CAILONG HUA

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A Ph.D. candidate with expertise in Artificial Intelligence, Machine Learning, and data analysis, driven by a passion for pushing the boundaries of machine learning in the field of single-molecule research.

EDUCATION

Ph.D. in Electrical Engineering with Computer Science Minor *08/2019 - Present*
University of Minnesota - Twin Cities | GPA: 3.947/4.0

Master of Science in Control Systems *09/2016 - 09/2017*
Imperial College London, London | GPA: 75.4/100 (Distinction)

Bachelor of Science in Automation Engineering *09/2015 - 07/2016*
Politecnico di Milano, Milano | GPA: 110/110

Bachelor of Engineering in Electronic Information and Engineering *09/2012 - 07/2016*
Tongji University, Shanghai | GPA: 89.52/100(4.45/5.0)

RESEARCH EXPERIENCE

Error Quantification for Non-Equilibrium Experiments with Limited Data *06/2020 - Present*
Ph.D. Thesis Project

- Developed algorithm for quantifying errors in non-equilibrium experiments
- Implemented the algorithm with a Python-based toolbox
- Validated the algorithm through a simulated spring-mass system under non-equilibrium conditions
- Established a proof through experiments conducted using Optical Tweezers with large noise

Single Molecule Modeling of Muscle Proteins *06/2021 - Present*
Ph.D. Thesis Project

- Designed force spectroscopy experiments characterizing muscle proteins that linked to muscular dystrophy
- Addressed electrostatic discharge issues in atomic force microscopy experiments through teamwork
- Automated analysis of experimental data with Matlab, reducing processing time from days to two hours
- Developed Monte Carlo simulation to replicate experimental processes
- Developed muscle protein modeling by conducting a statistical analysis of experimental data
- Reconstructed energy landscapes of proteins from noisy and uncertain data
- Collaborated with biochemists to investigate the impact of different expression systems on protein behavior
- In the process of developing Non-parametric energy landscape reconstruction methods with neural networks
- Planning to use machine learning to classify and generate force spectroscopy experimental data

Optical Tweezers Experiments *06/2023 - Present*
Ph.D. Thesis Project

- Carried out cell transfection, protein purification, DNA origami, gel assays, and motility assays for motor proteins myosin V and myosin VI
- Characterized motor proteins with Optical Tweezers
- Developed an experimental protocol for studying DNA hairpins with Optical Tweezers

Coordinating Wind Turbines in a Wind Farm *10/2016 - 09/2017*
Master Thesis Project

- Developed mechanical models for an individual wind turbine
- Created a wind farm model integrated with the electrical grid
- Designed a strategy to generate additional power according to variations in power frequency

RESEARCH PROJECTS

Determining Causality in Protein Unfolding Pathways *09/2022 - 12/2022*

- Uncovered causal relations from protein pulling data
- Quantified the change of effects among protein properties

- Examined both above questions assuming the existence of unobserved data.

Different Sampling Methods in Energy-Based Models/Neural Networks (EBMs) *09/2022 - 12/2022*

- Studied different Langevin-based sampling methods with 2D localization problem
- Employed these sampling techniques in conjunction with EBMs to reduce computational workload
- Improved performance on the MNIST dataset

Deep Learning based Pose-guided Person Image Generation *09/2021 - 12/2021*

- Employed a model based on Generative Adversarial Networks (GANs) to synthesize a realistic image of the person with the target pose based on a source image showing the person with a given pose
- Achieved performance improvement in terms of person transfer with the HUMBI dataset

Performance Discrepancy of Natural Language Processing (NLP) *09/2020 - 12/2020*

- Explored the effect of different fine-tuning layers and pooling strategies on the performance of the BERT model, a transformer based machine learning technique for NLP
- Improved both Accuracy and F1 scores compared to the original method

Robust Control for Self-erecting Inverted Pendulum *02/2020 - 05/2020*

- Stabilized control of the unstable self-erecting single inverted pendulum
- Implemented double PID control, LQR control, H_∞ and $\mu-$synthesis control

Automating Game Playing using Deep Reinforcement Learning *09/2019 - 12/2019*

- Designed an unsupervised agent to play the Flappy Bird game
- Applied Reinforcement Learning techniques to AI agent to learn the optimal policy and survive indefinitely

Control Techniques on Different Systems *10/2016 - 08/2018*

- Simulated unmanned aerial vehicles (UAVs) and implemented PID control on a physical UAV
- Utilized both PID control and model predictive control for an inverted pendulum system
- Performed H_∞ control design of HI-MAT experimental aircraft
- Carried out modeling and linearized control for grocery trolleys

PUBLICATIONS

Journals (In Preparation)

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

Journals (Published)

- Ramirez, M. P., Rajaganapathy, S., Hagerty, A. R., **Hua, C.**, Baxter, G. C., Vavra, J., ... & Ervasti, J. M. (2023). "Phosphorylation alters the mechanical stiffness of a model fragment of the dystrophin homologue utrophin." Journal of Biological Chemistry, 299(2).

Talks, Presentations, and Posters

- **Hua, C.**, Rajaganapathy, S., and Salapaka, M., "Quantifying Errors in the Jarzynski Estimator." In 9th Midwest Workshop on Control and Game Theory Poster 2023.
- Rajaganapathy, S., **Hua, C.** and Salapaka, M., "Confidence bounds for the Jarzynski estimator." In APS March Meeting Abstracts (Vol. 2022, pp. S09007), 2022.

TEACHING EXPERIENCE

Linear Control Systems Lab Teaching Assistant *09/2020 - Present*
University of Minnesota, Twin Cities

- Guided students in the successful implementation of linear control algorithms
- Transitioned the entire laboratory to an online format during the COVID time
- Enabled Hardwareinthe-Loop control for both DC motors and Magnetic Levitation Systems
- Mentored new teaching assistant

State Space Control Systems Lab Teaching Assistant *01/2021 - Present*
University of Minnesota, Twin Cities

- Instructed on advanced control technique implementation

- Modernized all experiments and updated manuals
- Enabled Hardwareinthe-Loop control for Torsion Systems, Inverted Pendulums, and Gyroscope

Electric Drives Lab Teaching Assistant *09/2022 - 12/2022*
University of Minnesota, Twin Cities

- Taught the principles and techniques of modeling and controlling DC motors and induction motors

Digital System Design Lab Teaching Assistant *09/2019 - 12/2019*
University of Minnesota, Twin Cities

- Instructed topics on four-way stoplight controller, Flip-Flops and multiplier, etc.

Microcontrollers Lab Teaching Assistant *01/2020 - 05/2020*
University of Minnesota, Twin Cities

- Instructed topics on programming, data structures, register maps, etc.
- Graded quizzes, lab reports, and projects

Mathematics Teaching Assistant *06/2013 - 07/2013*
Shanghai Only Education

- Assisted the instructor in preparing lessons and grading homework
- Taught a class of 40 students

SKILLS

Technical: Python; Matlab; Simulink; Latex; C; C++; R

Machine Learning Tools: Tensorflow, Pytorch, Scikit-Learn, Keras, Pandas, etc.

Communication: English; Chinese; Italian

HONORS & AWARDS

Appreciation in Teaching Assistant Support, University of Minnesota	*2021*
Electrical & Computer Engineering Department Fellowship, University of Minnesota	*2019*
Outstanding Graduate, Tongji University	*2016*
Third-Class Scholarship, Tongji University	*2014-2016*
China Scholarship Council Scholarship	*2015*
China National Scholarship	*2013*
First-Class Scholarship, Tongji University	*2013*