific programming. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SIAMCSE/2023/herrmann2023SIAMCSEtns/index.html

Herrmann, F. J., Louboutin, M., & Siahkoohi, A. (2021, March). ML@scale using randomized linear algebra.

Herrmann, F. J., Louboutin, M., Yin, Z., & Witte, P. A. (2021, October). Low-cost time-lapse seismic imaging of CCS with the joint recovery model.

Herrmann, F. J., Siahkoohi, A., Orozco, R., Rizzuti, G., Witte, P. A., & Louboutin, M. (2021, June). Learned wave-based imaging - variational inference at scale. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/Delft/2021/herrmann2021Delftlwi/herrmann2021Delftlwi.pdf

II, T. J. G., Khan, R., Louboutin, M., Yin, Z., Witte, P. A., Chandra, R., … Herrmann, F. J. (2022a, April). *Model-parallel fourier neural operators as learned surrogates for large-scale parametric PDEs*. Retrieved from https://slim.gatech.edu/Publications/Public/Submitted/2022/grady2022SCtll/grady2022SCtll.pdf

II, T. J. G., Khan, R., Louboutin, M., Yin, Z., Witte, P. A., Chandra, R., … Herrmann, F. J. (2022b, November). Effective scaling of numerical surrogates via domain-decomposed fourier neural operators. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/grady2022ML4SEISMICesn/index.html

Kukreja, N., Hückelheim, J., Louboutin, M., Hovland, P., & Gorman, G. (2019). Combining checkpointing and data compression to accelerate adjoint-based optimization problems. *Euro-Par 2019: Parallel Processing*, 87–100. doi:**10.1007/978-3-030-29400-7_7**

Kukreja, N., Hueckelheim, J., Louboutin, M., Washbourne, J., Kelly, P. H. J., & Gorman, G. J. (2022). Lossy checkpoint compression in full waveform inversion. *Geoscientific Model Development*, *15*(9), 3815–3829. doi:**10.5194/gmd-15-3815-2022**

Kukreja, N., Lange, M., Louboutin, M., Luporini, F., & Gorman, G. (2017). Devito: Symbolic math for automated fast finite difference computations. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SIAM/2017/kukreja2017SIAMdsm/kukreja2017SIAMdsm_pres.mov

Kukreja, N., Louboutin, M., Lange, M., Luporini, F., & Gorman, G. (2017, March). Leveraging symbolic math for rapid development of applications for seismic modeling. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/OGHPC/2017/kukreja2016OGHPClsm/kukreja2016OGHPClsm.pdf

Kukreja, N., Louboutin, M., Zacarias, F. V., Luporini, F., Lange, M., & Gorman, G. (2016, November). Devito: Automated fast finite difference computation. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SC/2016/WOLFHPC/kukreja2016WOLFHPCdaf/kukreja2016WOLFHPCdaf.pdf

Lange, M., Kukreja, N., Louboutin, M., Luporini, F., Zacarias, F. V., Pandolfo, V., … Gorman, G. (2016, November). Devito: Towards a generic finite difference DSL using symbolic python. doi:**10.1109/PyHPC.2016**

Lange, M., Kukreja, N., Luporini, F., Louboutin, M., Yount, C., Hückelheim, J., & Gorman, G. (2017, July). Optimised finite difference computation from symbolic equations. Retrieved from http://conference.scipy.org/proceedings/scipy2017/michael_lange.html

Louboutin, M. (2020, March). *Modeling for inversion in exploration geophysics* (phd). Georgia Institute of Technology, Atlanta. Retrieved from https://slim.gatech.edu/Publications/Public/Thesis/2020/louboutin2020THmfi/louboutin2020THmfi.pdf

Louboutin, M. (2021, November). ML4Seismic open source software environment. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2021/louboutin2021ML4SEISMICmos/Mon-10-10-Louboutin.pdf

Louboutin, M., Gorman, G., & Herrmann, F. J. (2016). *Optimizing the computational performance and maintainability of time-domain modelling-leveraging multiple right-hand-sides* (No. TR-EOAS-

2016-2). UBC. Retrieved from https://slim.gatech.edu/Publications/Public/TechReport/2016/louboutin2016SEGocp/louboutin2016SEGocp.html

