Sivaraman Rajaganapathy

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Research Fellow, Mayo Clinic

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An **electrical engineer** and **machine learning researcher** with expertise in **statistics, data analysis, leveraging large language** and **deep learning** models for biophysics and biomedical systems. Passionate about advancing AI for scientific discovery with **over 4 years experience and multiple interdisciplinary collaborations**.

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

- **Rare Disease Diagnosis and Phenotyping:** Developing AI solutions for early diagnosis and phenotyping of rare diseases
- **LLM Powered Clinical Synopsis:** Developed strategy and language model for the synthesis of cancer synoptic reports from clinical notes to reduce physician burden *[Published in npj Health Systems]*
- **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 *[Published in JAMIA]*
- **Clinical Trial Emulation:** Worked with cross-functional team to rapidly design tool for emulating heart-failure drug trials in a state-of-the-art Mayo Clinic Platform

Novel Data Driven Algorithms for Non-equilibrium Experiments   **JUN 2020 — FEB 2023**
Ph.D. Project

- Designed algorithm for quantifying errors in non-equilibrium experiments *[Presented in APS 2022]*
- Released Python 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.

- 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

- Collaborated with biochemists to design force spectroscopy experiments characterizing single molecules of proteins linked to muscular dystrophy *[Published in Nature - Scientific Reports 2019]*
- Implemented robust force control in an atomic force microscope *[Presented in ISPM 2018]*
- 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 *[Presented in BPS 2020]*
- Automated experimental analysis, reducing processing time from 1 work day to 2 hours

Self-Learning Change Detection Algorithm   **SEPT 2015 — JUL 2020**
Ph.D. Project

- 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 *[Published in Automatica 2022]*

Intelligent Identifier & Auto-Tuner   **JUL 2012 — JUN 2013**
Received Institute Silver Medal - Master's Thesis

- 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 **MAR 2023 — PRESENT**
Dept. of Artificial Intelligence and Informatics, Mayo Clinic *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 **JUN — AUG 2019, 2021**
Rhythm Management, Boston Scientific Inc. *Arden Hills, MN*
- Developed deep learning algorithms for cardiac rhythm classification

Research and Teaching Assistant **SEPT 2015 — FEB 2023**
University of Minnesota, Twin-Cities *Minneapolis, MN*
- Conducted original research, designed and executed experiments, collaborated across disciplines, and mentored students

Systems Validation Engineer **JUN 2013 — JUN 2015**
Cypress Semiconductor Corporation *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**
- 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
- Graded assignments and exams

Linear Systems & Optimal Control   SEPT 2019 — DEC 2019
- Graded assignments and exams, held office hours

Intro to Circuits & Electronics   JUN 2017 — AUG 2017
- Graded assignments, held office hours

Teaching Assistant
IIT Bombay

Automation & Feedback Control   JAN 2013 — MAY 2013
- Developed lecture notes, graded assignments

Systems & Control Lab   MAY 2012 — DEC 2012
- 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   JAN 2024 — PRESENT
Department of AI and Informatics | Mayo Clinic

Lab Safety Officer   SEPT 2018 — FEB 2023
Salapaka Lab | University of Minnesota, Twin-Cities

Graduate Student Mentor   MAR 2022 — FEB 2023
Electrical and Computer Engineering | University of Minnesota, Twin-Cities

Grants Review Committee   MAR 2021 — AUG 2022
Council of Graduate Students | University of Minnesota, Twin-Cities

Alumni Student Mentor   MAY 2018 — MAY 2020
Alumni Association | IIT Bombay

Department Placement Coordinator   JUL 2012 — MAY 2013
Career Cell | IIT Bombay

Chair   JUL 2009 — MAY 2010
IEEE Students' Chapter | Fr. C.R.I.T, University of Mumbai

PUBLICATIONS

JOURNALS
In preparation/Review

Rajaganapathy, S., Hua, C. and Salapaka, M.V., "Quantifying Errors in the Jarzynski Estimator."

Published

Rajaganapathy, S., Chowdhury, S., Li, X., Buchner, V., He, Z., Zhang, R., Jiang, X., Yang, P., Cerhan, J.R. and Zong, N., 2025. "Synoptic reporting by summarizing cancer pathology reports using large language models." npj Health Systems, 2(1), p.11.

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

Hua, C., **Rajaganapathy, S.**, Slick, R.A., Vavra, J., Muretta, J.M., Ervasti, J.M. and Salapaka, M., "A Physics-Augmented Deep Learning Framework for Classifying Single Molecule Force Spectroscopy Data." In Forty-second International Conference on Machine Learning, July 2025. (Acceptance rate ~27%)

Das, T., Li, X., 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." Accepted, AMIA 2025.

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

Alfasly, S., **Rajaganapathy, S.**, "Practical AI in Healthcare: From fine-tuning large models to deployment with open-source tools.", *(Workshop)*, Mayo Clinic 2025 AI Summit, Rochester, MN.

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, Esimation, 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-Directiona I 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:
- Journal of Clinical and Translational Sciences
- American Medical Informatics Association
- IEEE Connected Health: Applications, Systems and Engineering
- American Control Conference
- Control and Decision Conference
- Indian Control Conference

PROFESSIONAL DEVELOPMENT & CERTIFICATIONS

- Fundamentals of Clinical and Translational Science (Mayo Clinic) **2024**
- Grant Writing (Grant Central at Mayo Clinic) **2024**