ATHARVA AALOK

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EDUCATION

Indian Institute of Technology (IIT), Madras 2019-2023
- Bachelor of Technology with Honors in Aerospace Engineering Chennai, India
- **CGPA: *9.66/10*, Department Rank - *1/58***

BVB Vidyashram - Central Board of Secondary Education, India 2016-2019
- Standard 12 - Percentage: 95.2%, Science Stream Rank - *1* Jaipur, India
- Standard 10 - GPA: 10.0/10.0

PUBLICATIONS

Atharva Aalok, Induja Pavithran, R.I. Sujith. "Breaking points of Early Warning Signals: Robustness in Rate-delayed tipping regime". **Accepted in** Conference on Nonlinear Systems and Dynamics.

RESEARCH EXPERIENCE

Design of Jet Based UAVs with Thrust Vectoring May 2022 - Present
Prof. S. Sundaram, Artificial Intelligence and Robotics Lab, IISc Bangalore *Bangalore, India*

- Designing a high altitude (5000m+) jet based UAV with 50kg payload capacity and STOL capabilities.

Phase 2 (Ongoing) May 2022 - July 2022
- Working on building a prototype vehicle as proof of concept of a novel thrust vectoring mechanism.
- Produced through several design iterations a 3D model of the vehicle. Designed to optimize weight, distribution symmetry and simplicity of assembly.
- Working on controller design and fabricating the required vehicle parts.

Phase 1 August 2022 - Present
- Modelled a 3-DOF thrust stand and fabricated through laser cutting, CNC machining, milling and 3D printing. Chose and calibrated temperature, pressure and force sensors and set up data acquisition. Handled purchase worth over 10 Lakh ($12k).
- Modelled a novel 2-DOF thrust vectoring system in SolidWorks, fabricated associated parts and set up electronics.
- Automated engine control by setting up communication through RS232 protocol with the Engine Control Unit.

Robustness of Early Warning Signals June 2021 - November 2022
Prof. R.I. Sujith, Sujith's Lab, IIT Madras *Chennai, India*

- Rigorously studied the behavior of Early Warning Signals (EWSs) for a 3^{rd} order non-autonomous power system model.
- Performed computations and used Continuation software MatCont to explore the phase space and produce bifurcation plots. Then used extensive numerical simulation to study rate-delayed and rate-induced tipping regimes.
- Used Kendall's tau correlation to quantify the reliability of EWSs. Results submitted as a manuscript to CNSD.

Analytical Investigations in Rate-Induced Tipping – Bachelor's Thesis August 2022 - Present
Prof. R.I. Sujith, Sujith's Lab, IIT Madras *Chennai, India*

- Did extensive literature survey of existing theoretical results on rate-induced tipping and EWSs.
- Derived a novel analytical result governing the relative motion between the system state and its fixed points in phase space for a non-autonomous n^{th} order dynamical system.
- Developing an integration based approach combined with the derived analytical formula to attempt to prove empirical scaling laws that occur befor Hopf bifurcation.

TECHNICAL PROJECTS

Professional Plots August 2021 - October 2021
Open-Source at MATLAB, MathWorks *Jaipur, India*

- Programmed and open-sourced a plotting toolbox in MATLAB that allows users to create publication quality plots quickly and effectively. Continuously evolving with 21 Updates till date.
- Coded high-level functions, designed a new color-coding scheme and defined customizable plot template properties.
- The toolbox has over 1500 downloads on MATLAB file-exchange, has a 5-star rating and has been widely shared in MATLAB communities on different platforms such as twitter and reddit.
  Link: https://www.mathworks.com/matlabcentral/fileexchange/100766-professional-plots

Search and Rescue UAV Design January 2022 - June 2022
Guide: Prof. M. Ramakrishna and B. Govindarajan *Chennai, India*

- Worked in a team of 5 to produce conceptual design of a Search and Rescue, Fixed-wing, electric UAV with VTOL capability. The design uses state-of-the-art Computer Vision models for victim identification.
- Determined mission specifications, analyzed competitive aircraft data, calculated and optimized aircraft parameters and created a 3D model of the aircraft. Wrote over 2000 lines of code.
- Produced a 10.47kg, 1.95m wingspan UAV design with Payload capacity: 1.3kg, Range: 115km, Endurance: 90 min and Cruise Speed: 20m/s.
  Link: Github, Report, Presentation