Louboutin, M., Gorman, G., & Herrmann, F. J. (2017). *Optimizing the computational performance of time-domain modelling-leveraging multiple right-hand-sides* (No. TR-EOAS-2017-2). UBC. Retrieved from https://slim.gatech.edu/Publications/Public/TechReport/2017/louboutin2016OGHPCocp/louboutin2016OGHPCocp.pdf

Louboutin, M., Guasch, L., & Herrmann, F. J. (2017, June). Data normalization strategies for full-waveform inversion. doi:**10.3997/2214-4609.201700720**

Louboutin, M., & Herrmann, F. J. (2015a). Extending the search space of time-domain adjoint-state FWI w/ randomized implicit time shifts. SINBAD. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2015/Fall/louboutin2015SINBADFess/louboutin2015SINBADFess.pdf

Louboutin, M., & Herrmann, F. J. (2015b, October). Time compressively sampled full-waveform inversion with stochastic optimization. doi:**10.1190/segam2015-5924937.1**

Louboutin, M., & Herrmann, F. J. (2016). High-performance seismic applications of OPESCI. SINBAD. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2016/Fall/louboutin2016SINBADFhps/louboutin2016SINBADFhps.pdf

Louboutin, M., & Herrmann, F. J. (2017a). Data driven gradient sampling for seismic inversion. SINBAD. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2017/Fall/louboutin2017SINBADFddg/louboutin2017SINBADFddg.pdf

Louboutin, M., & Herrmann, F. J. (2017b, June). Extending the search space of time-domain adjoint-state FWI with randomized implicit time shifts. doi:**10.3997/2214-4609.201700831**

Louboutin, M., & Herrmann, F. J. (2021a, September). Ultra-low memory seismic inversion with randomized trace estimation. doi:**10.1190/segam2021-3584072.1**

Louboutin, M., & Herrmann, F. J. (2021b, November). Randomized linear algebra for inversion. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2021/louboutin2021ML4SEISMICrla/Tue-10-20-Louboutin.pdf

Louboutin, M., & Herrmann, F. J. (2022a, June). Enabling wave-based inversion on GPUs with randomized trace estimation. doi:**10.3997/2214-4609.202210531**

Louboutin, M., & Herrmann, F. J. (2022b, September). Abstractions and algorithms for efficient seismic inversion on accelerators. Retrieved from https://www.imageevent.org/Workshop/next-fwi-derived-products

Louboutin, M., & Herrmann, F. J. (2023, March). *Wave-based inversion at scale on GPUs with randomized trace estimation*. Retrieved from https://slim.gatech.edu/Publications/Public/Submitted/2023/louboutin2023rte/paper.html

Louboutin, M., Kartha, Y., Orozco, R., & Herrmann, F. J. (2022, November). Learned extensions for wave-based simulation and inversion. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/louboutin2022ML4SEISMIClew/index.html

Louboutin, M., Lange, M., Herrmann, F. J., Kukreja, N., & Gorman, G. (2017). Performance prediction of finite-difference solvers for different computer architectures. *Computers & Geosciences*, *105*, 148–157. doi:https://doi.org/10.1016/j.cageo.2017.04.014

Louboutin, M., Lange, M., Kukreja, N., Luporini, F., Herrmann, F. J., & Gorman, G. (2017). Raising the abstraction to separate concerns: Enabling different physics for geophysical exploration. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SIAM/2017/louboutin2017SIAMras/louboutin2017SIAMras_pres.mov

Louboutin, M., Lange, M., Luporini, F., Kukreja, N., Witte, P. A., Herrmann, F. J., … Gorman, G. J. (2019). Devito (v3.1.0): An embedded domain-specific language for finite differences and geophysical exploration. *Geoscientific Model Development*. doi:**10.5194/gmd-12-1165-2019**

Louboutin, M., Lange, M., Luporini, F., Kurjeka, N., Hueckelheim, J., Gorman, G., … Herrmann, F. J. (2017). Latest developments in devito. SINBAD. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2017/Fall/louboutin2017SINBADFldi/louboutin2017SINBADFldi.pdf

