

# Michaëlle N. Mayalu

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## EDUCATION & TRAINING

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<b>California Institute of Technology</b> <i>Postdoctoral Training in Computing and Mathematical Sciences</i>	Pasadena, CA March 2022
<b>Massachusetts Institute of Technology</b> <i>Doctor of Philosophy in Mechanical Engineering</i>	Cambridge, MA June 2017
<b>Massachusetts Institute of Technology</b> <i>Master of Science in Mechanical Engineering</i>	Cambridge, MA June 2012
<b>Massachusetts Institute of Technology</b> <i>Bachelor of Science in Mechanical Engineering</i>	Cambridge, MA June 2010

## POSITIONS & EMPLOYMENT

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<b>Assistant Professor of Mechanical Engineering</b> <i>Stanford University</i>	March 2022 – Present Stanford, CA
<b>Adjunct Assistant Professor of Engineering</b> <i>Harvey Mudd College</i>	August 2018 – Dec 2018 Claremont, CA

## AWARDS & HONORS

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- 2023 Hypothesis Fund Grantee**
- 2022 Burroughs Wellcome Fund PDEP Transition to Faculty Award**
- 2022 Terman Faculty Fellow**
- 2022 Gabilan Faculty Fellow**
- 2019 Burroughs Wellcome Fund Postdoctoral Enrichment Program Recipient**
- 2017 California Alliance Postdoctoral Fellowship Recipient**

## AFFILIATIONS & OTHER APPOINTMENTS

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<b>Stanford Bioengineering Department</b> <i>Courtesy Faculty appointment</i>	July 2023 - Present
<b>Stanford ICME</b> <i>Affiliated Faculty member</i>	May 2022 - Present
<b>Stanford Chem-H</b> <i>Affiliated Faculty member</i>	May 2022 - Present
<b>Stanford Bio-X</b> <i>Affiliated Faculty member</i>	March 2022 - Present
<b>Stanford Biophysics Graduate Program</b> <i>Participating Faculty member</i>	March 2022 - Present
<b>Stanford Mechanical Engineering Design Group</b> <i>Affiliated Faculty member</i>	May 2021 - Present
<b>Stanford Biomechanical Engineering Program</b> <i>Affiliated Faculty member</i>	May 2021 - Present
<b>Stanford Center for Longevity</b> <i>Affiliated Faculty member</i>	September 2022 - Present
<b>Stanford Wu Tzai Human Performance Alliance</b> <i>Affiliated Faculty member</i>	September 2022 - Present

*Authors are listed in the order of contribution, except for senior authors (e.g., advisors, PIs) who are listed at the end.*

### Refereed Journal Publications

- Huang, Y., **Mayalu, M. N.**, (2023). “Biomolecular Control Circuit with Inherent Bi-Stability is Applicable for Automatic Detection of Gut Infection.” *IEEE Control Systems Letters* vol. 7, pp. 2251–2256, doi: 10.1109/LCSYS.2023.3285766
- Ma, Y., Budde, M. W., **Mayalu, M. N.**, Zhu, J., Lu, A. C., Murray, R. M., Elowitz, M. B. (2022). “Synthetic mammalian signaling circuits for robust cell population control.” *Cell*, 185(6), 967-979.e12. doi : 10.1016/j.cell.2022.01.026
- **Mayalu M.N.**, Kim M-C, Asada HH (2019) “Multi-cell ECM compaction is predictable via superposition of nonlinear cell dynamics linearized in augmented state space.” *PLoS Comput Biol* 15(9): e1006798. <https://doi.org/10.1371/journal.pcbi.1006798>

