Abhinav Muraleedharan

Graduate Student, University of Toronto

Toronto, Canada

(+1)2269910117 | Abhinav.Muraleedharan@mail.utoronto.ca | www.abhinavmuraleedharan.com | Abhinav-Muraleedharan | Abhinav-Muraleedharan

Education

Masters in Engineering, Robotics/AI (UTIAS) — *Toronto, Ontario*

University of Toronto — *Jan 2022 - Current*

B.Tech, Mechanical Engineering — *Surathkal, Karnataka*

National Institute of Technology Karnataka — *June 2015 - May 2019*

Higher Secondary Education (CBSE) — *Kanjirappilly, Kerala*

St. Antony's Public School, 95.2 % — *June 2015*

Secondary Education (CBSE) — *Elanji, Kerala*

St. Philomena's Public School, 10/10 CGPA — *June 2013*

Research and Experience

Publications: — *Toronto, Canada*

Lead Author — *June 23*

- Beyond Dynamic Programming
- Link: https://arxiv.org/pdf/2306.15029.pdf

Math Outreach Office, UofT — *Toronto, Canada*

Course Instructor, Math for Contests — *July 22*

- Taught high school students math topics specific to contest preparation (COMC, CEMC)

DEEP Summer Academy, UofT Engineering Outreach Office — *Toronto, Canada*

Course Instructor, Introduction to Aerospace Engineering — *July 22*

- Taught 2 batches of DEEP Summer Academy students

Nathan Wiebe Research Group — *Toronto, Canada*

Researcher — *March 23 - Present*

- Developed reinforcement learning-based algorithms to synthesize optimal quantum circuits.
- Developed quantum algorithms with exponential speedup for simulating classical dynamical systems (ongoing research work).

Gradient-Ascent — *Toronto, Canada*

Research Consultant (Reinforcement Learning) — *May 23 - Present*

- Collaborated with the Gradient Ascent team on the development of a Reinforcement Learning (RL) agent for game-playing

Robotics and Automation Laboratory — *Toronto, Canada*

Researcher — *July 22 - March 23*

- Collaborated with Prof. Andrew Goldenberg on research involving the development of learning-based robot control algorithms for manipulation tasks.

Collins Aerospace (Raytheon Technologies), Bangalore, India — *Bangalore, India*

Associate Engineer — *Sep. 2019 - July 2021*

- Filed 1 Trade Secret
- Developed Machine learning Algorithms for Computational Design Of Aircraft Components (5-10K Decision Variables)
- Developed Motion Planning Algorithms for generating Dynamically Stable Chaotic Motion Trajectories for UAVs/missiles
- Computational Design and Development of Aircraft Components

LTA Systems Lab, IIT Bombay — *Bombay, India*

Research Intern — *May. 2018 - July. 2018*

- Developed Lyapunov Based Control Algorithms for Improving Lateral Stability of Airships
- Conceptual Design of Novel Fin Configurations For Enhanced Lateral Stability of Airships
- Designed and Developed Instrumentation Setup for Experimental Investigation of Lateral Stability of Airships
- ROS-Gazebo Simulation of Airships with Lyapunov-based control algorithms

M2D2 Lab, Indian Institute of Science — *Bangalore, India*

Research Intern — *May. 2017 - July. 2017*

- Invented Origami Inspired Mechanism for Assisting Finger Motion
- Mathematically Derived 3D Kinematic Equations of Origami- Inspired Spatial Mechanism
- Simulated 3D Motion of Origami Inspired Spatial Mechanism in MATLAB
- Developed Prototype of Mechanism and Evaluated Performance

Leadership

bendreality.ai — *Surathkal, Karnataka*

Founder — *Jul. 2017 - Jul. 2018*

- Spearheaded Research and Development of Robotic Exoskeleton for Stroke Rehabilitation
- Led team of 4, developed MVP and received feedback from Doctors
- Pitched Startup to Investors and Won Seed Funding