UAV Structural Design August 2022 - Present
Guide: Prof. H.S.N. Murthy and S. Murugan *Chennai, India*

- Working in a team of 5 to design and fabricate a Fixed-wing, electric UAV with VTOL capabilities based on our previous conceptual design.
- Analyzed and tested different materials and finalized an aluminium based frame. Wrote computer programs to calculate stresses in different Wing and Fuselage structural members and calculated and optimized dimensions of spars, stringers, ribs and bulkheads for design against failure. Design code open-sourced on MATLAB as a toolbox.
- Currently fabricating Wing and Fuselage components, and assembling and programming electronics.
  Link: Github

Vector Field Path Following for MAVs October 2022
Guide: Prof. S. Ghosh *Chennai, India*

- Implemented Vector Field based guidance algorithms for path following. Algorithms based on this paper.
- Suggested 2 possible extensions for faster convergence to desired path based on using multiple sliding surfaces.
  Link: Github, Presentation

Hurst Exponent September 2021
Colleague: Dr. I. Pavithran *Chennai, India*

- Implemented MFDFA algorithm in MATLAB for calculating Hurst Exponent of a time series based on this paper.
- The code was open-sourced on MATLAB and has ∼100 downloads.
  Link: https://in.mathworks.com/matlabcentral/fileexchange/100988-hurst-exponent

TECHNICAL SKILLS

Programming Languages	:	MATLAB, Python, C
Softwares and Packages	:	LaTeX, Simulink, ROS, Gazebo, MatCont, XPP AUTO, Proteus, Numpy, Tkinter, SciPy, Matplotlib, OpenCV, Pandas, Pygame
Hardware	:	Raspberry Pi, Arduino, Thermocouples, Pitot tubes, 6-axis Load Cells
3D Modelling	:	SolidWorks, Fusion 360
Creative Skills	:	Adobe Premiere Pro, Filmora, Adobe Photoshop, Gimp, Figma

AWARDS AND RECOGNITION

- Amongst the top 3% Contributor on the MathWorks Website (MATLAB Community). Present
- Recipient of the prestigious KVPY Fellowship by Dept. of Science and Technology, Govt. of India. 2019
- Awarded the coveted National Talent Search Examination (NTSE) fellowship by NCERT, Govt. of India 2018

OTHER PROJECTS

Face Recognition Neural Network - *MOOC: Machine Learning* May 2021

- Created a dataset of animated faces and trained a neural network on it. Achieved 97% accuracy on test set.

Image Filter - *MOOC: Harvard CS50* May 2020

- Programmed a cross-platform project in C for applying image filters: reflect, grayscale, blur, color invert.

Retro Game Console - *Self Project* June 2021

- Coded the snake game in python, integrated it on the Raspberry Pi4 and displayed it on an 8x8 LED matrix to make a playable retro game console.

Data Structures Library in C - *Guide: Late Mr. Goyal* September 2020

- Implemented a data structures library in C for creating and parsing linked lists, queues, stacks, binary trees both recursively and iteratively.

LEADERSHIP

Department Academic Legislator April 2022 - March 2023
Elected representative, Department of Aerospace Engineering *Chennai, India*

- Assembled and leading a team of 5 to create a student website with information on alumni, internship and placement statistics and academic resources.
- Helping students through their internship and job placement journey by acting as an official point of contact and guiding them through the process.

Member, Aerospace Engineering Association April 2022 - March 2023
Aerospace Engineering Association | IIT Madras *Chennai, India*

- Worked in a team to ideate and launch a professor research showcase and interaction series where every month 2 professors present their research to students.
- Ideated and launched an intra-department sports league to encourage informal student-professor interactions.
- Organized freshmen ice-breaker sessions and formal interaction sessions with seniors on academics and internships.

Freshman Mentor August 2021 - May 2022
SAATHI - IITM Mental Health and Wellness Community *Chennai, India*

- Mentored closely 6 freshmen through their first year by helping them with academic and general queries.
- Recognized as a *Star Mentor* - top 10 percent from over a 100 mentors.

EXTRA-CURRICULAR ACTIVITIES

- Acted in the opening scene of the film *History of Yoga* which has been screened in 6 different continents.
- Long distance events, running: 5km to 20km and cycling: upto 65km with participation in marathons in multiple cities.