Louboutin, M., Luporini, F., Witte, P. A., Nelson, R., Bisbas, G., Thorbecke, J., … Gorman, G. (2020). *Scaling through abstractions high-performance vectorial wave simulations for seismic inversion with devito* (No. TR-CSE-2020-3). Georgia Institute of Technology. Retrieved from https://slim.gatech.edu/Publications/Public/TechReport/2020/louboutin2020SCsta/louboutin2020SCsta.html

Louboutin, M., Orozco, R., Siahkoohi, A., & Herrmann, F. J. (2023, March). *Learned non-linear simultenous source and corresponding supershot for seismic imaging.* Retrieved from https://slimgroup.github.io/IMAGE2023/OneShot/abstract.html

Louboutin, M., Peters, B., Smithyman, B. R., & Herrmann, F. J. (2015). Regularizing waveform inversion by projections onto convex sets.

Louboutin, M., Rizzuti, G., & Herrmann, F. J. (2020a). *Time-domain wavefield reconstruction inversion in a TTI medium* (No. TR-CSE-2020-1). Georgia Institute of Technology. Retrieved from https://slim.gatech.edu/Publications/Public/TechReport/2020/louboutin2020SEGtwri/louboutin2020SEGtwri.html

Louboutin, M., Rizzuti, G., & Herrmann, F. J. (2020b, October). Time-domain wavefield reconstruction inversion in tilted transverse isostropic media. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SIAMTXLA/2020/louboutin2020SIAMTXLAtdw/louboutin2020SIAMTXLAtdw_pres.pdf

Louboutin, M., Siahkoohi, A., Wang, R., & Herrmann, F. J. (2021). *Low-memory stochastic backpropagation with multi-channel randomized trace estimation* (No. TR-CSE-2021-1). Retrieved from https://slim.gatech.edu/Publications/Public/TechReport/2021/louboutin2021NIPSmcte/louboutin2021NIPSmcte.pdf

Louboutin, M., Siahkoohi, A., Yin, Z., Orozco, R., II, T. J. G., Zhang, Y., … Herrmann, F. J. (2022, March). Abstractions for at-scale seismic inversion. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/RHPC/2022/louboutin2022RHPCafa/RiceHPC22.pdf

Louboutin, M., Witte, P. A., & Herrmann, F. J. (2018, October). Effects of wrong adjoints for RTM in TTI media. doi:**10.1190/segam2018-2996274.1**

Louboutin, M., Witte, P. A., Lange, M., Kukreja, N., Luporini, F., Gorman, G., & Herrmann, F. J. (2017). Full-waveform inversion - part 1: Forward modeling. *The Leading Edge*, *36*(12), 1033–1036. doi:**10.1190/tle36121033.1**

Louboutin, M., Witte, P. A., Lange, M., Kukreja, N., Luporini, F., Gorman, G., & Herrmann, F. J. (2018). Full-waveform inversion - part 2: Adjoint modeling. *The Leading Edge*, *37*(1), 69–72. doi:**10.1190/tle37010069.1**

Louboutin, M., Witte, P. A., Siahkoohi, A., Rizzuti, G., Yin, Z., Orozco, R., & Herrmann, F. J. (2022, May). Accelerating innovation with software abstractions for scalable computational geophysics. doi:**10.1190/image2022-3750561.1**

Louboutin, M., Yin, Z., Orozco, R., II, T. J. G., & Herrmann, F. J. (2022, November). ML4Seismic open-source software: Updates and developments. Retrieved from `https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/louboutin2022ML4SEISMICmos/index.html`

Louboutin, M., Yin, Z., Orozco, R., II, T. J. G., Siahkoohi, A., Rizzuti, G., … Herrmann, F. J. (2023, April). *Learned multiphysics inversion with differentiable programming and machine learning*. Retrieved from `https://slim.gatech.edu/Publications/Public/Submitted/2023/louboutin2023lmi/le_software.html`

Louboutin, M., Yin, Z., Zhang, Y., & Herrmann, F. J. (2020, October). Sparsity promoting least-squares migration for long offset sparse OBN.

