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# Ayush Pandey

## Employment

Fall 2023 – **(Tenure-Track) Assistant Professor of Teaching**, University of California, Merced, CA

Spring 2022 **Adjunct Professor**, Harvey Mudd College, CA, United States.

## 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 Gireeja Ranade at UC Berkeley.

UC Merced Academic Senate — PI for project on "Safety guarantees for large language models" funded by the Committee on Research.

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.

## Honors and Awards

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

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

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 — Conference travel support grants – NSF NAIRR AI Unlocked Workshop 2025, Google CAHSI Ideation Workshop 2024, AI at Scale workshop at UC Riverside, INSPIRE 2024 by CA Learning Lab, COMBINE 2018, IWBDA 2019, 2022, Build-A-Cell (2019, 2021, 2022)

## Peer-Reviewed Journal Publications

ACM TCPS 2025 — 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). ACM Transactions on Cyber Physical Systems (2025). .

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

ASEE 2025 Alex Frias, Shrivaikunth Krishnakumar, and **Ayush Pandey**. "FlexiGrader: an LLM-based personalized autograder to enable flexible and open-ended creative exploration in CS1" American Society of Engineering Education Symposium (2025). Accepted as an oral presentation (PDF).

CDC 2024 Inigo Incer, Ayush Pandey, Nicholas Nolan, Emma L Peterman, Kate E Galloway, Eduardo D Sontag, Domitilla Del Vecchio. "Guaranteeing System-level Properties in Genetic Circuits Subject to Context Effects" IEEE Conference on Decision and Control (2024). Accepted as an oral presentation.

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 as an oral presentation (PDF).

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

UCM UG Journal — Saaketh Raghava (Advisor: Ayush Pandey)."Classification of Hallucinations in Large Language Models Using a Novel Weighted Metric." UC Merced Undergraduate Research Journal 17.1 (2024).

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

LIGO 2015 — **Ayush Pandey**, Christopher Wipf, Jameson Graef Rollins, Rana Adhikari. "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) |
|---|---|---|---|
| Spring '25 EE 005: Designing and Building EE Systems (syllabus) | 73 UG | 4 UG readers | Hands-on EE |
| Fall '24 EE 021: Introduction to EE Programming (syllabus) | 80 UG | 1 Grad TA, 4 UG readers | CS1 with an EE flavor |
| Spring '24 USTU 020: Introduction to Problem Solving (syllabus) | 40 UG | 2 UG readers | Hands-on engineering education |
| Fall '23 ME 021: Engineering Computing (syllabus) | 207 UG | 3 Grad TAs, 1 UG reader | Personalized open-ended Python projects |
| Fall '23 CSE 019: Introduction to Computing (syllabus) | 57 UG | 1 Grad TA | Active learning in CSE |

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

| Course | Enrollment | Staff | Product |
|---|---|---|---|
| Spring '22 ENGR 163: Introduction to Biomedical Engineering | 5 | – | New interactive notebook-based course design |

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

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.

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 |
|---|---|---|---|
| Alex Frias | UC Merced | Research Specialist | – |
| Zoila Jurado Quiroga | Caltech | Ph.D. Committee (thesis) | – |
| Harikrishnan R. Namboothiri | Texas A&M University | M.S. Advisor | – |

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

| Name | Year/Program | Project | Next Position |
|---|---|---|---|
| Alex Frias | CSE Senior (2023-24) | LLM-based autograder | Research Specialist, UC Merced |
| Prerana Somarapu | CSE Junior (2024-) | Autonomous Vehicles | – |
| Saaketh Raghava | CSE Freshman (Summer 2024-) | Evaluation of LLMs | – |
| Collin Chuang | CSE Senior (Summer 2024) | AI autograder | UCI Grad Student |
| Jasper Morgal | CSE Senior (Fall 2024) | Autonomous Vehicles | – |
| Axel Muniz Tello | Applied Math Junior (2024-) | Kalman filters and LLMs | – |
| Shri Krishnakumar | CSE Senior (2024-) | Autograder | SJSU Grad Student |
| Thomas Williams | EE Freshman (2024-) | Thematic analysis | – |
| Randy Serrano | ME Senior (2023-24) | PURE modeling web app | – |
| Max Fu | CSE Freshman (2023-24) | LLM-based autograder | – |
| Mahanth Mohan | CSE Freshman (2023-24) | EE education | UCSD transfer |
| Aksheen Rathod | CSE Freshman (2023-24) | LLM-based autograder | – |
| Sy Wallace | Summer 2024, CV PATH | PURE modeling web app | – |
| Anirudh Kaushal | Summer 2024, CV PATH | Autograders for CS1 assessment | – |
| Alan Barrios | Summer 2024, Cal-Bridge | Cost analysis of an autograder | – |

