MATHEW HU

mathewhu@utexas.edu | (646)-393-7803 | www.linkedin.com/in/mathew-hu/

EDUCATION

The University of Texas at Austin, *Oden Institute for Computational Engineering & Sciences* — Austin, TX, USA
Ph.D., Computational Science, Engineering, and Mathematics, *GPA: 4.0/4.0* — Aug. 2019 - May 2025 (Expected)
Dissertation: Fast approximations of high-rank Hessians: Applications to seismic inversion and uncertainty quantification

New York University, *Courant Institute of Mathematical Sciences* — New York, NY, USA
Master of Science, Mathematics, *GPA: 4.0/4.0* — Aug. 2017 - May 2019

Fudan University, *School of Mathematical Sciences* — Shanghai, China
Bachelor of Science, Mathematics and Applied Mathematics, *GPA: 3.77/4.0* — Sept. 2013 - June 2017

INDUSTRY RESEARCH EXPERIENCE

TotalEnergies E&P USA, Inc. — Houston, TX, USA
Research Geophysicist Intern — May 2023 - Aug. 2023

- Developed **explainable deep learning** models to accelerate seismic inversion and seismic **data processing**.
- Designed and implemented a **neural network architecture** in **PyTorch** to approximate the second derivative (Hessian) for seismic inversion, overcoming traditional challenges in approximating this complex operator.
- Implemented **large-scale** preconditioned quasi-**Newton methods**, reducing seismic inversion time by 40%.
- Collaborated with a multidisciplinary team to interpret computational results using geoscience knowledge.
- Presented research findings to diverse audiences, clearly communicating complex concepts and fostering collaboration.

ACADEMIA RESEARCH EXPERIENCE

The University of Texas at Austin, *Oden Institute, OPTIMUS Lab* — Austin, TX, USA
Preconditioning, Optimization, and Uncertainty Quantification in Seismic Imaging — Dec. 2019 - Present

- Developed innovative **preconditioning algorithms** for seismic inversions, enhancing computational efficiency.
- Improved large-scale **optimization algorithms** (L-BFGS and inexact Newton-CG) by integrating novel preconditioners, reducing computation time by 50% and greatly enhancing imaging fidelity.
- Enhanced **MCMC** methods for **UQ** in seismic imaging within a **Bayesian inference** framework, generating 10x more effective samples and enabling more reliable **data interpretation** with deeper insights into subsurface structures.
- Executed large-scale acoustic wavefield **simulations** on the Frontera supercomputer using **HPC** tools.
- Developed and maintained **Python** and **Julia** codebases, ensuring robust and efficient computational tools.

New York University, *Courant Institute, Magneto-Fluid Dynamics Division* — New York, NY, USA
High-Order Computational Method for Magnetic Surfaces of Toroidal Fusion Devices — Feb. 2018 - May 2019

- Developed an efficient grid-based method in **MATLAB** to compute magnetic flux surfaces from discrete field data.
- Theoretically demonstrated spectral convergence for integrable magnetic fields.

COMPUTING SKILLS

Programming Languages:	Python, Julia, MATLAB, R, SQL, C++, PHP
Packages & Tools:	PyTorch, TensorFlow, Keras, AutoKeras, scikit-learn, SciPy, Pandas, OpenMP, MPI

AWARDS AND HONORS

- First Prize, National College Mathematics Contest (Shanghai Division), Nov. 2014, Nov. 2013
- First Prize, Chinese Mathematical Olympiad in Senior (Top 40 in Zhejiang, population 54.6 million), Oct. 2011
- First Prize, Chinese Southeast Mathematical Olympiad (Only Perfect Score, competing among students from southeastern China, population 370 million), Aug. 2011

RECENT CONFERENCE TALKS

- "Fast approximations of high-rank Hessians: Applications to seismic inversion and uncertainty quantification", *The International Meeting for Applied Geoscience & Energy (IMAGE)*. Houston, Texas, USA. Aug. 30, 2024.
- "Fast approximation of high-rank Hessians to accelerate MCMC for Bayesian seismic inversion", *SIAM Conference on Uncertainty Quantification*. Atlanta, Georgia, USA. April 12, 2022.