

MADHUVANTHI ATHANI

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EDUCATION

Doctor of Philosophy, Ph.D. Physics

Johns Hopkins University, Department of Physics and Astronomy

Dec 2024

GPA: 4.00

Bachelor and Master of Science, BS-MS Physics

Indian Institute of Science Education and Research, Mohali, India

May 2018

GPA: 3.6

SKILLS

Languages/platforms	Python, C++, C, JavaScript, Bash, Git, Matlab, R, SQL, AWS, GCP, Firebase
Libraries	NumPy, Matplotlib, PyTorch, Pandas, Hugging Face, Scikit-Learn, TensorFlow, Keras
Specialized Skills	LLM fine-tuning, RAG, prompt engineering, cloud computing, deep learning, NLP, vector database, statistics, linear algebra, stochastic dynamics, mathematical modeling

WORK EXPERIENCE

Machine Learning Applied Scientist - Qiwi Publishing, Inc

Feb 2025 - Present

- Develop and optimize text-to-speech deep learning models for expressive speech synthesis.
- Research and fine-tune multimodal AI models (text, vision, audio) for business integration.
- Build and maintain data pipelines to streamline model training and deployment, reducing development time.

Doctoral Research Assistant - Johns Hopkins University

Jan 2022 - Dec 2024

- Designed and developed stochastic differential equation-based Brownian dynamics simulation model to study the spontaneous emergence of order in non-equilibrium physical systems using Python and C++.
- Studied the influence of different physical and model parameters of agent-based simulations on the type of order and its stability.
- Authored multiple research papers in reputable peer-reviewed journals, contributing novel insights.

[1] Memarian, Lopes, Schwarzendah, **Athani et al.**, "Active nematic order and dynamic lane formation of microtubules driven by membrane-bound diffusing motors", *PNAS* **118**, 10.1073 (2021).

[2] **Athani et al.**, "Symmetry and stability of orientationally ordered collective motions of self-propelled, semi-flexible filaments," *Phys. Rev. Res.* **6**, 023319 (2024).

[3] **Athani et al.**, "Tunable rotating active nematic states in the collective motions of self-propelled, chiral filaments," Manuscript in preparation.

[4] Noerr, Kumar, **Athani et al.**, "Dynamics of single active chiral filaments," Manuscript in preparation.

- Led the supervised fine-tuning of Vision Transformers (ViTs) for object detection and counting on custom synthetic datasets, leveraging Parameter-Efficient Fine-Tuning (PEFT) and Low-Rank Adaptation (LoRA).
- Mentored four undergraduate students, including one on a project that used machine learning tools to interpret image sequence experimental data and provided on-boarding guidance to new group members.

RELEVANT PROJECTS

- Supervised Fine-Tuning of Vision Transformer (ViT):** Fine-tuned Hugging Face's google/vit-base-patch16-224-in21k model using PEFT LoRA to count overlapping filaments in domain-specific datasets. Built an ETL pipeline with Python, PyTorch, and Google Colab for data preprocessing, model training, and performance evaluation. This method was pivotal in estimating the surface number density of biofilaments, providing key insights into emergent effects relevant to my Ph.D. research.
- AI Explainability Research:** Leading a project to understand and classify 'learning' using a Gaussian approximation of the learned weight matrices across different types of data and various network architectures.
- Web Application Development with LLM Prompt Engineering:** Designed and implemented an end-to-end serverless web application featuring a JavaScript frontend and Python backend, integrating OpenAI APIs with advanced prompt engineering techniques. Deployed the application on Firebase (GCP) to enable real-time, insightful LLM-based analysis.