

SHREYAS SUNIL GAIKWAD

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EDUCATION

University of Texas at Austin

Ph.D. in Computational Science, Engineering, and Mathematics (CSEM), GPA: 4.0/4.0 2020–2025

M.S. in Computational Science, Engineering, and Mathematics (CSEM), GPA: 4.0/4.0 2019–2021

Indian Institute of Technology (IIT) Bombay, India

B.Tech with Honors in Mechanical Engineering (Minor in Computer Science), Rank: 4/150, GPA: 9.32/10.0 2015–2019

WORK EXPERIENCE

Graduate Research Assistant, UT Austin

2020–Present

Ph.D. Thesis: Reconstructing Holocene Ice Sheet Dynamics over Greenland via Bayesian Inversion

- Developed a scalable **Bayesian inversion** framework for the Fortran-based ice sheet model SICOPOLIS using open-source **Algorithmic Differentiation (AD)** tools for efficient gradient computation [I][3]
- Solving high-dimensional inverse problems governed by partial differential equations (PDEs), estimating $\mathcal{O}(10^6)$ uncertain boundary conditions, initial states, and model parameters in a continental-scale ice sheet model
- Reduced sensitivity analysis cost from $\mathcal{O}(N^3)$ to $\mathcal{O}(1)$ model evaluations using adjoint-based gradients
- Developed a novel interpretation technique for neural networks using physics-informed adjoints and **eXplainable-AI (XAI)** methods in **Keras** to validate deep learning insights against physically consistent adjoint sensitivities [1]

Machine Learning Intern, Ansys Inc.

Summer 2024

- Built a unified **Neural Radiance Field (NeRF)** architecture to implicitly represent multiple, diverse object geometries
- Developed a scalable **GenAI** pipeline for image-to-3D synthesis in **PyTorch** (**106 million parameters**), combining the unified NeRF architecture with a pre-trained, 3D-aware, **multi-view 2D diffusion model** for 3D asset generation
- Trained the NeRF without 3D data using 3D-aware diffusion priors and **Score Distillation Sampling (SDS)** loss

Visiting Scholar, Argonne National Laboratory

Summer 2022

- Developed the **first open-source, MPI-parallel, AD-based** Bayesian optimization framework for atmospheric and ocean circulation model MITgcm, an alternative to a proprietary tool costing \sim **\\$15,000/year per user** [I][2]

RESEARCH PROJECTS

Machine Learning Applications in Geophysics

Spring 2021

- Developed CNNs & U-Nets in **Keras** for earthquake (**96% accuracy**) & seismic fault (**97% accuracy**) detection
- Applied variational autoencoders for subsurface rock classification via latent-space clustering

Physics-Informed Machine Learning

Spring 2021

- Trained a deep neural network in **PyTorch** to emulate and assimilate a nonlinear PDE-based mountain glacier model leveraging higher-order derivatives from PyTorch’s computational graph

Laplacian 2D Finite Difference (FD) Solver Application

Fall 2020

- Features: OOP (**C++**); solvers (Gauss, Jacobi, PETSc); build (Autotools); testing (Bats, Travis CI, Docker); **98% coverage** (lcov); **0% memory errors** (Valgrind); HPC environment (SLURM); parsing & logging (GRVY)

OPEN-SOURCE CONTRIBUTIONS

I **MITgcm-AD v2**, open-source adjoint-based data assimilation framework for a general circulation model

II **SICOPOLIS-AD v2**, open-source adjoint-based data assimilation framework for an ice sheet model

TECHNICAL SKILLS

- **Languages:** Python (PyTorch, Keras, Tensorflow), Julia, C/C++, Fortran-77/90, MATLAB
- **HPC toolkit:** OpenMP, MPI, CUDA, SLURM, git, docker, shell scripts, CI, autotools, valgrind, lcov, GRVY

HONORS AND AWARDS

- Reviewer for the *Journal of Open Source Software (JOSS)* 2023–Present
- Invited talk at SIAM TX-LA: *Computational Science to Enable Digital Twins of the Oceans* 2023
- Recipient of the Peter O’Donnell Graduate **Fellowship (\\$48,000)** 2019
- Ranked 509/1,500,000 (**99.97 percentile**) in India’s national university entrance exam 2015

SELECT JOURNAL AND CONFERENCE ARTICLES

1. H. Pillar*, **S.S. Gaikwad*** et al., “Pairing eXplainable AI with Adjoint Modeling for Flexible Investigation and Robust Attribution of Ocean Variability”, *In preparation for Geophysical Research Letters* (2025).
2. **S.S. Gaikwad** et al., “MITgcm-AD v2: Open source tangent linear and adjoint modeling framework for the oceans and atmosphere enabled by the AD tool Tapenade”, *Future Generation Computer Systems* (2024).
3. **S.S. Gaikwad** et al., “SICOPOLIS-AD v2: tangent linear and adjoint modeling framework for ice sheet modeling enabled by automatic differentiation tool Tapenade”, *Journal of Open Source Software* (2023).

* Equal contributions to this manuscript.