Amal S. Sebastian

amalss18.github.io
Github Profile

Education

2023- **Ph.D.**
University of Michigan, Ann Arbor, Aerospace Engineering and Scientific Computing.

2022–2023 **Ph.D. (transferred to the University of Michigan)**
Carnegie Mellon University, Mechanical Engineering.

2017–2022 **Master of Technology and Bachelor of Technology**
Indian Institute of Technology Bombay, Aerospace Engineering, GPA – 9.29/10.
Minor in Computer Science and Engineering

Projects

Ongoing

2023 - Present **Self supervised pretraining for partial differential equations** .
- Built a vision transformer inspired PDE solver that generalizes in parameter space.
- Carried out large scale training across multiple GPUs using distributed training paradigms.
- Obtained 4x speedup by making use benchmarking and profiling to remove I/O bottlenecks from the dataloaders.
- Awarded NVIDIA Academic grant to scale up model and training.
- Working on encoding symmetries in the network for stronger theoretical guarantees.

2024 - Present **Neural ODE battery surrogate** .
- Built a battery surrogate using Neural ODEs to predict state of health for satellite batteries.
- Currently working on using this surrogate to find accelerate aging protocols through gradient based optimization.

Past projects

2022 - 2023 **Co-Administrator of the Arjuna Supercomputing Cluster** .
- Performed ongoing maintenance and improvements for the 23 GPU and 52 CPU nodes in the cluster
- Provide user support with setting up accounts, and issues surrounding the use of Slurm and Spack.

2021 - 2022 **Surface Tension Modelling in Smoothed Particle Hydrodynamics** .
- Implemented and reproduced results of six **standard surface tension** models in Smoothed Particle Hydrodynamics for an open-source SPH framework, **PySPH**.
- Tested the implemented models against a variety of **benchmark problems** to assess how they capture interfacial oscillations, their performance in high density ratio and high viscosity ratio simulations as well as their ability to capture complex interfacial dynamics for problems like Kelvin-Helmholtz instability, air bubbles rising in water.

2020	**Simulation of sloshing tanks, dam break using SPH** .
	○ Carried out simulations of rectangular sloshing tanks under horizontal and rotational excitations, and dam break problems with different obstacles. Compared computed results with experimental data from literature and close agreement between the two was obtained. Now used as benchmark tests in PySPH.
2019	**PySPH and Mayavi** .
	Worked on improving functionality and adding features to PySPH and Mayavi which are open source Python projects
	○ Developed code to generate uniform particle distribution and surface particle distribution of a STL object which can used for SPH simulations in PySPH
	○ Developed code to visualize STL objects along with their normals and allow for inversion of the normals using mouse interaction for Mayavi a 3D scientific data visualization toolkit

Technical skills

Languages	C, C++, Python, Julia
Tools	Git, Linux, PyTorch, JAX, MPI, OpenMP, Slurm, Spack, Bash

Awards, Scholarships and Achievements

2024	30,000 A100 GPU hours via the Nvidia academic compute grant.
2019	Inducted as a student member of the Indian National Academy of Engineering.
2015	Recipient of the prestigious National Talent Search Examination (NTSE) scholarship given by NCERT.

Publications

Preprint	Madhavan, V.*, **Sebastian, A. S.***, Ramsundar, B., & Viswanathan, V. (2024). Self-supervised pretraining for partial differential equations. arXiv. `https://doi.org/10.48550/arxiv.2407.06209`.
Published	Prabhu Ramachandran, Aditya Bhosale, Kunal Puri, Pawan Negi, Abhinav Muta, A. Dinesh, Dileep Menon, Rahul Govind, Suraj Sanka, **Amal S. Sebastian**, Ananyo Sen, Rohan Kaushik, Anshuman Kumar, Vikas Kurapati, Mrinalgouda Patil, Deep Tavker, Pankaj Pandey, Chandrashekhar Kaushik, Arkopal Dutt, and Arpit Agarwal. 2021. PySPH: A Python-based Framework for Smoothed Particle Hydrodynamics. *ACM Transactions on Mathematical Software*. *https://doi.org/10.1145/3460773*.

* - equal contribution

Teaching and Mentorship Experience

2022	Teaching Assistant: AE 779: Optimization for Engineering Design
2021	Teaching Assistant: AE 695: State space methods for flight vehicles
2020-2021	Coordinator - Department Academic Mentorship Program, Department of Aerospace Engineering, IIT Bombay
2019-2021	Department Academic Mentor