Luporini, F., Louboutin, M., Lange, M., Kukreja, N., Witte, P. A., Hückelheim, J., … Gorman, G. J. (2020). Architecture and performance of devito, a system for automated stencil computation. *ACM Trans. Math. Softw.*, *46*(1). doi:**10.1145/3374916**

Orozco, R., Louboutin, M., & Herrmann, F. J. (2022a). *Memory efficient invertible neural networks for 3D photoacoustic imaging* (No. TR-CSE-2022-2). Retrieved from `https://slim.gatech.edu/Publications/Public/TechReport/2022/orozco2022MIDLmei/midl_2022.html`

Orozco, R., Louboutin, M., & Herrmann, F. J. (2022b, November). Normalizing flows for regularization of 3D seismic inverse problems. Retrieved from `https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/orozco2022ML4SEISMICnfr/index.html`

Orozco, R., Louboutin, M., & Herrmann, F. J. (2023a, March). *Amortized bayesian full waveform inversion and experimental design with normalizing flows*. Retrieved from `https://slimgroup.github.io/IMAGE2023/BayesianFWI/abstract.html`

Orozco, R., Louboutin, M., & Herrmann, F. J. (2023b, March). *Generative seismic kriging with normalizing flows*. Retrieved from `https://slimgroup.github.io/IMAGE2023/BayesianKrig/abstract.html`

Orozco, R., Louboutin, M., Siahkoohi, A., Rizzuti, G., & Herrmann, F. J. (2022, November). Adjoint operators as summary functions in amortized bayesian inference frameworks. Retrieved from `https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/orozco2022ML4SEISMICaos/index.html`

Orozco, R., Louboutin, M., Siahkoohi, A., Rizzuti, G., Leeuwen, T. van, & Herrmann, F. J. (2023, July). Amortized normalizing flows for transcranial ultrasound with uncertainty quantification. Retrieved from `https://slim.gatech.edu/Publications/Public/Conferences/MIDL/2023/orozco2023MIDLanf/paper.pdf`

Peters, B., Smithyman, B. R., Louboutin, M., & Herrmann, F. J. (2015). Regularizing waveform inversion by projections onto intersections of convex sets. SINBAD. Retrieved from `https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2015/Fall/peters2015SINBADFrwi/peters2015SINBADFrwi.pdf`

Ren, Y., Witte, P. A., Siahkoohi, A., Louboutin, M., Yin, Z., & Herrmann, F. J. (2021, December). Seismic velocity inversion and uncertainty quantification using conditional normalizing flows. Retrieved from https://agu.confex.com/agu/fm21/meetingapp.cgi/Paper/815883

Rizzuti, G., Louboutin, M., Wang, R., Daskalakis, E., & Herrmann, F. J. (2019a, March). A dual formulation for time-domain wavefield reconstruction inversion.

Rizzuti, G., Louboutin, M., Wang, R., Daskalakis, E., & Herrmann, F. J. (2019b, September). A dual formulation for time-domain wavefield reconstruction inversion. doi:**10.1190/segam2019-3216760.1**

Rizzuti, G., Louboutin, M., Wang, R., & Herrmann, F. J. (2020, January). Time-domain wavefield reconstruction inversion for large-scale seismics. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/EAGE/2020/rizzuti2020EAGEtwri/rizzuti2020EAGEtwri.html

Rizzuti, G., Louboutin, M., Wang, R., & Herrmann, F. J. (2021a). A dual formulation of wavefield reconstruction inversion for large-scale seismic inversion. *Geophysics*, *86*(6), 1ND–Z3. doi:**10.1190/geo2020-07**

Rizzuti, G., Louboutin, M., Wang, R., & Herrmann, F. J. (2021b, June). Time-domain wavefield reconstruction inversion for large-scale seismic inversion. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SIAMGS/2021/rizzuti2021SIAMGSwrid/rizzuti2021SIAMGSwrid.pdf

Rizzuti, G., Louboutin, M., Wang, R., & Herrmann, F. J. (2021c, November). A dual formulation of wavefield reconstruction inversion for large-scale seismic inversion. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2021/rizzuti2021ML4SEISMICdfw/Tue-10-55-Rizzuti.pdf

