THIVIN ANANDH

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🌐 thivinanandh.github.io | ⭘ Github | 🔗 Linkedin | G Google Scholar
📑 Stack Overflow | 📑 Scicomp Stack Exchange

OVERVIEW

PhD in computational and Datasciences from the Indian Institute of Science (IISc) Bangalore, specializing in Scientific Machine Learning (SciML), Finite Element Methods, and High Performance Computing (HPC). Passionate about developing efficient and scalable algorithms that combine modern ML techniques with HPC to solve complex problems in physics.

EXPERIENCE   TOTAL: 2 YEARS 5 MONTHS

- **Data Scientist**   Bangalore, India
  Zenteiq AI Tech   Oct 2024 - Present
  - Developing Action Models for Scientific ML for solving PDE's using PINNs and Neural Operators
- **Software Engineer**   Chennai, India
  Accenture India Pvt Ltd.   Jun 2015 - Jul 2017
  - Developed automated testing routines for financial products at First Data
  - Awarded: ACE Gold Standard Team award (Accenture's highest recognition); Exide Innovator Award (for automation initiative saving client $3K/annum)

EDUCATION

- **Ph.D. in Computational and Data Sciences |** Advisor: Prof. Sashikumaar Ganesan 🔗   CGPA: 8.0/10
  Indian Institute of Science, Bangalore, India   2018 - 2024
  - Thesis: "Improving hp-Variational Physics-Informed Neural Networks: A Tensor-driven Framework for Complex Geometries, and Singularly Perturbed and Fluid Flow Problems"
  - Worked on Industry Collaboration projects with ITC Research India (HPC), Shell Research India(SciML).
- **Bachelor of Engineering (Mechanical)**   GPA: 8.6/10
  Anna University, Chennai, India   2011 - 2015
  - Gold Medalist for overall best outgoing student (2011-2015 batch)

PUBLICATIONS

Journal Articles

- T. Anandh et. al, "Improving hp-Variational Physics-Informed Neural Networks for Steady-State Convection-Dominated Problems." *Computer Methods in Applied Mechanics and Engineering (CMAME), Accepted for Publication*, 2024 [📄 | ⭘ | 🔗]
- T. Anandh et. al, "FastVPINNs: Tensor-Driven Acceleration of VPINNs for Complex Geometries." *SIAM Journal on Scientific Computing (SIAM-SISC), Accepted for Publication*, 2024 [📄 | ⭘ | 🔗]
- T. Anandh et. al, "FastVPINNs: An efficient tensor-based Python library for solving partial differential equations using hp-Variational Physics Informed Neural Networks." *Journal of Open Source Software*, 2024 [📄 | ⭘ | 🔗]
- T. Anandh et. al, "An efficient hp-Variational Physics Informed Neural Network framework for Incompressible Navier-Stokes equations." *arXiv preprint*, 2024 [📄 | ⭘ | 🔗]
- S. M. Joshi, T. Anandh, B. Teja, S. Ganesan, "On the choice of hyper-parameters of artificial neural networks for stabilized finite element schemes." *International Journal of Advances in Engineering Sciences and Applied Mathematics*, 2021 [📄 | 🔗]
- S. Ganesan, D. Subramani, T. Anandh, D. Ghose, G. R. Babu, "Ensemble forecast of COVID-19 in Karnataka for vulnerability assessment and policy interventions." *medRxiv preprint*, 2021 [📄 | 🔗]

Conference Proceedings

- T. Anandh et. al, "Fast and Efficient hp-Variational PINNS framework for solving the Incompressible Navier-Stokes equations." *International Conference on Computational Fluid Dynamics (ICCFD-12), Kobe, Japan*, 2024 [📄]
- T. Anandh et. al, "GPU-Accelerated FEM-Based Lagrangian Particle Tracking Framework for Human Air Pathway." *ParCFD-2024, University Club Bonn, Germany*, 2024 [🔗]

- S. M. Joshi, T. Anandh, S. Ganesan, "A Deep Learning Simulation Framework for Building Digital Twins of Wind Farms: Concepts and Roadmap." *12th International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH-2022), Lisbon, Portugal*, 2024 [🔖 | 🔗]

Book Chapters

- S. Ganesan, B. Teja, T. Anandh, "Computational Ship Hydrodynamics: Modeling and Simulation." *Computational Science and its Applications, 1st edition, Taylor & Francis*, 2020 [🔖]