Honors & Awards

2020 **Spot Award**, Collins Aerospace — *Bangalore, India*

2017 **Finalist (Top 30)**, Indian Innovation Challenge 2017 — *Bangalore, India*

Projects

Expo-Descent: Exponential Learning Rate Descent Algorithm — *Kerala, India*

Independent Research — *October. 2020 - November. 2020*

- Invented Novel Learning Rate Scheduling Algorithm for Faster Convergence of Optimization Problems

Computational Design of Wire Pattern Geometries — *Bangalore, India*

Collins Aerospace — *April 2020 - June 2020*

- Formulated an Optimization Problem for Computational Design of Wire Pattern Geometry
- Invented a Novel Algorithm for Simplifying Non-Convex Optimization Problem to Multiple Convex Optimization Sub Problems
- Implemented the Algorithm in Python based Program

Model Based Distributed Control of Serial Link Manipulators — *NITK, Surathkal*

Undergraduate Thesis — *Aug. 2018 - May. 2019*

- Mathematically Derived Distributed Control Law for 2R Manipulators
- Simulated Motion Trajectories of 2R Manipulator With Distributed Control in MATLAB
- Developed Prototype of 2R Manipulator with Micro Controller Unit and Evaluated Performance
- Developed trajectory optimization based distributed control algorithm for 2R manipulators

Wearable Robotic Exoskeleton For Stroke Rehabilitation — *Centre For System Design, NITK*

Mini- Project — *Jul. 2017 - Jul. 2018*

- Developed System-Level Design of Wearable Robotic Exoskeleton System
- Analysed Mechanics and Selected Actuators for the Wearable Robotic System
- Developed Prototype of complete system and Evaluated Performance

Path Planning of Multi-Robot System In Interconnected Graph — *Centre For System Design, NITK*

Mini-Project, Theory and Practices of Sensors and Actuators — *Jan. 2018 - May. 2018*

- Implemented Dijkstra Path Planning Algorithm for High Level Motion Planning of Autonomous bots in Smart City
- Developed Low Level Planning Algorithm that Generated Steering Commands from Pre-Computed Optimal Routing Plan
- Collaborated in Implementation of Algorithm With a Computer Vision Based Perception System

Targeted Drug Delivery With External Trigger and Control — *NITK*

Mini Project, MEMS — *Feb. 2018 - May. 2018*

- Designed Novel Externally Controllable Micro-Bot for Drug Release
- Computed Mechanical Design Parameters of Micro-Bot to Release Drug When Subjected to External Rotating Magnetic Field

Path Planning of Autonomous Football Bots Using Artificial Potential Fields — *NITK*

Technical Fest — *Aug. 2017 - Sep. 2017*

- Led Team of 4 With team members working on Perception, Planning and Hardware Development
- Implemented Artificial Potential Field Based Algorithm For Path Planning of Autonomous Football Bots
- Collaborated in Deploying the Planning Algorithm On Actual System With an Overhead Camera Based Perception System

Inventions (Trade Secrets)

Computer Program And Algorithm for Generative Design of Wire Pattern Geometries in Electric(Aircraft) Heaters.

Origami Inspired Spatial Mechanism For Assisting Finger Motions .

Conferences

Dynamically Stable Chaotic Motion Trajectories for Drones. Raytheon Systems Engineering And Technology Symposium 2020.

Distributed Control Architecture for Drones. Raytheon Systems Engineering And Technology Symposium 2020 .

Bridging Simulation to Reality With Deep Neural Networks. Raytheon Systems Engineering And Technology Symposium 2020 .

Computational Design And Applications in Aerospace Components. Raytheon Systems Engineering And Technology Symposium 2020 .

Skills

CAD	Siemens NX, CATIA V5
Analysis	MATLAB, Mathematica
Robotics	Drake, ROS/Gazebo
Programming	Python, C++, LaTeX, PyTorch, TensorFlow, Pandas,SQL,MySQL,R
Languages	Malayalam, English, Hindi