Sharan, S., Kumar, R., Dumani, D. S., Louboutin, M., Wang, R., Emelianov, S., & Herrmann, F. J. (2018, October). Sparsity-promoting photoacoustic imaging with source estimation. doi:**10.1109/ULTSYM.2018.8580037**

Siahkoohi, A., Louboutin, M., & Herrmann, F. J. (2019a). *Neural network augmented wave-equation simulation* (No. TR-CSE-2019-1). Georgia Institute of Technology. Retrieved from https://slim.gatech.edu/Publications/Public/TechReport/2019/siahkoohi2019TRnna/siahkoohi2019TRnna.html

Siahkoohi, A., Louboutin, M., & Herrmann, F. J. (2019b). The importance of transfer learning in seismic modeling and imaging. *Geophysics*. doi:**10.1190/geo2019-0056.1**

Siahkoohi, A., Louboutin, M., & Herrmann, F. J. (2022, May). Velocity continuation with fourier neural operators for accelerated uncertainty quantification. doi:**10.1190/image2022-3750475.1**

Siahkoohi, A., Louboutin, M., Kumar, R., & Herrmann, F. J. (2018, October). Deep convolutional neural networks in prestack seismic-two exploratory examples. doi:**10.1190/segam2018-2998599.1**

Siahkoohi, A., Orozco, R., Rizzuti, G., Witte, P. A., Louboutin, M., & Herrmann, F. J. (2021a, September). Fast and reliability-aware seismic imaging with conditional normalizing flows. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/KAUST/2021/siahkoohi2021EarthMLfar/siahkoohi2021EarthMLfar.pdf

Siahkoohi, A., Orozco, R., Rizzuti, G., Witte, P. A., Louboutin, M., & Herrmann, F. J. (2021b, November). Multifidelity conditional normalizing flows for physics-guided bayesian inference. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2021/siahkoohi2021ML4SEISMICmcn/Mon-11-45-Siahkoohi.pdf

Siahkoohi, A., Rizzuti, G., Louboutin, M., & Herrmann, F. J. (2020, October). Unsupervised data-guided uncertainty analysis in imaging and horizon tracking. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SIAMTXLA/2020/siahkoohi2020SIAMTXLAudg/siahkoohi2020SIAMTXLAudg_pres.pdf

Siahkoohi, A., Rizzuti, G., Louboutin, M., Witte, P. A., & Herrmann, F. J. (2021a, January). Preconditioned training of normalizing flows for variational inference in inverse problems. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/AABI/2021/siahkoohi2021AABIpto/siahkoohi2020ABIfab.html

Siahkoohi, A., Rizzuti, G., Louboutin, M., Witte, P. A., & Herrmann, F. J. (2021b, March). Deep bayesian inference for task-based seismic imaging.

Siahkoohi, A., Witte, P. A., Louboutin, M., Herrmann, F. J., & Rizzuti, G. (2020, July). Seismic imaging with uncertainty quantification: Sampling from the posterior with generative networks. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SIAMIS/2020/siahkoohi2020SIAMISsiu/siahkoohi2020SIAMISsiu_pres.pdf

Siahkoohi, A., Yin, Z., Louboutin, M., & Herrmann, F. J. (2022, November). Amortized velocity continuation with fourier neural operators. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/yin2022ML4SEISMICavc/index.html

Silva, C. D., Wason, H., Louboutin, M., Peters, B., Sharan, S., Fang, Z., & Herrmann, F. J. (2015). Scaling SINBAD software to 3-d on yemoja. SINBAD. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2015/Fall/dasilva2015SINBADFsss/dasilva2015SINBADFsss.pdf

Wang, R., Louboutin, M., Peters, B., Daskalakis, E., & Herrmann, F. J. (2017). Noise robust and time-domain formulations of wavefield reconstruction inversion. SINBAD. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2017/Fall/wang2017SINBADFnra/wang2017SINBADFnra.pdf

Witte, P. A., Louboutin, M., Gorman, G., & Herrmann, F. J. (2017). *A large-scale time-domain seismic modeling and inversion workflow in julia* (No. TR-EOAS-2017-1). UBC. Retrieved from https://slim.gatech.edu/Publications/Public/TechReport/2017/witte2016OGHPClst/witte2016OGHPClst.pdf

Witte, P. A., Louboutin, M., & Herrmann, F. J. (2015a). *Overview on anisotropic modeling and inversion* (No. TR-EOAS-2015-6). UBC. Retrieved from https://slim.gatech.edu/Publications/Public/TechReport/2015/witte2015TRoam/witte2015TRoam.html

Witte, P. A., Louboutin, M., & Herrmann, F. J. (2015b). Time-domain FWI in TTI media.

