

Achu Shankar

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EDUCATION

University of Michigan Aug 2022 - Dec 2023
Master of Science in Aerospace engineering, specialisation in computational sciences

Indian Institute Of Technology Madras July 2016 – July 2021
Dual degree (B.Tech & M.Tech) in Aerospace engineering

RESEARCH Experience

Research Intern May 2023 – Aug 2023
Robert Bosch Centre for Data Science and Artificial Intelligence, IITM

- Worked on training techniques to train large neural network, particularly LLMs, for specific task
- Trained a custom T-5 and GPT-2 model on Stanford QA dataset using PEFT library with LORA technique
- Achieved 30% memory and computational improvement with comparable results to fine-tuning entire model

Graduate Student Research Assistant Aug 2022 – May 2023
CASLAB, UMICH

- Developed and integrated data-driven ROMs for efficient simulation of rocket combustor system behavior
- Enabled an increase in prediction speed up to 10 orders promising efficient simulation of complex systems
- Integrated adaptive ROMs based on proper orthogonal decomposition into inhouse solver PERFORM

Research Assistant Aug 2021 – Jul 2022
Geophysical Flows Lab, IITM

- Developed high-accuracy parallel Navier Stokes solver using Spectral Methods in python to simulate fluid flow
- Conducted Large Eddy Simulation (LES) of flow over an aircraft wing to analyze the interaction of tip vortices
- Designed and integrated an environmental sensor package into a hexacopter for studying the bay of Bengal

Undergraduate Research Assistant Aug 2019 – Jul 2021
Instabilities in Aircraft Wakes (Dual Degree Thesis), IITM

- Analysed shortwave instability mechanisms that affect vortices in wakes of fixed-wing aircraft
- Conducted study on analytical and numerically generated baseflows using local stability approach

Undergraduate Research Assistant Mar 2020 – June 2021
Entropically Damped Artificial Compressibility Solver, IITM

- Developed a high-order accurate finite difference incompressible fluid solver with EDAC approach
- Found significant speedup over traditional incompressible approaches for dynamically deforming grids

PUBLICATIONS

- **Achu Shankar**, and Nagabhushana Rao Vadlamani. "Entropically Damped Artificial Compressibility Solver Using Higher Order Finite Difference Schemes on Curvilinear and Deforming Meshes" AIAA SciTech 2022 Forum
- **Achu Shankar**; M S Manikandan; M G Bharath. "Three-dimensional, short-wavelength instabilities in idealized models of aircraft wake vortices" APS DFD 2021

PROFESSIONAL EXPERIENCE

Aircraft Design Engineer Intern

June 2020 – Sep 2020

The ePlane Company

- Facilitated design and development of a novel electric ducted propulsion system for VTOL UAVs
- Analyzed the interaction of vertical axis rotors on wings of VTOL UAVs in horizontal flight using CFD
- Demonstrated positive aerodynamic effects with proper placement of operational rotor during cruise

Software Developer

Jan 2018 – May 2018

Jivass

- Developed software system to control and monitor textile machines of *Microspin Machine Works*
- Developed browser-based GUI enabling easy access of the machines from anywhere in the world

TEACHING EXPERIENCE

Indian Institute of Technology Madras, Teaching Assistant

Aug 2020 – June 2021

AS5213: Design of MAVs and UAVs

- Assisted in the development of course curriculum; set questions for and organized online exams
- Organised weekly design reviews and conducted doubt clearing sessions

Indian Institute of Technology Madras, Teaching Assistant

Aug 2020 – Dec 2020

AS2100: Basic Aerospace Engineering Lab

- Assisted in the development of course curriculum; set questions for and organized online exams
- Formulated course project problem statements and guided students

OTHER TECHNICAL EXPERIENCES

Team Anveshak - IITM Mars Rover team

Team Lead

June 2018 - May 2019

- Led the team to victory at the Indian Rover Challenge and 12th at University Rover Challenge 2019
- Developed autonomous navigation software for GPS waypoint navigation and obstacle avoidance

Robotics club

July 2017 - May 2018

Coordinator

- Mentored 50+ teams for the Asian record of largest number of robots cleaning a specified area
- Organised numerous sessions on embedded systems, Robot Operating System, and basic electronics

