Science and Engineering 2, 381
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Ayush Pandey

Employment

Fall 2023 – **Assistant Professor of Teaching**, University of California, Merced, CA

Spring 2022 **Adjunct Professor**, Harvey Mudd College, CA, United States.
Designed and taught a course on "Introduction to Biological System Design" (E164 webpage)

Education

2018 – 2023 **California Institute of Technology**, Pasadena, CA, United States
Ph.D. in Control & Dynamical Systems
Advisor: *Dr. Richard M. Murray*
Committee: *Dr. John C. Doyle, Dr. Domitilla Del Vecchio, and Dr. Niles A. Pearce*
Thesis: Modeling Frameworks for Modular and Scalable Biocircuit Design

2017 – 2018 **California Institute of Technology**, Pasadena, CA, United States
Master's in Electrical Engineering

2012 – 2017 **Indian Institute of Technology (IIT)**, Kharagpur, India
Bachelor's in Instrumentation Engineering and Master's in Control Systems Engineering
Advisors: *Dr. Saurav Patra* & *Dr. Siddhartha Mukhopadhyay*

Research Grants

CITRIS-UC Institute — Lead PI for project on "Safety guarantees in the context of generative artificial intelligence models" funded under the CITRIS Seed Grant program. This project is in collaboration with Prof. Gireeja Ranade, UC Berkeley.

AFOSR MURI — As a graduate student, I co-wrote with Richard M. Murray along with five other PIs from MIT and Northeastern University a proposal that was funded by the Air Force Office of Scientific Research (AFOSR) MURI program. I helped write the proposed research to be conducted at Caltech as a part of this grant.

Caltech CEMI — Co-wrote a grant with a graduate student on "Model-Based Design of Microbial Self-Assembly Response to Environmental Conditions" for Caltech for Environmental Microbial Interactions (CEMI) seed grant call. Result: Funded with $20,000 support for supplies and graduate student stipend.

Honors and Awards

Faculty Success Initiative — Awarded $3000 by the School of Engineering, UC Merced for participation in the Faculty Success Initiative – Extramural Funding Fellowship.

Best Poster — For our poster at IWBDA 2020 on BioCRNpyler – a modular software for compiling biological system models in diverse contexts

Best Thesis — Awarded the best senior thesis in Instrumentation Engineering, IIT Kharagpur for the academic year 2015-2016

Ph.D. Fellowship — Awarded by the Electrical Engineering Department at Caltech for the academic year 2017-2018

Research Fellowship — Awarded $6000 for my summer internship in the SURF program at Caltech in 2015

Best Engineering Design — Won $8000 at a national engineering innovation competition organized by KPIT, India for designing an autonomous bicycle with dual mode of locomotion

Travel Grants — For travel and lodging support at conferences – COMBINE 2018, IWBDA 2019, Build-A-Cell (2019, 2021, 2022)

Peer-Reviewed Journal Publications

JOSS 2023 — **Ayush Pandey***, William Poole*, Anandh Swaminathan*, Victoria Hsiao, and Richard M. Murray. "Fast and flexible simulation and parameter estimation for synthetic biology using bioscrape." Journal of Open Source Software (JOSS), 2023. DOI: 10.21105.joss.05057, bioRxiv preprint.

* denotes equal contribution

ACS 2022 — **Ayush Pandey**, Makena L. Rodriguez, William Poole, and Richard M. Murray. "Characterization of Integrase and Excisionase Activity in Cell-free Protein Expression System Using a Modeling and Analysis Pipeline" ACS Synthetic Biology (2023). DOI:10.1021/acssynbio.2c00534

PLoS 2022 — William Poole, **Ayush Pandey**, Zoltan Tuza, Andrey Shur, and Richard M. Murray. "BioCRNpyler: Compiling chemical reaction networks from biomolecular parts in diverse contexts." PLoS Computational Biology (2022). DOI:10.1371/journal.pcbi.100997S

IJRNC 2022 — **Ayush Pandey**, and Richard M. Murray. "Robustness guarantees for structured model reduction of dynamical systems with applications to biomolecular models." International Journal of Robust and Nonlinear Control (2022). DOI:10.1002/rnc.6013

Peer-Reviewed Conference Papers

IWBDA 2022 **Ayush Pandey***, Inigo Incer*, Alberto Sangiovanni-Vincentelli, and Richard M. Murray. "From Specification to Implementation: Assume-Guarantee Contracts for Synthetic Biology." International Workshop on Bio-Design Automation (2022). Accepted as a talk. DOI:10.1101/2022.04.08.487709

* denotes equal contribution

IWBDA 2022 **Ayush Pandey**, Makena L. Rodriguez, William Poole, and Richard M. Murray. "Characterization of integrase and excisionase activity in cell-free protein expression system using a modeling and analysis pipeline" International Workshop on Bio-Design Automation (2022). Accepted as a talk.

