

## EDUCATION

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

## RESEARCH EXPERIENCE

<b>Novel Data Driven Algorithms for Non-equilibrium Experiments</b>	JUN 2020 — FEB 2023
<i>Ph.D. Project</i>	
<ul style="list-style-type: none"> <li>Designed algorithm for quantifying errors in non-equilibrium experiments [Presented in APS 2022]</li> <li>Released Python based toolbox for error quantification and validated on experimental data</li> </ul>	
<b>Modeling Nano-Mechanics of Muscle Proteins</b>	JAN 2017 — JAN 2023
<i>Ph.D. Project</i>	
<ul style="list-style-type: none"> <li>Collaborated with biochemists to design force spectroscopy experiments characterizing single molecules of proteins linked to muscular dystrophy [Published in Nature - Scientific Reports 2019]</li> <li>Implemented robust force control in an atomic force microscope [Presented in ISPM 2018]</li> <li>Developed Monte Carlo methods to capture molecules' observed behaviors</li> <li>Devised statistical tests to evaluate proteins for potential therapy</li> <li>Designed and conducted experiments revealing effect of expression system on proteins [Presented in BPS 2020]</li> <li>Automated experimental analysis, reducing processing time from 1 work day to 2 hours</li> </ul>	
<b>Self-Learning Change Detection Algorithm</b>	SEPT 2015 — JUL 2020
<i>Ph.D. Project</i>	
<ul style="list-style-type: none"> <li>Devised learning based method for detecting events with unknown event size and timing with provable guarantees</li> <li>Incorporated methods to handle noise, sensor dynamics, and non-linear distortion</li> <li>Implemented Python toolbox [Published in Automatica 2022]</li> </ul>	
<b>Intelligent Identifier &amp; Auto-Tuner</b>	JUL 2012 — JUN 2013
<i>Received Institute Silver Medal - Master's Thesis</i>	
<ul style="list-style-type: none"> <li>Developed an expert system to start controlling a plant with limited human supervision from a cold start</li> <li>Created algorithm that found models with &gt;60% fit for a large class of systems</li> </ul>	

## PROFESSIONAL EXPERIENCE

<b>Research Fellow</b>	MAR 2023 — PRESENT
<i>Dept. of Artificial Intelligence and Informatics, Mayo Clinic</i>	<i>Rochester, MN</i>
<ul style="list-style-type: none"> <li><b>Optimized Treatment Regimen:</b> Mentored intern to develop an algorithm that can optimize the Alzheimer's disease treatment regimen at the level of junior physicians.</li> <li><b>Automated Clinical Synopsis:</b> Developed strategy and language model for the synthesis of cancer synoptic reports from clinical notes to reduce physician burden.</li> <li><b>Alzheimer's Disease Prediction:</b> Developing smart models to detect Alzheimer's Disease using multi-modal lab tests, cognitive assessments, and clinical observations.</li> <li><b>Clinical Trial Emulation:</b> Working with cross-functional team to design tool for emulating heart-failure drug efficacy clinical trials in a state-of-the-art AI cloud-based platform.</li> </ul>	
<b>Research Intern</b>	JUN 2021 — AUG 2021
<i>Rhythm Management, Boston Scientific Inc.</i>	<i>Arden Hills, MN</i>
<ul style="list-style-type: none"> <li><b>Deep Learning Performance Analysis:</b> Identified limitations in the training data-set that lead to the prediction errors</li> <li><b>Data Augmentation:</b> Created methods to augment limited training data for improved machine learning model performance</li> </ul>	
<b>Research Intern</b>	JUN 2019 — AUG 2019
<i>Rhythm Management, Boston Scientific Inc.</i>	<i>Arden Hills, MN</i>
<ul style="list-style-type: none"> <li><b>Rhythm Classification:</b> Developed deep learning models to classify electrocardiograms from implantable devices</li> <li><b>Deep Learning Automation:</b> Built framework for hyper-parameter search (model optimization) and for using unlabeled data</li> </ul>	

## Systems Validation Engineer

Cypress Semiconductor Corporation

JUN 2013 — JUN 2015

Bengaluru, India

- **Generic Automation Platform:** Designed platform for automated validation of all Programmable Systems on Chips (PSoC)
- **Validation:** Responsible for functional validation of CAN and CapSense blocks and EMI/EMC certification of PSoCs
- **CapSense Algorithm Development:** Developed auto-tuning algorithms for capacitive touch sensors and gesture detection using 4 sensors

## PROJECTS

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### Deep Reinforcement Learning for Multi-System Interaction

- Investigated conditions that promote system-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

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### 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 — PRESENT

- 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

- Developed lecture notes, graded assignments

JAN 2013 — MAY 2013

### Systems & Control Lab

- Developed exercises for 2-Degree of Freedom helicopter control

MAY 2012 — DEC 2012

## SKILLS

Technical	Python, MATLAB, Simulink, Labview, Git, 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

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

*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.

*In preparation/Review*

**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.”

## 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

### Reviewed 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