### Refereed Conference/Symposia Proceedings

- **Mayalu, M.N.**, Sarma, A., Xiao, F., Doyle, J.C., Murray, R.M., “Systems Level Model of Dietary Effects on Cognition via the Microbiome-Gut-Brain Axis,” *Proceedings of the 2021 European Control Conference (ECC)*, Virtual Conference, June 29 - July 2, 2021.
- **Mayalu, M.N.**, Mehta, H., Murray, R.M., “Model of Paradoxical Signaling Regulated T-Cell Population Control for Design of Synthetic Circuits,” *Proceedings of the 2019 European Control Conference (ECC)*, Naples, IT, June 25-28, 2019.
- **Mayalu, M.N.**, Asada, H.H., “Modeling of Collective Cell Behaviors Interacting with Extracellular Matrix Using Dual Faceted Linearization,” *Proceedings of the 2018 ASME Dynamic Systems and Control Conference (DSCC)*, Atlanta, GA, September 30–October 3, 2018.
- **Mayalu, M.N.**, Asada, H.H., and Kim, M.C. “Latent Space Superposition of Multiple Solutions to Predict Emergent Behaviors of Nonlinear Cellular Systems,” *Proceedings of the 2017 American Control Conference (ACC)* Seattle, WA, May 24–26, 2017.
- Kim, M.C., **Mayalu, M.N.**, and Asada, H.H., “Dynamic Modeling of Collective Cell Migration on an Elastic Substrate of Extracellular Matrix fiber network,” *Proceedings of the 2016 American Control Conference (ACC)*, Boston, MA, July 6-8, 2016.
- **Mayalu, M.N.**, Kim, M.C., and Asada, H.H., “A Reduced Order Systems Approach to Prediction of Emergent Behaviors of Cellular Systems,” *Proceedings of the 2016 American Control Conference (ACC)*, Boston, MA, July 6-8, 2016.
- Asada, H.H., Wu, F., Girard, A., **Mayalu, M.N.**, “A Data-Driven Approach to Precise Linearization of Nonlinear Dynamical Systems in Augmented Latent Space,” *Proceedings of the 2016 American Control Conference (ACC)*, Boston, MA, July 6-8, 2016.
- **Mayalu, M.N.**, and Asada, H.H., “Multi-Model Selection of Integrated Mechanistic-Empirical Models Describing T-Cell Response,” *Proceedings of the 2015 American Control Conference (ACC)*, Chicago, IL, July 1-3, 2015.
- **Mayalu, M. N.**, Kim, M.C., Chan, V., Neal, D., Kim, H.Y., Asada, H.H., “A New Approach to Predicting Emergent Behaviors of Cell-ECM Interactions Using Stochastic Rules Generated from Mechanistic Computational Models,” *Proceedings of the 7th World Congress of Biomechanics*, Boston, MA, July 6-11, 2014.
- **Mayalu, M. N.**, and Asada, H.H. “An information-theoretic approach to integrated mechanistic-empirical modeling of cellular response based on intracellular signaling dynamics,” *Proceedings of 2014 American Control Conference (ACC)*, pp. 1755-1760, Portland, OR, June 4-6 2014.
- **Mayalu, M.N.**, Asada, H.H., “Integrated Mechanistic-Empirical Modeling of Cellular Response Based on Intracellular Signaling,” *Proceedings of the 2013 ASME Dynamic Systems and Control Conference (DSCC)*, Palo Alto, CA, October 21–23, 2013.
- **Mayalu, M.N.**, Asada, H.H., “A Time-Based Approach to Stochastic Modeling of Intracellular Signaling Events,” *Proceedings of the Dynamic Systems and Control Conference (DSCC)*, Fort Lauderdale, FL, October 17–19, 2012.
- Asada HH., Wang Y., **Mayalu M.N.** “Molecular Signaling Observer and Predictor: A Framework for Closed-Loop Control of Cell Behaviors Having Long Time Delay”, *Proceedings of the 2011 American Control Conference (ACC)*, San Francisco, CA, June 29 -July 1, 2011.

### Non-Refereed Publications

- **Mayalu, M. N** and Murray, R. M. (2020) “Theoretical Design of Paradoxical Signaling-Based Synthetic Population Control Circuit in *E. coli*”, *bioRxiv*. Cold Spring Harbor Laboratory, p. 2020.01.27.921734. doi: 10.1101/2020.01.27.921734.

