

EDUCATION

Ph.D. in Electrical Engineering with Computer Science Minor	2023
University of Minnesota, Twin-Cities	GPA: 3.795/4
Advisor: Prof. Murti Salapaka	
Master of Technology in Systems and Control	2013
Indian Institute of Technology, Bombay	GPA: 9.82/10
Bachelor of Engineering in Electrical Engineering	2011
University of Mumbai	GPA: 79.04/100

RESEARCH EXPERIENCE

New Clinical Applications Using Learning Algorithms	MAR 2023 — PRESENT
Research Fellow, Mayo Clinic	
<ul style="list-style-type: none"> Optimized Treatment Regimen: Mentored intern to develop an algorithm using reinforcement learning to optimize Alzheimer's disease treatment regimen, equivalent to the level of junior physicians [<i>Published in JAMIA</i>] LLM Powered Clinical Synopsis: Developed strategy and language model for the synthesis of cancer synoptic reports from clinical notes to reduce physician burden [<i>Presented in AMIA-CIC 2024</i>] Clinical Trial Emulation: Worked with cross-functional team to rapidly design tool for emulating heart-failure drug trials in a state-of-the-art cloud-based AI platform Alzheimer's Disease Prediction: Developing transformer based models to detect and subtype Alzheimer's disease using multi-modal electronic health records 	
Novel Data Driven Algorithms for Non-equilibrium Experiments	JUN 2020 — FEB 2023
Ph.D. Project	
<ul style="list-style-type: none"> Designed algorithm for quantifying errors in non-equilibrium experiments [<i>Presented in APS 2022</i>] Released <u>Python</u> based toolbox for error quantification and validated on experimental data 	
Deep Learning for Cardiac Rhythm Classification	JUN — AUG 2019, 2021
Research Internship, Boston Scientific Inc.	
<ul style="list-style-type: none"> Developed deep learning models to classify electrocardiograms from implantable devices Built framework for hyper-parameter search (model optimization) and for using unlabeled data Identified limitations in the training data that lead to the prediction errors Designed techniques to augment limited training data for improved machine learning model performance 	
Modeling Nano-Mechanics of Muscle Proteins	JAN 2017 — JAN 2023
Ph.D. Project	
<ul style="list-style-type: none"> Collaborated with biochemists to design force spectroscopy experiments characterizing single molecules of proteins linked to muscular dystrophy [<i>Published in Nature - Scientific Reports 2019</i>] Implemented robust force control in an atomic force microscope [<i>Presented in ISPM 2018</i>] Developed Monte Carlo methods to capture molecules' observed behaviors Devised statistical tests to evaluate proteins for potential therapy Designed and conducted experiments revealing effect of expression system on proteins [<i>Presented in BPS 2020</i>] <u>Automated</u> experimental analysis, reducing processing time from 1 work day to 2 hours 	
Self-Learning Change Detection Algorithm	SEPT 2015 — JUL 2020
Ph.D. Project	
<ul style="list-style-type: none"> Devised learning based method for detecting events with unknown event size and timing with provable guarantees Incorporated methods to handle noise, sensor dynamics, and non-linear distortion Implemented Python toolbox [<i>Published in Automatica 2022</i>] 	
Intelligent Identifier & Auto-Tuner	JUL 2012 — JUN 2013
Received Institute Silver Medal - Master's Thesis	
<ul style="list-style-type: none"> Developed an expert system to control a plant with limited human supervision from a cold start Created algorithm that found models with >60% fit for a large class of systems 	

PROFESSIONAL APPOINTMENTS

Research Fellow

Dept. of Artificial Intelligence and Informatics, Mayo Clinic

MAR 2023 — PRESENT

Rochester, MN

- **Research:** Conducted collaborative research to develop novel AI methods for clinical applications
- **Grant Involvement:** Assisted in the preparation and submission of grant proposals to support research initiatives
- **Mentorship:** Guided interns in research and professional development
- **Service:** Contributed to institutional activities, including peer review, journal club organization, and presentations

Research Intern

Rhythm Management, Boston Scientific Inc.

JUN — AUG 2019, 2021

Arden Hills, MN

- Developed deep learning algorithms for cardiac rhythm classification

Research and Teaching Assistant

University of Minnesota, Twin-Cities

SEPT 2015 — FEB 2023

Minneapolis, MN

- Conducted original research, designed and executed experiments, collaborated across disciplines, and mentored students

Systems Validation Engineer

Cypress Semiconductor Corporation

JUN 2013 — JUN 2015

Bengaluru, India

- **Automating Validation:** Designed automation platform for comprehensive validation, responsible for EMI/EMC certification
- **Algorithm Development:** Developed auto-tuning algorithms for capacitive touch sensors and gesture detection