CDC 2021 **Ayush Pandey** and Richard M. Murray. "Robustness Guarantees for Structured Model Reduction of Dynamical Systems". 2021 IEEE Conference on Decision and Control. PDF.

ACC 2020 **Ayush Pandey** and Aaron D. Ames. "On a Converse theorem for Finite-time Lyapunov Functions to Estimate Domains of Attraction." In American Control Conference (ACC). IEEE, 2020. DOI: 10.23919/ACC45564.2020.9147709

IWBDA 2019 **Ayush Pandey** and Richard M. Murray. "An automated model reduction tool to guide the design and analysis of synthetic biological circuits." bioRxiv (2019). DOI: 10.1101/640276

IRC 2017 **Ayush Pandey**, Siddharth Jha, and Debashish Chakravarty. "Modeling and control of an autonomous three wheeled mobile robot with front steer." In First IEEE International Conference on Robotic Computing (IRC). IEEE, 2017. DOI: 10.1109/IRC.2017.67

ITEC 2015 **Ayush Pandey**, Subhamoy Mahajan et al. "Low cost autonomous navigation and control of a mechanically balanced bicycle with dual locomotion mode." In International Transportation Electrification Conference (ITEC). IEEE, 2015. DOI: 10.1109/ITEC-India.2015.7386938

Preprints

bioRxiv 2023 Zoila E. Jurado Quiroga, **Ayush Pandey**, Richard M Murray. "A pure chemical reaction network of PURE" bioRxiv (2023). DOI: 10.1101/2023.08.14.553301

arXiv 2023 Inigo Incer, Apurva Badithela, Josefine Graebener, Piergiuseppe Mallozzi, **Ayush Pandey**, Sheng-Jung Yu, Albert Benveniste, Benoit Caillaud, Richard M Murray, Alberto Sangiovanni-Vincentelli, Sanjit A Seshia. "Pacti: Scaling Assume-Guarantee Reasoning for System Analysis and Design" arXiv (2023). DOI: arXiv:2303.17751

IBDRC 2020 **Ayush Pandey** and Richard M. Murray. "A two-state ribosome and protein model can robustly capture the chemical reaction dynamics of gene expression." bioRxiv (2020). DOI: 10.1101/2020.11.25.399287

bioRxiv 2020 Liana N. Merk, Andrey S. Shur, **Ayush Pandey**, Richard M. Murray, and Leopold N. Green. "Engineering Logical Inflammation Sensing Circuit for Modulating Gut Conditions." bioRxiv (2020). DOI: 10.1101/2020.11.10.377085

SEED 2019 Reed D. McCardell, **Ayush Pandey**, and Richard M. Murray. "Control of density and composition in an engineered two-member bacterial community." bioRxiv (2019). DOI: 10.1101/632174

q-Bio 2020 **Ayush Pandey** and Richard M. Murray. "Model Reduction Tools For Phenomenological Modeling of Input-Controlled Biological Circuits." bioRxiv (2020). DOI: 10.1101/2020.02.15.950840

arXiv 2016 **Ayush Pandey** "Information Performance Tradeoffs in Control." arXiv preprint:(2016). DOI: 1611.01827v2

LIGO 2015 **Ayush Pandey**, Christopher Wipf, et al. "Quantization Noise Analysis in Advanced LIGO Digital Control System". In: Technical Report, LIGO, Louisiana, USA. 2015. PDF.