SELECTED COURSEWORK

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| • Introduction to AI | • Numerical Linear Algebra | • Parallel computing |
| • Data Science and Predictive Analysis | • Numerical Methods and Scientific Computing | • High Performance Computing for Engineering Applications |
| • Inference Estimation and Learning | • Deep Learning | |

SKILLS

Languages : Python, C, C++, Fortran, CUDA, R, SQL

Frameworks and Libraries: Tensorflow, Pytorch, Spark, Numpy, Pandas, Sklearn, • OpenMP, MPI, Pft, GCP, Stable-Baseline3, OPENAI gym, Git, Linux

SELECTED COURSE PROJECTS

- Multi-Agent RL for Portfolio Mgmt. with Transformers** Aug 2023 – Dec 2023
EECS 592- Introduction to AI
- Integrated policy function modeling in a multi-agent portfolio framework using DDPG, PPO, and SAC methods
 - Incorporated customized multi-agent functionality into the FINRL framework utilizing transformers
 - Yielded performance comparable to state-of-the-art methods within the portfolio management domain
- Parallel SPH solver** Jan 2020 – June 2020
EECS 580 - Parallel Computing
- A mesh free CFD solver using smoothed particle hydrodynamics method written in python
 - Parallelized using MPI framework and capable of running on multiprocessor computing clusters
- Field Inversion and Machine learning** Jan 2023 – May 2023
AEROSP 623 - CFD II
- Developed efficient C++ code for Discrete Galerkin finite element CFD solver with adaptive mesh refinement
 - Utilized field inversion techniques and machine learning algorithms to accurately estimate model parameters of a gradient limiter, demonstrating proficiency in data analysis and mathematical modeling
- Inference Estimation & Learning** Aug 2022 – Dec 2022
AEROSP 567 - Inference Estimation & Learning
- Implemented and evaluated multilevel Monte Carlo, importance sampling, and rejection sampling methods
 - Applied Bayesian inference with GPR and EI algorithms to successfully predict the location of an object
 - Implemented Adaptive DRAM Metropolis algorithm for inference of stochastic PDE model parameters
 - Implemented Unscented Gauss-Hermite Kalman filters, and particle filters for nonlinear dynamical systems
- Non-intrusive Reduced Order Modelling Using Autoencoders** Aug 2022 – Dec 2022
HS 650 - Data science and predictive analysis
- Developed ROM framework based on autoencoders, obtained superior results to traditional methods
 - Conducted extensive analysis of various medical dataset using advanced clustering techniques such as k-means++, hierarchical clustering, and Gaussian mixture models to identify and delineate salient features
- Solid Rocket Design** Jan 2021 – May 2021
AS5610- Rocket Propulsion
- Designed a solid rocket motor stage equivalent to the liquid core stage of SLS Block 1 rocket
 - Developed a custom python code to predict the grain burnback and to optimize the grain geometry
- GASDyn (Gas And Shockwave dynamics) python library** Aug 2020 – Dec 2020
AS6060- Shockwave dynamics
- Regular reflection and mach reflection solutions using two and three shock theory, and shock polars
 - Mach stem height estimation using Li and Ben-Dor, and Mounton's method
- Compressible Navier Stokes solver with high-order schemes** Jan 2020 – June 2020
AS6041- Advanced CFD-Eddy Resolving Methods
- Finite difference compressible Navier-Stokes solver using high-order schemes in curvilinear coordinates
 - Capable of direct numerical simulation of flow over complex geometries and dynamic meshes
- Vortex Induced Vibrations of a cylinder in two dimensions** Jan 2020 – June 2020
AS6050 - Dynamic Fluid Structure Interactions
- Parametric study of wake induced vibrations of a cylindrical structure submerged in a fluid
 - Wake induced vibrations in two dimensions were modelled using a phenomenological model.
- High endurance fixed-wing mini UAV** Jan 2019 – Dec 2019
AS5213 - Design of MAVs and UAVs
- A fully electric fixed-wing surveillance UAV with a reinforced carbon composite body
 - Endurance of more than four hours with a maximum payload capacity of 800g