## OTHER SCHOLARLY ACTIVITY

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### Invited lectures and seminars

- BIOPHYS 250: Seminar in Biophysics, Stanford, CA, February, 8th, 2024.
- Johns Hopkins University Mechanical Engineering Departmental Seminar, Baltimore, MD, November 30, 2023.
- Stanford BIOE 393: Bioengineering Departmental Research Colloquium Lecture, October 10, 2023.
- LIIGH-UNAM Horizons in Genomics Seminar, Virtual, Sept, 11, 2023.
- EBRC Synthetic Biology Young Speaker Series, Virtual, Sept 7, 2023.
- BIRS Emerging Mathematical Challenges in Synthetic Biological Network Design, August 17, 2023.
- CSHL Summer 2023 Synthetic Biology - Lecturer, Long Island, NY, July, 31, 2023.
- BIOPHYS 250: Seminar in Biophysics, Stanford, CA, Dec, 8, 2022.
- Stanford Bio-X Talks in English, Stanford, CA, Dec, 5, 2022.
- Stanford Advanced Seminar in Microbial Molecular Biology, Stanford, CA, Oct, 10, 2022.
- Stanford Biophysics Retreat Student Selected Faculty Talk, Stanford, CA, Sept, 19, 2022.
- University of Southern California, Aerospace and Mechanical Engineering Departmental Seminar, Los Angeles, CA, August 24, 2022.
- Stanford ICME Xpo Research Symposium Faculty Vision Talk, Stanford, CA, May, 24, 2022.
- BioControl Journal Club, Virtual, April 26, 2022.
- University of Virginia Mechanical Engineering Departmental Seminar, Virtual, April 14, 2022.
- Stanford Shriram Basement Seminar, Stanford, CA, July 8, 2022.
- 15th Annual q-bio Conference Invited Talk, Colorado State University, Fort Collins Colorado, June 15-17, 2022
- Stanford ICME Xpo Research Symposium Faculty Vision Talk, Stanford, CA, May, 24, 2022.
- BioControl Journal Club, Virtual, April 26, 2022.
- University of Virginia Mechanical Engineering Departmental Seminar, Virtual, April 14, 2022.
- Stanford Mechanical Engineering Women's Group Seminar, Stanford, CA, January 27, 2022.
- 3rd Annual AFROBIOTECH Conference, Virtual, October 27, 2021.
- University of Notre Dame Electrical Engineering Emerging Frontiers in the System Sciences Seminar, Virtual, Dec 9, 2020.
- Samueli Mechanical & Aerospace Engineering Department Seminar, UCLA, Los Angeles, CA, October 19, 2019.
- International Workshop on Control Engineering & Synthetic Biology, Oxford University, Oxford, UK, September 9–11, 2019.
- CS9: Intro to Computer Science Research, California Institute of Technology, Pasadena, CA, November 19, 2018.
- Southern California Control Workshop, UCLA, Los Angeles, CA, November 16, 2018.
- Controls and Dynamics Systems Seminar, California Institute of Technology, Pasadena, CA, January 23, 2017.

### Presentations given for Grant Reviews & Reports | *Selected presentations*

- ARO MURI Annual Review on Nutritional and Environmental Effects on the Gut Microbiome and Cognition, February 3 2023.
- ARO MURI Annual Review on Nutritional and Environmental Effects on the Gut Microbiome and Cognition, October 1 2021.
- DARPA Biological Control site visit and program review, University of California Berkeley, Berkeley, CA January 10 - 12 2017
- EBICS (Emergent Behaviors in Integrated Cellular Systems) Annual Retreat, UIUC, June 23-26 2012.
- NSF Emerging Frontiers in Research and Innovation Grantees Conference, Washington DC, March 23-25, 2011.