2023 – **High School Students**, *UC Merced*.

| Name | Year | Project | Next Position |
|---|---|---|---|
| Rachit Jaiswal | High school (Summer 2024) | LLMs for navigation | – |
| William Yang | High school (Summer 2024) | Evaluation of LLMs | – |
| Mohit Ramesh Kumar | High school (Summer 2024) | Autograders for CS1 assessment | – |

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

| Name | Year | Project | Next Position |
|---|---|---|---|
| Makena Rodriguez | Senior Biological Engineering (2021-22) | Biocircuit design. | – |
| 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 Pre-Frosh 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 Granted: 558183 (2025)

## 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.

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| 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.<br>Faculty participant in the "Experience UC Merced" program where I demonstrated UC Merced classroom teaching to prospective students<br>Participated in a faculty panel at the UC Merced Admissions' Office reception event for newly admitted students and their parents.<br>Bobcat day tabling to promote the new EE major among newly admitted students.<br>Faculty participant in the high school educators tour where I consulted with educators and counselors from across California about unique aspects of UC Merced. |
| AIAA Student Chapter | Mentoring the AIAA student chapter at UC Merced in their research activities related to aviation and control. Faculty mentor for the CITRIS aviation prize team of AIAA club. |
| 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.<br>Faculty mentor in the Central Valley Pathways into Academic, Teaching, and Higher Education program<br>Faculty mentor in the Cal-Bridge Summer program where I mentored a scholar from Fresno State University on a research project.<br><br>Lab representative for Diversity, Equity, and Inclusion (DEI) in Biology and Biological Engineering at California Institute of Technology.<br>Resident Associate for two undergraduate dorms at California Institute of Technology.<br>Mentor in the Freshman Summer Research Institute (FSRI) program at Caltech designed to introduce scientific research to underrepresented minorities in STEM.<br>Awareness drive in the undergraduate housing at Caltech as a part of Black History Month. |

## Academic Community Service

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| Guest Editor | Virtual Special Issue on IWBDA 2022 in ACS Synthetic Biology. Published editorial: DOI:10.1021/acssynbio.4c00340 |
| Executive Editor | Member of the executive editorial board for the Art of Molecular Programming book leading the problem set team. The goal of the team is to review, edit, and add problem sets so that they are pedagogically consistent. |

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| Publication Chair | Part of the core organizing team and the publication chair for the 14th International Workshop on Bio-Design Automation (IWBDA) |
| Session Chair | American Society for Engineering Education (ASEE) Symposium (Session W133: Evaluating Engineering Excellence) |
| | International Workshop on Bio-Design Automation (Session 4: Softwares and Pipelines) |
| Panel Review | NSF Graduate Research Fellowship Program 2024-25 |
| Reviewer | IEEE Transactions on Automatic Control (2 papers) |
| | Conference on Decision and Control (3 papers) |
| | Wiley International Journal of Robust and Nonlinear Control (2 papers) |
| | ACM Special Interest Group on Computer Science Education (3 papers; 3 assignments) |
| | ASEE Data Science and Analytics Division (3 papers) |
| | ASEE Pre-College Engineering Education Division (3 papers) |
| | IEEE EDUCON Conference (3 papers) |
| | ACS Synthetic Biology (4 papers) |
| | International Journal of Control (1 paper) |
| | Nature Scientific Reports (2 papers) |
| | International Workshop on Bio-Design Automation (7 papers) |
| | Journal of Open Source Software (JOSS) (4 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. |
| | Faculty panelist at AIAA UC Merced Student Chapter's panel on graduate education |
| Workshop Organizer | Organized a modeling workshop at the 13th International Workshop on Bio-Design Automation (IWBDA) conference |

## Professional Development

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

## Contributed & Invited Talks

ASEE 2024 — "Can high school students learn neural networks?". 2024 American Society for Engineering Education (ASEE) Annual Symposium, Pre-College Engineering Education Division.

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.

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

Inclusion Certificate on Anti-Racist pedagogy, awarded by the Division of Equity, Justice, & Inclusive Excellence at UC Merced

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