PROJECTS

Deep Reinforcement Learning for Multi-System Interaction

- Investigated conditions that promote system to system language evolution from scratch
- Measured performance improvements for bridge crossing when using agent derived communication

Robustness of Control Via Deep Reinforcement Learning

- Evaluated the robustness of control obtained via reinforcement learning
- Improved stability of derived controllers, validated on openAI Gym's unstable cart-pole system

Automating Deep Learning for Game Playing

- Created an unsupervised agent that learned to play the game Super Hexagon using only video data
- Reinforcement learning used to train a neural network to achieve survival times 3x random actions

Conveyor Belt Tracking for on the Fly Machine Operations

- Designed PID controllers to enable machine tools to operate on moving objects to reduce time and energy wastage

Modeling & Control of Vehicle with Four Wheel Steering

- Estimated dynamic models (ARX, ARMAX) for vehicle dynamics from input-output data
- Designed and simulated optimal pole placement controllers with Kalman filters for improved performance and safe operation

TEACHING EXPERIENCE

Teaching Assistant

University of Minnesota, Twin-Cities

Control Systems Lab Development

JAN 2022 — SEPT 2022

- Coordinated with faculty, staff, and vendors to improve student experience of 2 lab courses
- Identified syllabus gaps and created 3 new experiments
- Modernized over 15 experiments and manuals
- Enabled Hardware-In-Loop control for 5 control plants such as DC Motors, Inverted Pendulums, Magnetic Levitation Systems
- Trained teaching assistants for the new labs

Linear Control Systems Lab

SEPT 2016 — DEC 2022

- Instructed students in successfully implementing linear control algorithms
- Mentored students on technical writing
- Trained 3 new teaching assistants
- Consistently rated more than 5 out of 6 in student feedback

State Space Control Systems Lab	JAN 2017 — MAY 2020
<ul style="list-style-type: none"> • Taught techniques to implement advanced control • Guided students with reports and technical writing • Developed remote experiments for COVID-19 safety • Mentored 4 new teaching assistants • Consistently rated more than 5 out of 6 in student feedback 	

Non-linear Systems	MAR 2020 — JUN 2020
<ul style="list-style-type: none"> • Graded assignments and exams 	

Linear Systems & Optimal Control	SEPT 2019 — DEC 2019
<ul style="list-style-type: none"> • Graded assignments and exams, held office hours 	

Intro to Circuits & Electronics	JUN 2017 — AUG 2017
<ul style="list-style-type: none"> • Graded assignments, held office hours 	

Teaching Assistant <i>IIT Bombay</i>	
Automation & Feedback Control	JAN 2013 — MAY 2013
<ul style="list-style-type: none"> • Developed lecture notes, graded assignments 	
Systems & Control Lab	MAY 2012 — DEC 2012
<ul style="list-style-type: none"> • Developed exercises for 2-Degree of Freedom helicopter control 	

SKILLS

Technical	Python, MATLAB, Simulink, Labview, Git, SQL, C, C++, R
Machine Learning Tools	Tensorflow, Keras, PyTorch, Pandas
Knowledge Base	Machine Learning, Artificial Intelligence, Optimization, Filtering, Estimation, Identification

HONORS AND AWARDS

John Bowers Excellence in Teaching Assistance Award	2020
Electrical & Computer Engineering Department Fellowship, University of Minnesota	2015-2016
Institute Silver Medal, Systems & Control Engineering, Indian Institute of Technology, Bombay	2013
J.R.D. Tata Trust Scholarship, University of Mumbai	2010-2011

INSTITUTIONAL SERVICE

AI Journal Club Organizer <i>Department of AI and Informatics Mayo Clinic</i>	JAN 2024 — APR 2024
Lab Safety Officer <i>Salapaka Lab University of Minnesota, Twin-Cities</i>	SEPT 2018 — FEB 2023
Graduate Student Mentor <i>Electrical and Computer Engineering University of Minnesota, Twin-Cities</i>	MAR 2022 — FEB 2023
Grants Review Committee <i>Council of Graduate Students University of Minnesota, Twin-Cities</i>	MAR 2021 — AUG 2022
Alumni Student Mentor <i>Alumni Association IIT Bombay</i>	MAY 2018 — MAY 2020
Department Placement Coordinator <i>Career Cell IIT Bombay</i>	JUL 2012 — MAY 2013
Chair <i>IEEE Students' Chapter Fr. C.R.I.T, University of Mumbai</i>	JUL 2009 — MAY 2010

PUBLICATIONS

JOURNALS <i>In preparation/Review</i>	
Rajaganapathy, S., Chowdhury, S., Buchner, V., He, Z., Jiang, X., Yang, P., Cerhan, J.R. and Zong, N., 2024. Synoptic Reporting by Summarizing Cancer Pathology Reports using Large Language Models. medRxiv, pp.2024-04.	
Rajaganapathy, S., Hua, C. and Salapaka, M.V., “Quantifying Errors in the Jarzynski Estimator.”	