### Presentations given at conferences

- *Note: All conference papers above with my name as first author were presented by me at the associated conference.*

## PROFESSIONAL SOCIETY MEMBERSHIP

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**IEEE Control Systems Society**  
**National Society of Black Engineers**  
**American Society of Mechanical Engineers**  
**Society of Women Engineers**

## SIGNIFICANT STUDENT SUPERVISION

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### Graduate Students

- **Yulin Huang.** Current Stanford PhD student whose project surrounds dynamics and control theory of synthetic biological systems.
- **Gowri Subedar.** Current Stanford PhD student whose project surrounds modeling the communication axis between the gut, brain and skin.
- **Shai Bernard.** Current Stanford PhD student whose project surrounds dynamics and control theory of synthetic biological systems.

## INSTRUCTIONAL ACTIVITIES

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### Dynamics and Feedback Control of Living Systems

Stanford University, Stanford, CA

*Graduate course: BIOE 305, ME 305*

*Autumn quarter 2022, 2023*

- I developed and taught a new cross-disciplinary course that draws on principles from Systems Biology, Control and Dynamical Systems Theory with Numerical and Stochastic Simulation to explore feedback control mechanisms that living organisms implement to execute their function and the basics of re-engineering feedback control systems in order for cells to execute new decision making behaviors.

### Feedback Control Design

Stanford University, Stanford, CA

*Undergraduate course: ENGR 105*

*Winter quarter 2022, 2023*

- Design of linear feedback control systems for command-following error, stability, and dynamic response specifications. Root-locus and frequency response design techniques. Examples from a variety of fields.

### Optimization Techniques in Engineering Design

Haverly Mudd College, Claremont CA

*Graduate course (taught to undergraduates): E206*

*Autumn quarter 2018*

- I developed and taught a new course that provided a broad theoretical basis for system identification and estimation. Topics included Least squares estimation and its convergence properties, Principle Component Analysis, Partial Least Squares Regression, Kalman filter and extended Kalman filter, Noise Dynamics and System Representation.

## SERVICE

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### Professional & Other

- Stanford Mechanical Engineering Graduate Admissions Committee, Stanford, CA, 2023/2024
- Stanford Bioengineering Graduate Admissions Committee, Stanford, CA, 2023/2024
- Stanford Biophysics Graduate Admissions Committee, Stanford, CA, 2023/2024
- NIH Modeling and Analysis of Biological Systems Study Section Early Career Reviewer, Bethesda, MD, June, 2023
- Stanford Biophysics PhD Thesis Committee Member, Stanford, CA, May, 10, 2023
- NSF ERC for Connected Health and Aging-in-Place Technology Grant Planning Committee, Multi-Institutional, 2022/2023
- Stanford Mechanical Engineering Graduate Admissions Committee, Stanford, CA, 2022/2023
- Stanford Bionengineering PhD Thesis Defense Chair, Stanford, CA, November, 4, 2022
- Rising Stars in Mechanical Engineering Landing the Faculty Position Panelist, Stanford, CA, October, 6, 2022
- Session Co-chair at IEEE European Control Conference (ECC), Virtual, June 29 - July 2, 2021.
- Co-Chair of Student Activities Committee for 7th IEEE Conference on Control Technology and Applications (CCTA) 2023, Bridgetown, Barbados
- Session Co-chair at IEEE European Control Conference (ECC), Virtual, June 29 - July 2, 2021.
- Caltech Computing Advisory Committee, 2019.
- Session Co-chair at IEEE American Control Conference (ACC), Seattle, WA May 24-26, 2017.

### Community

- Stanford Women's Community Center We Are STEM: Faculty Discuss Gender, Identity, and their Journeys in STEM, Panelist, 2023
- Rising Stars in Mechanical Engineering Workshop Panelist, 2022
- Mentor for West-Ridge School for Girls student, 2018.
- Cambridge Science Festival, 2014.
- MIT Educational Studies Splash Program, 2013.