Karthik Suresh

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Core Skills

ML, DL & Modeling	Bayesian optimization, adaptive experimentation, predictive modeling, generative models, anomaly detection	$\geq$ 5 yrs
Realtime Inference & ML Systems	ML pipelines, real-time inference, model monitoring, A/B testing	$\geq$ 3 yrs
Programming & Data Processing	Python, SQL, R, C/C++, PyTorch, TensorFlow, scikit-learn	$\geq$ 7 yrs
MLOps & Deployment Tools	MLFlow, Tensorboard, Git, Docker	$\geq$ 3 yrs
Distributed Computing	HPC, distributed optimization, large-scale data processing, OSG	$\geq$ 6 yrs
Project & Workflow Tools	Agile workflows (GitHub Projects, Kanban), collaborative tools	$\geq$ 5 yrs
Data Visualization	matplotlib, seaborn, Plotly, D3.js	$\geq$ 6 yrs
Web Development	Flask, Django, FastAPI, Streamlit	$\geq$ 3 yrs

Professional Experience

Data Scientist (Research) September 2025 – Ongoing
College of William and Mary *Williamsburg, VA, USA*

- Developing a **distributed optimization framework** that scales Bayesian and evolutionary optimization across **high-performance computing (HPC)** clusters and geographically distributed compute sites (**Open Science Grid**), enabling **real-time optimization** and design decision-making for complex systems.
- Delivering advanced **online inference**, **monitoring**, and **adaptive experimentation pipelines** to support continuous model evaluation and robust ML-driven decision support in production-like environments.
- Driving the development of **LLM evaluation** and **Retrieval-Augmented Generation (RAG)** methods for domain-specific AI applications, with integrated online inference and real-time feedback loops.

Postdoctoral Research Associate September 2023 – September 2025
College of William and Mary *Williamsburg, VA, USA*

- Phase-I of AID2E project, A lead developer on distributed optimization framework for detector design for EIC

Graduate Researcher October 2018 – September 2023
University of Regina *Regina, SK, Canada*

- Developed advanced **Big Data analysis pipelines** (**Partial Wave Analysis**) to extract meaningful insights from large-scale, noisy sensor data in a $40M international experiment (GlueX at Jefferson Lab), applying **Bayesian inference** and **high-dimensional statistical modeling**.
- Engineered a novel **deep learning solution** (CNN-based) for **photon vs. neutron classification** from calorimeter sensor data, achieving first successful differentiation of these particle types and enabling enhanced particle identification in real-time data processing.
- Advanced **sensor calibration** and **signal processing** workflows, delivering robust models for gain calibration of optical sensors (Silicon Photomultipliers and Photomultiplier Tubes), improving measurement accuracy and system reliability.

Selected Projects

AI-assisted Detector Design Optimization 2022–Ongoing

arXiv:2205.09185 & Interactive App

- Developed advanced multi-objective optimization pipelines using **Bayesian optimization** and **evolutionary algorithms** to drive design optimization for complex experimental systems (EIC detector design).
- Designed and deployed an **interactive online visualization app** to navigate Pareto-optimal design solutions, integrating **real-time inference**, optimization results, and 3D detector visualization for decision support.
- Currently driving the **AID2E distributed optimization project**, scaling optimization pipelines across **HPC clusters** and geographically distributed compute sites to enable robust and scalable ML-driven design optimization workflows.

RAG4EIC: Retrieval-Augmented Generation for Electron Ion Collider 2023–Ongoing

arXiv:2403.15729 & RAG4EIC App

- Led the development of an end-to-end **LLM-powered Retrieval-Augmented Generation (RAG)** system for summarizing complex scientific knowledge, the first of its kind in the Nuclear and Particle Physics community.
- Designed and deployed an interactive **RAG-based web app** with integrated **Uncertainty Quantification (UQ)** and automated evaluation metrics (**RAGAS scores**), enabling real-time assessment of retrieval and generation quality.
- Provided technical **leadership** across the project, mentoring undergraduate students and coordinating cross-institutional collaboration with Indian research groups to drive further development and adoption.

LLM/ML Hackathon Platform Development & Operations 2022–2025

ePIC Hackathon, AI4EIC Hackathon & Vibe coding hackathon

- Designed, developed, and deployed end-to-end **hackathon platforms** across multiple large-scale AI4EIC and ePIC EIC workshops, supporting cross-functional teams in building and evaluating AI solutions.
- Built robust **web applications** for submission portals, **OAuth2-based leaderboards**, and real-time result evaluation pipelines, enabling scalable and transparent competition workflows.
- Designed the problem and the infrastructure for the first ever vibe coding hackathon organized at AI4EIC 2023.
- Led **data generation, cleaning, and validation** processes for the AI4EIC hacakthon, and implemented **ML pipeline setups** to ensure consistent and high-quality benchmarks for hackathon participants.
- Drove the deployment and operations of interactive web apps, providing ongoing **technical leadership and support** during live hackathons with international participation.

Track Reconstruction using Neural Network June 2018

D. Samuel and K. Suresh 2018 JINST 13 P10035

- Designed and implemented an artificial neural network-based solution to extract accurate object tracks from noisy multi-sensor data. Achieved up to a **60% improvement in reconstruction accuracy over traditional geometric fitting methods under high-noise conditions**, demonstrating the potential of deep learning to enhance real-time data processing pipelines.

Education

University of Regina October 2018 – September 2023

PhD (Hybrid Meson Spectroscopy) – Full Thesis *Regina, SK, Canada*

Central University of Karnataka August 2016 – June 2018

M.Sc in Physics Full Thesis *Gulbarga, Karnataka, India*

University of Madras August 2013 – May 2016

B.Sc in Physics *Chennai, Tamil Nadu, India*

Selected Talks

Invited Lecture at Hampton University Graduate Studies Program 2025 Jefferson Lab, VA, USA
webpage, CNN, Optimization Theory *June 2025*

Invited Talk at Law School William & Mary, VA, USA
Introduction to Generative AI and Large Language Models *January 2025*

AI for Detector Design Bootcamp William & Mary, VA, USA
An extensive bootcamp for design optimization *July 2024*

3^{rd} **Workshop on AI4EIC** CUA, Washington D.C USA
A Large Language Model-based Assistant for the Electron Ion Collider –RAGS4EIC-webapp *Dec 2023*

Canadian Association of Physicists (CAP) McMaster University, Hamilton
AI-assisted Optimization of the ECCE Tracking System at the Electron Ion Collider *Jun 2022*

Artificial Intelligence for Science Industry and Society (AISIS) Virtual
EIC-ECCE Detector Design Optimization with AI *October 2021*

Selected Publications

AI-Assisted Detector Design for the EIC (AID(2)E)
July 2024 JINST 19 C07001
Towards a RAG-based summarization for the Electron Ion Collider
July 2024 JINST 19 C07006
Artificial Intelligence for the Electron Ion Collider (AI4EIC)
Feb 2024 CSBS. 10.1007
AI-assisted Optimization of the ECCE Tracking System at the Electron Ion Collider
Feb 2023 NIMA. 2022.167748 –Interactive Visualization of results

References

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