

Athul Chakkithara Dharmarajan

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EDUCATION

Purdue University

PhD, Mechanical Engineering

Relevant Courses: Data Mining, Advanced Scientific Machine Learning, Analysis and Design of Robotic Manipulators

West Lafayette, IN

Aug '22 – Present

Indian Institute of Technology Bombay (IITB)

Bachelor of Technology & Master of Technology, Mechanical Engineering

Relevant Courses: Data Structures and Algorithms, Nonlinear Dynamics, High Performance Scientific Computing, Operations Analysis

Mumbai, India

Jul '17 – Jun '22

SKILLS

Programming: Python, C++, JAX, PyTorch, MATLAB, R, OpenMP, MPI, CUDA, git, SQL, scikit-learn, pandas, NumPy

RESEARCH EXPERIENCE

Research Assistant, Design Engineering Lab Purdue

West Lafayette, IN

Trusted Artificial Intelligence Challenge

May '24 – Present

- Successfully led a seven-membered student team from Purdue University to a top 2 finish in the competition across 10 teams
- Architected an innovative reinforcement learning-based decision-making system using multi-arm bandits for human-AI collaboration, enabling safe and efficient navigation of mine-laden terrain

Quantitative Model for Design Performance

May '23 – Present

- Pioneered a cognitive psychology-based explanatory model for predicting design performance in the early-stage design, quantifying the relationship between designer expertise and design quality
- Developed persona-based prompting methodology for enhancing the performance of Large Language Models (LLMs) in design tasks and modeled the performance of frontier models across engineering disciplines

Probabilistic Simulation Model for Robotic Arm Design

Aug '22 – Present

- Constructed a Bayesian probabilistic generative model for estimating the performance of designers with varying expertise
- Simulated design of International Space Station Astrobee robotic arm by experts and crowdsourcing using Monte Carlo method

Research Assistant, Control and Coordination lab IITB

Mumbai, India

Multi-Agent Paradigm for Disaster Management

May '21 – Jun '22

- Created a novel equitable area assignment algorithm that improved coverage efficiency by 30% in nonconvex environments
- Designed a decentralized collaborative path planning scheme, enabling autonomous robots to achieve optimal coverage configuration without central coordination, reducing response time by 20% in simulated disaster scenarios

TECHNICAL PROJECTS

Generating Designs Using Denoising Diffusion Probabilistic Models (DDPMs)

Jan '24 – May '24

- Trained a DDPM using JAX for generating parametric ship hull designs, achieving a 99.5% feasibility rate, a 149× improvement over random sampling, while maintaining design space coverage
- Leveraged performance-guided generation, resulting in designs with an average 91.4% reduction in wave drag coefficients

Tangram Solver Using LLMs

Jun '23 – Jul '23

- Finetuned T5 (Text-to-Text Transfer Transformer) to solve tangram puzzles on 3x3 grid using a synthetically generated dataset
- Achieved a 95% success rate in puzzle completion, demonstrating the potential of LLMs in visual-spatial reasoning tasks

Implementation of Classification Algorithms from Scratch

Aug '22 – Nov '22

- Built bespoke implementations of different classifying algorithms like support vector machines (SVM), k-nearest neighbors, naïve Bayes, and decision trees in Python without using standard libraries like scikit-learn
- Evaluated the models using the North American mushroom datasets with SVM achieving 98.7% accuracy across 8127 samples

Time Series Forecasting for Predicting Sales in Walmart Stores

Jan '21 – May '21

- Engineered features to significantly improve predictive accuracy by leveraging statistical transformations and aggregations
- Conducted a comprehensive performance analysis comparing statistical model ARIMA and gradient boosting-based LGBM

Path Planning Using Parallel Computing

Jan '21 – May '21

- Generated high-performance implementations of Dijkstra's, Floyd-Warshall, and Bellman-Ford Algorithm for path planning
- Leveraged parallel computing techniques like CUDA, OpenMP, and MPI to speed up execution over the NY state road map

SELECTED LEADERSHIP EXPERIENCE, AWARDS AND HONORS

- Outreach Chair, Official Mechanical Engineering Graduate Association, Purdue University

May '24 – Present

- Editorial Board Member, Insight IIT Bombay

Apr '19 – Apr '20

- Innovative Presentation Award, ASME CIE SciTechBuzz Summit, Washington D.C.

Aug '24

- National Science Foundation Frontiers in Design Representation Travel Fellowship

Jun '23, Jun '24

SELECTED PUBLICATION

Dharmarajan, A. C. et al., "Valuing Outliers: A Modeling Framework to Consider Non-Traditional Solutions from Non-Traditional Solvers," *ASME 2024 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC/CIE 2024)*, Washington, D.C., USA. August 25-28, 2024. Paper Number: IDETC2024-143509.