Teaching Experience

2023 **Assistant Professor**, *UC Merced*.
ME 021: Engineering Computing (student evaluation 6.1/7) and CSE 019: Introduction to Computing (student evaluation 6.1/7)

2022 **Adjunct Professor**, *Harvey Mudd College*.
Designed a course on biological system design, mathematical modeling, and computational tools for systems engineering and analysis. Apart from designing the course topics, syllabus, and assignments from scratch, I gave 36 hours of in-person lectures, held regular office hours, and mentored class projects. Student evaluations 6.59/7.

Winter 2022 **Teaching Assistant**, *Caltech*.
TA for the Optimal Control and Estimation course for 20 graduate students at Caltech. Gave a tutorial-style lecture on Bayesian inference in addition to the regular office hours, recitation, homework design, and grading work.

Fall 2021 & Fall 2022 **Workshop Organizer**, *International Workshop on Bio-Design Automation (IWBDA)*.
Organized a workshop at IWBDA 2021 and 2022 on modeling biological systems and using Bayesian inference to identify parameters from experimental data.

Spring 2020 **Lecturer**, *Caltech BE240 – Open Source Tools for Biological Circuit Design*.
Gave 4 lectures and organized tutorial sessions for graduate and undergraduate students enrolled for the BE240 course at Caltech.

Summer 2020 **Organizer & Lecturer**, *YouTube Tutorial Series on Modeling & Analysis of Biological Systems*.
Organized a bootcamp for summer undergraduate research fellows (SURF) at Caltech and members of the Build-A-Cell consortium. The video lectures from the series were later published as tutorials on YouTube.

Fall 2019 **Teaching Assistant**, *Caltech*.
TA for the Linear Systems Course for 32 students at Caltech. Gave 4 lectures in addition to the regular office hours, homework design, and grading work.

Spring 2017 **Teaching Assistant**, *IIT Kharagpur*.
TA for the Nonlinear Control course for graduate students at IIT Kharagpur. Designed and presented recitation material for students.

2017 – 2018 **Teaching Assistant**, *IIT Kharagpur*.
TA for two labs: Measurements and Instrumentation (Fall) and Control Systems (Spring).

Mentoring Experience

2022 – **Graduate Students**.

Name	University	Role	Next Position
Zoila Jurado Quiroga	Caltech	Ph.D. Committee Member	–
Harikrishnan R. Namboothiri	Texas A&M University	Ph.D. Committee Member	–
Alex Johnson	Caltech	Mentor	–
Nikos Mynhier	Caltech	Mentor	–

2023 – **Undergraduate Students**, *UC Merced*.

Name	Year	Project	Next Position
Alex Frias	CSE Senior (2023-24)	LLM-based autograder	–
Max Fu	CSE Freshman (2023-24)	LLM-based autograder	–
Hiruy Benyam	EE Freshman (2023-24)	EE education	–
Aksheen Rathod	CSE Freshman (2023-24)	LLM-based autograder	–

2017 – 2023 **Undergraduate Students**, *Caltech*.

Name	Year	Project	Next Position
Makena Rodriguez	Senior Biology and Biological Engineering (2021-22)	Model-guided biological circuit design. Manuscript published in ACS Synthetic Biology.	–
Anthony Chiang	Caltech SURF 2022	Cell-free modeling	–
Robert Hansen Jagrelius	Caltech SURF 2022	Metabolic modeling	–
Bridget Yang	Caltech SURF 2021	Synthetic cell modeling	–
Pranay Satya	Caltech SURF 2021	Synthetic cell modeling	–
Halle Holzbauer	Caltech SURF 2021	Synthetic cell modeling	–
Katherine Pan	Caltech SURF 2020	–	Harvard Medical School
Ankita Roychudhary	Caltech SURF and Senior Thesis 2020	Metabolic modeling	Northwestern Grad
Liana Merk	Caltech SURF 2020	Biocircuit modeling	Harvard Grad
Nazmus Sadaat	Caltech SURF 2020	Biocircuit modeling	–
Agrima Deedwania	Caltech SURF 2020	Biocircuit modeling	–
Hope Arnett	Caltech Freshman Summer Research Institute (FSRI) 2020	Biocircuit modeling	–

2022 **Undergraduate Students**, *Harvey Mudd College*.

Name	Year	Project	Next Position
Spencer Uyematsu	Senior, Pomona College (2022-23)	Stem-cell differentiation modeling	–
Trenton Weasley	Senior, Computational Biology (2022)	Stochastic cell-fate simulations	–

2023 – **Co-adviser IEEE Student Chapter**, *UC Merced*.
The IEEE Student Chapter at UC Merced is leading hands-on undergraduate projects.

