Stanford



# Michaëlle Ntala Mayalu

Assistant Professor of Mechanical Engineering and, by courtesy, of Bioengineering

NIH Biosketch available Online  Curriculum Vitae available Online

## Bio

### BIO

Dr. Michaëlle N. Mayalu is an Assistant Professor of Mechanical Engineering. She received her Ph.D., M.S., and B.S., degrees in Mechanical Engineering at the Massachusetts Institute of Technology. She was a postdoctoral scholar at the California Institute of Technology in the Computing and Mathematical Sciences Department. She was a 2017 California Alliance Postdoctoral Fellowship Program recipient and a 2019 Burroughs Wellcome Fund Postdoctoral Enrichment Program award recipient. She is also a 2023 Hypothesis Fund Grantee.

Dr. Michaëlle N. Mayalu's area of expertise is in mathematical modeling and control theory of synthetic biological and biomedical systems. She is interested in the development of control theoretic tools for understanding, controlling, and predicting biological function at the molecular, cellular, and organismal levels to optimize therapeutic intervention.

She is the director of the Mayalu Lab whose research objective is to investigate how to optimize biomedical therapeutic designs using theoretical and computational approaches coupled with experiments. Initial project concepts include: i) theoretical and experimental design of bacterial "microrobots" for preemptive and targeted therapeutic intervention, ii) system-level multi-scale modeling of gut associated skin disorders for virtual evaluation and optimization of therapy, iii) theoretical and experimental design of "microrobotic" swarms of engineered bacteria with sophisticated centralized and decentralized control schemes to explore possible mechanisms of pattern formation. The experimental projects in the Mayalu Lab utilize established techniques borrowed from the field of synthetic biology to develop synthetic genetic circuits in E. coli to make bacterial "microrobots". Ultimately the Mayalu Lab aims to develop accurate and efficient modeling frameworks that incorporate computation, dynamical systems, and control theory that will become more widespread and impactful in the design of electro-mechanical and biological therapeutic machines.

### ACADEMIC APPOINTMENTS

- Assistant Professor, Mechanical Engineering
- Assistant Professor (By courtesy), Bioengineering
- Member, Bio-X
- Member, Wu Tsai Human Performance Alliance
- Member, Institute for Computational and Mathematical Engineering (ICME)
- Faculty Fellow, Sarafan ChEM-H
- Member, Wu Tsai Neurosciences Institute

### HONORS AND AWARDS

- Hypothesis Fund Grantee, Hypothesis Fund (2023-2024)
- Postdoctoral Enrichment Program Transition to Faculty Award, Burroughs Wellcome Fund (2022 - 2023)
- Gabilan Faculty Fellow, Stanford University (2021 - 2024)
- Terman Faculty Fellow, Stanford University (2022)
- Postdoctoral Enrichment Program Award, Burroughs Wellcome Fund (2019 - 2021)
- California Alliance Postdoctoral Fellowship Award, The California Alliance (2017 - 2019)

### PROFESSIONAL EDUCATION

- Postdoctoral Scholar, Caltech , Computing and Mathematical Sciences (2022)
- PhD, Massachusetts Institute of Technology , Mechanical Engineering (2017)
- MS, Massachusetts Institute of Technology , Mechanical Engineering (2012)
- BS, Massachusetts institute of technology , Mechanical Engineering (2010)

### LINKS

- MayaluLab Website: https://mayalulab22.sites.stanford.edu
- Google Scholar: https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Michaelle+Mayalu&oq=Michaelle+

## Teaching

### COURSES

**2026-27**

- Dynamics and Feedback Control of Living Systems: BIOE 305, ME 305 (Aut)
- Feedback Control Design: ENGR 105 (Win)
- Identification and Estimation in Engineering Design: ME 286 (Spr)

**2025-26**

- Dynamics and Feedback Control of Living Systems: BIOE 305, ME 305 (Aut)
- Feedback Control Design: ENGR 105 (Win)

**2024-25**

- Dynamics and Feedback Control of Living Systems: BIOE 305, ME 305 (Aut)
- Feedback Control Design: ENGR 105 (Win)
- Identification and Estimation in Engineering Design: ME 286 (Spr)

**2023-24**

- Dynamics and Feedback Control of Living Systems: BIOE 305, ME 305 (Aut)
- Feedback Control Design: ENGR 105 (Win)
- Identification and Estimation in Engineering Design: ME 286 (Spr)