Skills

- **Programming Languages:** C, C++, Python
- **High Performance Computing:** MPI, OpenMP, CUDA, pympi, OpenACC
- **Machine Learning & AI:** TensorFlow, scikit-learn, flask, DeepXDE (PINNs), Jax
- **Scientific Computing:** deal.II, Gmsh, CMake, Paraview
- **MLOps:** Git, DVC, GitHub Actions, Docker, Kubernetes, Jenkins
- **Others:** HTML, CSS, Javascript, p5.js

Honors and Awards

- **Best Poster Award** - IGHASC, Heidelberg University, Germany   Oct 2024
  Presentation titled: Variational PINNs for Singularly Perturbed PDE's
- **Best Presentation Award (AI/ML Track)** - EECS, IISc   Feb 2024
  Presentation titled: FastVPINNs: Efficient hp-Variational PINNs for large scale simulations
- **Best Presentation Award (AI/ML Track)** - EECS, IISc   Feb 2023
  Presentation titled: Large Scale - AI Augmented simulations for wind farms, IISc, India
- **Gold Medalist - Best Outgoing Student** - KEC   Jul 2015

Projects

- **FastVPINNs: Fast and efficient hp-Variational Physics-Informed Neural Networks**   Github
  Skills: TensorFlow | CI/CD | Docker | SciML
  - * Developed a tensor-based computational framework achieving 100x speedup in training time for solving PDEs using hp-VPINNs
  - * Extended framework to handle complex geometries and inverse problems with superior performance over conventional PINNs

- **GPU-Accelerated Particle Tracking**   Github
  Skills: CUDA (GPU) | C++ | FEM | CFD; *Industry Collaboration Project*
  - * Developed GPU-accelerated FEM-based Lagrangian particle tracking framework for human airway simulations, achieving 100x speedup over sequential and 8x over OpenMP implementations
  - * Designed efficient zonal-based particle searching algorithms and optimized FEM data structures for GPU computation, reducing simulation time from days to hours

- **hp-VPINNs for Incompressible Navier-Stokes Equations**   Github
  Skills: TensorFlow | CFD | SciML; *In collaboration with Shell Research India Pvt Ltd.*
  - * Extended FastVPINNs framework for vector-valued PDEs, achieving successful solutions for Burgers and Incompressible Navier-Stokes equations
  - * Demonstrated framework's capability on solving benchmark problems like Falker-Skan, Flow past backward facing step and also in solving Inverse Problems

- **SUPG Stabilized VPINNs for Convection-Dominated Problems**   Github
  Skills: Tensorflow | SciML | FEM
  - * Incorporated SUPG stabilization technique for VPINNs to handle convection-dominated flows
  - * Achieved superior accuracy compared to standard PINNs for high Péclet number problems.

- **Contact Tracing Algorithm using OpenMP and CUDA**   Github
  Skills: CUDA | OpenMP | Parallel Computing
  - * Developed an asynchronous contact tracing system using hybrid OpenMP-CUDA implementation, achieving efficient parallel processing for large-scale contact networks
  - * Optimized performance through CUDA streams for overlapping computation with data transfers, and

indent: implemented parallel file I/O using OpenMP for reduced execution time

- **Digital Shadow Framework for Wind Farms**   Github ⊙
  Skills: DMD | PINNs; *In Collaboration with Shell Research India Pvt Ltd*
    * Developed a hybrid PINNs-DMD framework for real-time monitoring of wind farms using reduced-order models
    * Implemented edge-device compatible solution for efficient on-site deployment and monitoring

- **Asynchronous Mesh movement computations in GPU for ALE-FEM Framework**   Github ⊙
  Skills: CUDA | C++ | HPC; *Parallel Programming, Course Captsone Project*
    * Implemented asynchronous mesh movement computations in GPU using CUDA streams, overlapping computation with data transfers for improved performance
    * Optimized FEM data structure transfer between CPU-GPU using mapped memory and developed efficient CUDA kernels for cell parameter calculations

- **3D FEM-ALE Free Surface Flow Simulation**   Github ⊙
  C++ | ParMooN | ALE-FEM | CFD
    * Developed 3D ALE-FEM solver for free surface flows using the in-house FEM library ParMooN, incorporating pressure projection and mesh movement algorithms
    * Implemented mesh deformation techniques to handle curved surfaces and edge cases.