Witte, P. A., Louboutin, M., & Herrmann, F. J. (2017a). A large-scale framework in julia for fast prototyping of seismic inversion algorithms. SINBAD. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SINBAD/2017/Fall/witte2017SINBADFals/witte2017SINBADFals.pdf

Witte, P. A., Louboutin, M., & Herrmann, F. J. (2017b). Large-scale workflows for wave-equation based inversion in julia. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/SIAM/2017/witte2017SIAMlsw/witte2017SIAMlsw_pres.mov

Witte, P. A., Louboutin, M., & Herrmann, F. J. (2019). Domain-specific abstractions for large-scale geophysical inverse problems. Retrieved from https://slim.gatech.edu/Publications/Public/Lectures/HotCSE/2019/witte2019HOTCSEdsagip/witte2019HOTCSEdsagip.pdf

Witte, P. A., Louboutin, M., Jones, C., & Herrmann, F. J. (2020, March). Serverless seismic imaging in the cloud. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/RHPC/2019/witte2019RHPCssi/witte2019RHPCssi.html

Witte, P. A., Louboutin, M., Kukreja, N., Luporini, F., Lange, M., Gorman, G. J., & Herrmann, F. J. (2019a). A large-scale framework for symbolic implementations of seismic inversion algorithms in julia. *Geophysics*, *84*(3), F57–F71. doi:**10.1190/geo2018-0174.1**

Witte, P. A., Louboutin, M., Kukreja, N., Luporini, F., Lange, M., Gorman, G. J., & Herrmann, F. J. (2019b). Geophysics bright spots: Efficient coding of large-scale seismic inversion algorithms. *The Leading Edge*, *38*(6), 482–484. doi:**10.1190/tle38060482.1**

Witte, P. A., Louboutin, M., Lensink, K., Lange, M., Kukreja, N., Luporini, F., … Herrmann, F. J. (2018). Full-waveform inversion - part 3: optimization. *The Leading Edge*, *37*(2), 142–145. doi:**10.1190/tle37020142.1**

Witte, P. A., Louboutin, M., Luporini, F., Gorman, G. J., & Herrmann, F. J. (2019a). Compressive least-squares migration with on-the-fly fourier transforms. *Geophysics*, *84*(5), R655–R672. doi:**10.1190/geo2018-0490.1**

Witte, P. A., Louboutin, M., Luporini, F., Gorman, G. J., & Herrmann, F. J. (2019b, March). Compressive least squares migration with on-the-fly fourier transforms.

Witte, P. A., Louboutin, M., Modzelewski, H., Jones, C., Selvage, J., & Herrmann, F. J. (2019, September). Event-driven workflows for large-scale seismic imaging in the cloud. doi:**10.1190/segam2019-3215069.1**

Witte, P. A., Louboutin, M., Modzelewski, H., Jones, C., Selvage, J., & Herrmann, F. J. (2020). An event-driven approach to serverless seismic imaging in the cloud. *IEEE Transactions on Parallel and Distributed Systems*, *31*(9), 2032–2049. doi:**10.1109/TPDS.2020.2982626**

Witte, P. A., Louboutin, M., Siahkoohi, A., Rizzuti, G., Peters, B., & Herrmann, F. J. (2021, July). InvertibleNetworks.jl - memory efficient deep learning in julia. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/JuliaCon/2021/witte2021JULIACONmedlj/witte2021JULIACONmedlj.pdf

Witte, P. A., Tu, N., Esser, E., Yang, M., Louboutin, M., & Herrmann, F. J. (2015). Sparsity-promoting least-square migration with linearized bregman and compressive sensing.