### STANFORD ADVISEES

**Doctoral Dissertation Reader (AC)**

Julian Perez

**Postdoctoral Faculty Sponsor**

Rohita Roy

**Doctoral Dissertation Advisor (AC)**

Shai Bernard, Valerie Perez Medina, Gowri Subedar

**Master's Program Advisor**

Rohan Garg, Gregory Osha, Jack Ren, Max Schaldach

**Doctoral Dissertation Co-Advisor (AC)**

Lucas Sant'Anna

**Doctoral (Program)**

Sitan Huang, Annie Mascot, Elise Yang, Jiawei Yang

### GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Biophysics (PhD Program)

## Publications

### PUBLICATIONS

- **CAR T cells from code to clinic: Framing modeling approaches with current translational research goals.** *Cell systems*
  Sant'Anna, L. E., Roy, R., Schwab, J. C., Perez, J. I., Mayalu, M. N.
  2026: 101716
- **Design and Modeling of Engineered Self-Organized Bacterial Colonies Exhibiting Substance-Responsive Pattern Perturbations** *IEEE CONTROL SYSTEMS LETTERS*
  Bernard, S., Mayalu, M. N.
  2025; 9: 2627-2632
- **Model of Biomolecular Controller with Bi-stability Simulates Gut Infection Detection and Treatment via Various Strategies**
  Zhang, D., Huang, Y., Mayalu, M. N., IEEE
  IEEE.2025: 2047-2052
- **Biomolecular Control Circuit With Inherent Bi-Stability Is Applicable for Automatic Detection of Gut Infection** *IEEE CONTROL SYSTEMS LETTERS*
  Huang, Y., Mayalu, M. N. N.
  2023; 7: 2251-2256
- **Synthetic mammalian signaling circuits for robust cell population control.** *Cell*
  Ma, Y., Budde, M. W., Mayalu, M. N., Zhu, J., Lu, A. C., Murray, R. M., Elowitz, M. B.
  2022
- **Systems Level Model of Dietary Effects on Cognition via the Microbiome-Gut-Brain Axis** *European Control Conference (ECC)*
  Mayalu, M. N., Sarma, A., Xiao, F., Doyle, J. ., Murray, R. .
  2021: 312-318
- **Systems Level Model of Dietary Effects on Cognition via the Microbiome-Gut-Brain Axis**
  Mayalu, M. N., Sarma, A., Xiao, F., Doyle, J. C., Murray, R. M., IEEE
  IEEE.2021: 312-318
- **Multi-cell ECM compaction is predictable via superposition of nonlinear cell dynamics linearized in augmented state space.** *PLoS computational biology*
  Mayalu, M. N., Kim, M. C., Asada, H. H.
  2019; 15 (9): e1006798
- **Model of Paradoxical Signaling Regulated T-Cell Population Control for Design of Synthetic Circuits** *18th European Control Conference (ECC)*

Mayalu, M. N., Mehta, H., Murray, R. .
2019: 2152-2158

- **Model of Paradoxical Signaling Regulated T-Cell Population Control for Design of Synthetic Circuits**
  Mayalu, M. N., Mehta, H., Murray, R. M., IEEE
  IEEE.2019: 2152-2158
- **Modeling of Collective Cell Behaviors Interacting with Extracellular Matrix Using Dual Faceted Linearization** *ASME Dynamic Systems and Control Conference*
  Mayalu, M. N., Kim, ., Asada, H.
  2018
- **Latent space superposition of multiple solutions to predict emergent behaviors of nonlinear cellular systems** *American Control Conference (ACC)*
  Mayalu, M. N., Asada, H., Kim, M.
  2017: 2146-2151
- **Latent Space Superposition of Multiple Solutions to Predict Emergent Behaviors of Nonlinear Cellular Systems**
  Mayalu, M. N., Asada, H., Kim, M., IEEE
  IEEE.2017: 2146-2151
- **A Reduced Order Systems Approach to Prediction of Emergent Behaviors of Cellular Systems**
  Mayalu, M. N., Kim, M., Asada, H., IEEE
  IEEE.2016: 2181-2186

## PRESENTATIONS

- Control Theoretic Applications for Biomedical Therapeutics - 3rd Annual AFROBIOTECH Conference (October 27, 2021)
- How Cells Control Their Population Size: Implications for Synthetic Biology - University of California Los Angeles (October 19, 2019)
- Modeling and Theoretical Design of Synthetic Paradoxical Signaling-Based Population Control Circuit - Oxford University (September 9, 2019 - September 11, 2019)