2013 **Workshop Leader**, *IEEE Sponsored Robotics Workshop*.
Hands-on tutorial for robotics and 20 lectures on electronic circuit design for mobile robots.

Patent

2016 **Ayush Pandey**, Subhamoy Mahajan, et al. "Autonomous Two-Wheeler with Dual Mode of Locomotion". Indian Patent Under Review: 201631025904, Filed Oct. 2016. Revised Jan 2022.

Community Service

DEI Lab representative for Diversity, Equity, and Inclusion (DEI) in Biology and Biological Engineering.

Resident Associate for two undergraduate dorms at Caltech.

Mentor in the Freshman Summer Research Institute (FSRI) program at Caltech designed to introduce scientific research to underrepresented minorities in STEM.

Awareness drive in the undergraduate housing at Caltech as a part of Black History Month.

Conferences 2022: Publication Chair, Core Organizing Team, 14th International Workshop on Bio-Design Automation (IWBDA)

2021: Conference on Decision and Control (CDC) Volunteer

2021: Workshop Organizer at 13th International Workshop on Bio-Design Automation (IWBDA) conference

Guest Editor Virtual Special Issue on IWBDA 2022 in ACS Synthetic Biology

Reviewer 2023: ACS Synthetic Biology

2023: Wiley International Journal of Robust and Nonlinear Control (IJRNC)

2022: Conference on Decision and Control

2022: International Journal of Control

2022: International Workshop on Bio-Design Automation

2021: Journal of Open Source Software (JOSS)

Contributed & Invited Talks

Data Science, Berkeley "Enhancing Student Learning and Research with Open-Source Tools for Data Science". Data Science Seminar, Electrical Engineering and Computer Science, University of California, Berkeley.

Colloquium, UCR "Empowering Interdisciplinary Learning and Research with Open-Source Tools for Computational Biology". Computer Science Colloquium, University of California, Riverside.

IWBDA 2022 "Characterization of integrase and excisionase activity in cell-free protein expression system using a modeling and analysis pipeline". International Workshop on Bio-Design Automation held with iGEM Jamboree, in Paris, France.

IWBDA 2022 "From Specification to Implementation: Assume-Guarantee Contracts for Synthetic Biology". International Workshop on Bio-Design Automation held with iGEM Jamboree, in Paris, France.

IBDRC 2021 "On reduced models for gene expression and biological circuit design". International Bio-Design Research Conference (IBDRC), Virtual.

Build-A-Cell 2020 "On biosensors and synthetic biology". Build-A-Cell Seminar Series, Virtual.

ACC 2020 "On a new converse Lyapunov theorem and its application for domain of attraction computation". American Control Conference, Virtual.

q-Bio 2020 "On Auto-Reduce – A Python toolbox for model reduction". Quantitative Biology at Hawaii, US.

Imperial College "On an automated method for model reduction of synthetic biological circuits". At Imperial College London, July 2019.

IWBDA 2019 "On an automated method for model reduction of synthetic biological circuits". International Workshop on Bio-Design Automation at University of Cambridge, UK.

COMBINE 2018 "On Sub-SBML – A software package to combine multiple models of biological systems using compartmentalization". COMBINE at University of Boston, US.

IRC 2017 "On modeling and control of an autonomous three-wheeled mobile robot with front steer". International Robotics Conference at Taichung, Taiwan (ROC).

ITEC 2015 "On i-Bike – An autonomous bike with switchable modes of locomotion". International Transportation Electrification Conference at Chennai, India.

Workshops & Certifications

Teaching Attended the "Mobile Summer Institute on Scientific Teaching" workshop organized by UC Merced Teaching and Learning Commons and the Howard Hughes Medical Institute (HHMI) Inclusive Excellence Grant.

Teaching Received the "Certificate of Interest in Teaching" organized by Caltech Project for Effective Teaching (CPET)

Teaching Attended workshops on teaching pedagogy and teaching accessibility organized by Caltech Center for Teaching, Learning, and Outreach (CTLO) office

Student Wellness Certificate workshop on suicide prevention at Caltech