Yin, Z., Erdinc, H. T., Gahlot, A. P., Louboutin, M., & Herrmann, F. J. (2022, November). Simulation-based framework for geological carbon storage monitoring. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/yin2022ML4SEISMICsfg/index.html

Yin, Z., Erdinc, H. T., Gahlot, A. P., Louboutin, M., & Herrmann, F. J. (2023). Derisking geological carbon storage from high-resolution time-lapse seismic to explainable leakage detection. *The Leading Edge*, *42*(1), 6976. doi:**10.1190/tle42010069.1**

Yin, Z., Louboutin, M., & Herrmann, F. J. (2021a, September). Compressive time-lapse seismic monitoring of carbon storage and sequestration with the joint recovery model. doi:**10.1190/segam2021-3569087.1**

Yin, Z., Louboutin, M., & Herrmann, F. J. (2021b, November). Improved seismic monitoring of CO2 sequestration with the weighted joint recovery model. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2021/yin2021ML4SEISMICism/Tue-11-20-Yin.html

Yin, Z., Louboutin, M., Møyner, O., & Herrmann, F. J. (2023, March). *Coupled physics inversion for geological carbon storage monitoring*. Retrieved from https://slimgroup.github.io/IMAGE2023/yin2023IMAGEend2end/abstract.html

Yin, Z., Louboutin, M., Witte, P. A., Siahkoohi, A., Rizzuti, G., Orozco, R., … Herrmann, F. J. (2022, April). Julia for geoscience. Retrieved from https://transform.softwareunderground.org/2022-julia-for-geoscience

Yin, Z., Orozco, R., Louboutin, M., Siahkoohi, A., & Herrmann, F. J. (2023, June). Uncertainty-aware time-lapse monitoring of geological carbon storage with learned surrogates.

Yin, Z., Orozco, R., Siahkoohi, A., Louboutin, M., & Herrmann, F. J. (2022, November). Uncertainty-aware time-lapse CO_2 monitoring with learned end-to-end inversion. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/yin2022ML4SEISMICutc/index.html

Yin, Z., Orozco, R., Witte, P. A., Louboutin, M., Rizzuti, G., & Herrmann, F. J. (2020, September). Extended source imaging - a unifying framework for seismic and medical imaging. doi:**10.1190/segam2020-3426**

Yin, Z., Siahkoohi, A., Louboutin, M., & Herrmann, F. J. (2022, May). Learned coupled inversion for carbon sequestration monitoring and forecasting with fourier neural operators. doi:**10.1190/image2022-3722848.1**

Yu, T., Orozco, R., Yin, Z., Louboutin, M., & Herrmann, F. J. (2023, March). *Monitoring subsurface CO2 plumes with sequential bayesian inference*. Retrieved from https://slimgroup.github.io/IMAGE2023/SequentialBayes/abstract.html

Zhang, Y., Louboutin, M., Siahkoohi, A., Yin, Z., Kumar, R., & Herrmann, F. J. (2022, May). A simulation-free seismic survey design by maximizing the spectral gap. doi:**10.1190/image2022-3751690.1**

Zhang, Y., Louboutin, M., Siahkoohi, A., Yin, Z., Kumar, R., Lopez, O., & Herrmann, F. J. (2022, November). Time-lapse seismic survey design by maximizing the spectral gap. Retrieved from https://slim.gatech.edu/Publications/Public/Conferences/ML4SEISMIC/2022/zhang2022ML4SEISMICtss/index.html

Zhang, Y., Yin, Z., Lopez, O., Siahkoohi, A., Louboutin, M., & Herrmann, F. J. (2023, March). *3D seismic survey design by maximizing the spectral gap*. Retrieved from https://slimgroup.github.io/IMAGE2023/zhang2023IMAGEsg/abstract.html

Zhang, Y., Yin, Z., Lopez, O., Siahkoohi, A., Louboutin, M., Kumar, R., & Herrmann, F. J. (2023). Optimized time-lapse acquisition design via spectral gap ratio minimization. *Geophysics*. Retrieved from https://slim.gatech.edu/Publications/Public/Submitted/2023/zhang2023otl/Spectral_Gap_Paper.html