# Ayush Pandey

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## Employment

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| Fall 2023 – | **Tenure-Track Assistant Professor of Teaching**, University of California, Merced, CA |
| Spring 2022 | **Adjunct Professor**, Harvey Mudd College, CA, United States. |

## Education

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| 2018 – 2023 | **California Institute of Technology**, Pasadena, CA, United States<br>Ph.D. in Control & Dynamical Systems<br>Advisor: *Dr. Richard M. Murray*<br>Committee: *Dr. John C. Doyle, Dr. Domitilla Del Vecchio, and Dr. Niles A. Pearce*<br>*Thesis*: Modeling Frameworks for Modular and Scalable Biocircuit Design |
| 2017 – 2018 | **California Institute of Technology**, Pasadena, CA, United States<br>Master's in Electrical Engineering |
| 2012 – 2017 | **Indian Institute of Technology (IIT)**, Kharagpur, India<br>Bachelor's in Instrumentation Engineering and Master's in Control Systems Engineering<br>Advisors: *Dr. Saurav Patra & Dr. Siddhartha Mukhopadhyay* |

## Research Grants

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| 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 Gireeja Ranade at UC Berkeley. Total funded amount: $60,000 |
| UC Merced Academic Senate | PI for project on "Safety guarantees for large language models" funded by the Committee on Research. Total funded amount: $9872. |
| 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, 2022, Build-A-Cell (2019, 2021, 2022)

## Professional Development

AI for education — Selected to participate in the professional development workshop on designing courses to use AI as an ally. Awarded $2000 for this Course Design Institute.

Scientific Teaching — Awarded $300 professional development funds for participation in UC Merced's 3rd Mobile Summer Institute on Scientific Teaching (MoSIST).

Early career mentorship — Selected to participate in the early career faculty mentorship program to participate in the ACM Technical Symposium on Computer Science Education (TS SIGCSE 2024). Awarded $1500 for this mentoring program.

ABET Program Assessment — Eight professional development hours for participation in the ABET Fundamentals of Program Assessment Workshop

## Peer-Reviewed Journal Publications

**ACM TCPS 2024** 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. Minor revision in ACM Transactions on Cyber Physical Systems.

**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. "BioCRN-pyler: 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

**ASEE 2024** Shailja, Satish Kumar, Arthur Caetano, and **Ayush Pandey**. "Scaffolding AI research projects increases self-efficacy of high school students in learning neural networks (Fundamental)" American Society of Engineering Education Symposium (2024). Accepted for presentation in June 2024.

**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

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.*

| Course | Enrollment | Staff | Products (in progress) | Evaluation (/7) |
|---|---|---|---|---|
| Spring '24 USTU 020: Introduction to Problem Solving | 40 UG | 2 UG readers | Hands-on engineering education | – |
| Fall '23 ME 021: Engineering Computing | 207 UG | 3 Grad TAs, 1 UG reader | Scalable active learning in engineering | $6.1 \pm 1.3$ |
| Fall '23 CSE 019: Introduction to Computing | 57 UG | 1 Grad TA | Active learning in CSE | $6.1 \pm 1.3$ |

**2022** **Adjunct Professor**, *Harvey Mudd College.*

| Course | Products | Evaluation |
|---|---|---|
| Spring '22 ENGR 163: Introduction to Biomedical Engineering | New interactive notebook-based course design | 6.59/7 |

**Fall 2019 &** **Teaching Assistant**, *Caltech.*
**Winter 2022** (Winter 2022) TA for the Optimal Control and Estimation course. (Fall 2019) TA for the Linear Systems course

**Fall 2021 &** **Workshop Organizer**, *International Workshop on Bio-Design Automation (IWBDA).*
**Fall 2022** 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.

**2017 – 2018** **Teaching Assistant**, *IIT Kharagpur.*
TA for the Nonlinear Control course for graduate students. TA for two lab courses for undergraduates: 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/Program | Project | Next Position |
|---|---|---|---|
| Alex Frias | CSE Senior (2023-24) | LLM-based autograder | – |
| Max Fu | CSE Freshman (2023-24) | LLM-based autograder | – |
| Mahanth Mohan | CSE Freshman (2023-24) | EE education | – |
| Aksheen Rathod | CSE Freshman (2023-24) | LLM-based autograder | – |
| Saaketh Raghava | CSE Freshman (Summer 2024) | LLM performance and evaluations | – |

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

| Name | Year | Project | Next Position |
|---|---|---|---|
| Makena Rodriguez | Senior Biology and Biological Engineering (2021-22) | Model-guided biocircuit 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 (Med 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 of the 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.

## University Service

EE Curriculum Design   Co-designed a novel curriculum with four unique emphasis areas for the newly established Electrical Engineering department in the School of Engineering, UC Merced.

Curriculum Committee   Member of the curriculum founding committee for the new Electrical Engineering department at UC Merced. Participated in the development of three new Electrical Engineering courses and reviewed the proposed curriculum for 12 courses in total.

Enrollment Outreach   Participated in various outreach activities in an effort to expand enrollment at the university and in the Electrical Engineering program in the School of Engineering at UC Merced.

Faculty participant in the "Experience UC Merced" program where I demonstrated UC Merced classroom teaching to prospective students

Participated in a faculty panel at the UC Merced Admissions' Office reception event for newly admitted students and their parents.

Bobcat day tabling to promote the new EE major among newly admitted students.

Faculty participant in the high school educators tour where I consulted with educators and counselors from across California about unique aspects of UC Merced.

IEEE Chapter   Faculty co-advisor to the IEEE student chapter at UC Merced, part of the IEEE Oakland East Bay section. Organized outreach activities such as a soldering workshop, events in collaboration with the UC Merced makerspace lab, and robotics competitions.

DEI Activities   Participated in a faculty panel at the Fiat Lux Scholars Program designed to promote networking among eligible first-generation undergraduate students at UC Merced.

Faculty mentor in the Central Valley Pathways into Academic, Teaching, and Higher Education program

Faculty mentor in the Cal-Bridge Summer program where I mentored a scholar from Fresno State University on a research project.

Lab representative for Diversity, Equity, and Inclusion (DEI) in Biology and Biological Engineering at California Institute of Technology.

Resident Associate for two undergraduate dorms at California Institute of Technology.

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.

## Academic Community Service

**Publication Chair** — Part of the core organizing team and the publication chair for the 14th International Workshop on Bio-Design Automation (IWBDA)

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

**Reviewer** — IEEE Transactions on Automatic Control (1 paper)
ACS Synthetic Biology (2 papers)
Wiley International Journal of Robust and Nonlinear Control (2 papers)
Conference on Decision and Control (3 papers)
International Journal of Control (1 paper)
International Workshop on Bio-Design Automation (7 papers)
Journal of Open Source Software (JOSS) (2 papers)

**Volunteer** — Conference on Decision and Control (CDC), 2021 Volunteer

**Panel Speaker** — Invited panelist at the career panel for the Postdoctoral Fellowship Program for Engineering Excellence at MIT
Faculty panelist at UC Merced Admissions Office Bay area reception for newly admitted students and parents.

**Workshop Organizer** — Organized a modeling workshop at the 13th International Workshop on Bio-Design Automation (IWBDA) conference

## Contributed & Invited Talks

**UROC, UC Merced** — "Measuring the hallucinations of ChatGPT". Undergraduate Research Opportunities Center (UROC), Faculty Flash Talks, University of California, Merced.

**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.

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| 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

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| 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 |