Hua, C., **Rajaganapathy, S.**, Slick, R.A., Vavra, J., Muretta, J.M., Ervasti, J.M., and Salapaka, M.V., “Identifying single molecule force spectroscopy data using deep learning with physics augmentation.”

Das, T., Bhattarai, K., **Rajaganapathy, S.**, Wang, Y., Su, C., Wang, L., Cerhan, J.R., Zong, N., “Leveraging multi-source data to resolve inconsistency across pharmacogenomic datasets in drug sensitivity prediction.”

Published

Bhattarai, K., **Rajaganapathy, S.**, Das, T., Kim, Y., Chen, Y., *The Alzheimer’s Disease Neuroimaging Initiative, The Australian Imaging Biomarkers and Lifestyle Flagship Study of Ageing*, Dai, Q., Li, X., Jiang, X., and Zong, N., “Using artificial intelligence to learn optimal regimen plan for Alzheimer’s disease.” *Journal of the American Medical Informatics Association*, Volume 30, Issue 10, July 2023, Pages 1645-1656.

Ramirez, M.P., **Rajaganapathy, S.**, Hagerty, A.R., Hua, C., Vavra, J., Gordon, W.R., Muretta, J.M., Salapaka, M.V. and Ervasti, J.M., “Phosphorylation alters the mechanical stiffness of a model utrophin fragment.” *Journal of Biological Chemistry*, 299.2, 2023.

Rajaganapathy, S., Melbourne, J. and Salapaka, M.V., “Change detection using an iterative algorithm with guarantees.” *Automatica*, 136, p.110075, 2022.

Rajaganapathy, S., McCourt, J.L., Ghosal, S., Lindsay, A., McCourt, P.M., Lowe, D.A., Ervasti, J.M. and Salapaka, M.V., “Distinct mechanical properties in homologous spectrin-like repeats of utrophin.” *Scientific reports*, 9(1), pp.1-11, 2019.

CONFERENCES

Rigorous Peer Review

Rajaganapathy, S., Melbourne, J., Aggarwal, T., Shrivastava, R. and Salapaka, M.V., “Learning and estimation of single molecule behavior.” In 2018 Annual American Control Conference (ACC) (pp. 5125-5130). IEEE, June, 2018.

TALKS, PRESENTATIONS, AND POSTERS

Rajaganapathy, S., Chowdhury, S., Buchner, V., He, Z., Jiang, X., Yang, P., Cerhan, J.R., Zong, N., “Synoptic Reporting using Large Language Models”, AMIA Clinical Informatics Conference 2024, Minneapolis, MN.

Rajaganapathy, S., Shrivastava, R., Salapaka, M., “Modeling, Estimation, and Control for Single Molecule Investigation - Part 2 Instrumentation”, (*invited tutorial*), Modeling, Estimation, and Control Conference 2022, Jersey City, NJ.

Rajaganapathy, S., Hua, C. and Salapaka, M., “Confidence bounds for the Jarzynski estimator.” In APS March Meeting Abstracts (Vol. 2022, pp. S09-007), 2022.

Lopez, M.P.R., **Rajaganapathy, S.**, Gordon, W.R., Salapaka, M.V. and Ervasti, J.M., “The Mechanical Properties of a Utrophin Construct Encoding the Tandem CH Actin Binding Domain through Spectrin Repeat 3 is Altered by the Cell Expression System through Post-Translational Modifications.” *Biophysical Journal*, 118(3), pp.257a-258a, 2020.

Shrivastava, R., Bhaban, S., Melbourne, J., **Rajaganapathy, S.** and Salapaka, M., “A Semi-Analytical Model to Investigate Cargo Transport by Bi-Directional Molecular Motor Ensemble.” In APS March Meeting Abstracts (Vol. 2019, pp. R64-006), 2019.

Rajaganapathy, S., Shrivastava, R., Jaro, J., Ghosal, S., Salapaka, M.V., “Robust Force Control for Single Molecule Force Spectroscopy.” Poster at International Scanning Probe Microscopy, Tempe, AZ, 2018.

Shrivastava, R., Bhaban, S., **Rajaganapathy, S.**, Li, M., Hays, T.S. and Salapaka, M.V., “Transport Properties of Molecular Motor Ensemble with Bi-Directional Motors: A Computational Approach.” In *Molecular Biology Of The Cell* (Vol. 29, No. 26, pp. 109-110). 8120 Woodmont Ave, Ste 750, Bethesda, MD 20814-2755 USA: American Society of Cell Biology, December, 2018.

REVIEWS

Reviewer for contributed articles in:

- American Medical Informatics Association
- IEEE Connected Health: Applications, Systems and Engineering
- American Control Conference
- Control and Decision Conference
- Indian Control Conference