- **COVID-19 Ensemble Forecasting**   Github ⊙
  FEM | Statistics
    * Created ensemble forecast model with 972 scenarios for COVID-19 Wave-3 prediction in Karnataka, analyzing key factors like vaccination rates and behavioral compliance
    * Analyzed scenarios predicting Wave-3 emergence conditions, showing importance of parameters like vaccine rates that could prevent wave occurrence.

- **Uncertainty Quantification using DO Field Equations**   Github ⊙
  C++ | FEM | Monte Carlo | Stochastic Systems
    * Implemented DO field equations method for reduced-order uncertainty quantification in FEM.
    * Validated framework against Monte Carlo simulations for both linear and non-linear systems, demonstrating computational efficiency

Leadership & Organizational Experience

Conference Organizer - CASML 2024 IISc, Bangalore | Dec 2024   🔗
First scientific machine learning conference in India with 300+ participants

Lead Student Organizer - IGCM-2024 IISc, Bangalore | Mar 2023   🔗
Coordinated Indo-German conference on Computational mathematics with 100+ attendees

Speaker & Organizer - Kotak-IISc ML School IISc, Bangalore | Mar 2023   🔗
Organized and delivered ML training to 50+ non-CS faculty from Bangalore region

Lead Student Organizer - Parallel FEM Workshop IISc, Bangalore | Oct 2019 🔗
Coordinated workshop and taught parallel computing concepts to 100+ students

Speaker - NSM Workshop on PDE Methods IISER Trivandrum | Aug 2022   🔗
Delivered talks on Practical FEM and Parallel Implementation

Professional Certifications

- **Google**: TensorFlow Developer Certificate | Jan 2024   🔗
- **DeepLearning.AI**: TensorFlow Developer Professional Certificate | Dec 2023 🔗
- **NVIDIA Deep Learning Institute**: Deep Learning | Feb 2022   🔗
- **NVIDIA Deep Learning Institute**: Accelerating Data Engineering Pipelines | Feb 2022 🔗
- **University of Michigan**: The Finite Element Method for Problems in Physics | Jul 2020 🔗

Open Source Libraries

FastVPINNs   Github ⊙
Tensor-driven hp-Variational PINNs written in TensorFlow 2.0
    * Implemented comprehensive CI/CD pipelines using GitHub Actions and Docker containerization
    * Published as Python package on PyPI with over 3.2k downloads

ParMooN
C++ based Finite Element framework

* Developed CUDA-based GPU codes for asynchronous mesh displacement computations
* Implemented CUDA routines for Lagrangian particle tracking in complex geometries like human air pathway
* Contributed 4000+ lines of CUDA/C++ code to the library

TEACHING EXPERIENCE   10+ TASHIPS IN TOTAL

Led 10+ Teaching Assistantships where I have conducted lectures, tutorials, and responsible for creating course assessments (quizzes and assignments). For details, refer here.

Introduction to Data Science   Jan-2022
PG Course @ IISc, Bangalore [Online M.Tech]   Feedback: 4.9/5 🔗

* Python ML libraries, Linear algebra, Machine learning algorithms for 60+ participants

MLOps at Scale   Jan-2022
PG Course @ IISc, Bangalore [Online M.Tech]   Feedback: 4.4/5 🔗

* Parallel programming(OpenMP, MPI, CUDA), docker, Github Actions, distributed training with tf

Introduction to Computing for AI and ML   Jan-2023,Jan-2022
PG Course @ IISc, Bangalore [Online M.Tech]   Feedback: 4.5/5 🔗

* Computer Architecture, Calculus, Data Munging, Machine learning algorithms and Neural Networks

Introduction to Computing for AI and ML   Aug-2024, Jan-2023, Jun-203, Jan-2022
Center for continuing education @ IISc, Bangalore

* Python ML libraries, Machine Learning algorithms, Neural Networks, Github Actions

Finite Elements: Theory and Algorithms   Aug-2022
Offline PG Course at Indian Institute of Science

* FEM Algorithms, Implementation in C++

Numerical Methods   Sep-2021
Offline PG Course at Indian Institute of Science

* Taylor series, Polynomial fitting, Numerical differentiation, Numerical integration

VOLUNTEERING & SERVICE

Member, CDS Wellness Committee | Indian Institute of Science   2022 - 2023
NCC 'C' Certificate Holder | National Cadet Corps   2015
Rashtrapati Award (President Award) | Bharat Scouts and Guides   2009

EXTRACURRICULAR ACTIVITIES

Keyboard Player | Rhythmica Music Band, IISc   2020 - Present