Santosh M. Rajkumar

Address and Contact Information

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Education

The Ohio State University *Columbus, OH*
Ph.D. in Mechanical Engineering (**GPA:** 4.0/4.0) *Aug 2023 – Present*

- **Status:** Post-Qualification (Areas: Mathematics, Measurements and Controls, System Dynamics and Vibration).
- **Focus:** *Data-driven modeling and control for nonlinear systems using Koopman Theory and ML.*

Miami University *Oxford, OH*
Master of Science in Mechanical Engineering (**GPA:** 4.0/4.0) *Jan 2021 – Jun 2023*

- **Thesis:** *Haptic Rendering in Touch Surfaces Using Multifrequency Electrostatic Actuation.*

National Institute of Technology Silchar *Silchar, India*
Bachelor of Technology in Electrical Engineering *Aug 2013 – May 2017*

- **Thesis:** *Online Time-delay Estimation & Adaptive Compensation in Control Over a Wireless Network.*

Experiences

Graduate Research Associate *Columbus, OH*
SOAR Lab, Department of MAE, The Ohio State University *Aug 2023 – Present*

- Developed data-driven bilinear models of nonlinear systems from noisy, partially measured data.
- Derived an analytical Koopman-based linear formulation for quadrotor dynamics on SE(3).
- Implemented a real-time Model Predictive Control (MPC) scheme using the linearized Koopman formulation for quadrotor flight control (in simulation).
- Leading experimental validation of the Koopman-linearized formulation and MPC scheme.

Graduate Research Assistant *Oxford, OH*
Singh Research Group, Department of MME, Miami University *Aug 2021 – May 2023*

- Developed finite element (FE) models of touch displays with electrostatic vibration actuators.
- Designed MATLAB routines for FE model dynamic simulation and demonstrated frequency-tuned haptic feedback in simulation.
- Fabricated prototypes for experimental validation of haptic touch interfaces.
- Utilized R for advanced visualization and clustering of experimental modal analysis data.

Senior Engineer *Dimpaur, India*
Indian Oil Corporation Limited (Fortune 500) *Jun 2017 – Dec 2020*

- Maintained automation and electrical systems in critical petroleum installations.
- Applied vibration-based monitoring on rotating machinery.

- Led vision-based robotic inspections of storage facilities.
- Developed web applications (JS, Python, AWS) and managed vendor negotiations and SAP-based acquisitions.
- Trained large industrial workforces in safety procedures.

Publications and Scholarly Works

Patents

- Deb, D., Dey, R., Chakraborty, S., **Rajkumar, S. M.** (2017). Wireless Network Based Embedded Control Design Method for Actuators with Uncertain Delays (Indian Patent No. 498633). Patent Journal

Article Preprints

- **Rajkumar, S. M.**, Cheng, S., Hovakimyan, N., & Goswami, D. (2024). Linear Model Predictive Control for Quadrotors with an Analytically Derived Koopman Model. (Submitted to IEEE Control System Letters.) arXiv
- **Rajkumar, S.** (2022). Effect of Infill Pattern and Build Orientation on Mechanical Properties of FDM Printed Parts: An Experimental Modal Analysis Approach. arXiv

Journal Articles

- **Rajkumar, S. M.**, Singh, K. V., Yang, T. H., & Koo, J. H. (2023). Modeling and Experimental Evaluation of Haptic Localization Using Electrostatic Vibration Actuators. *IEEE Access*, 11, 18582–18589. link
- **Rajkumar, S. M.**, Chakraborty, S., Dey, R., & Deb, D. (2020). Online Delay Estimation and Adaptive Compensation in Wireless Networked Systems: An Embedded Control Design. *International Journal of Control, Automation and Systems*, 18(4), 856–866. link

Peer-Reviewed Conference Articles

- **Rajkumar, S. M.**, Singh, K. V., Koo, J. H., & Yang, T. H. (2023, August). Modeling and Analysis of a Thin Plate with Multiple Harmonic Excitations for Vibrotactile Touch Display Applications. In *IDETC-CIE* (Vol. 87400, p. V012T12A018). link
- **Rajkumar, S. M.**, Singh, K. V., & Koo, J. H. (2022, October). Modeling and Analysis of Multiple Electrostatic Actuators on a Vibrotactile Haptic Device. In *ASME IMECE* (Vol. 86625, p. V001T01A004). link

Electronic Thesis

- **Rajkumar, S. M.** (2023). *Modeling and Experimental Evaluation of Haptic Rendering in Touch Surfaces Using Multifrequency Electrostatic Actuation* (Master's thesis, Miami University). link

Technical Presentations

- **2024 Midwest Robotics Workshop,** Toyota Technological Institute at Chicago: Poster on *Linear MPC for Quadrotors: A Model-based Koopman Approach* (April 2024).
- **ASME IDETC-CIE Conference 2023,** Boston, MA: Presentation on *Modeling and Analysis of a Thin Plate with Multiple Harmonic Excitations for Vibrotactile Touch Display Applications* (August 2023).
- **ASME IMECE 2022,** Columbus, OH: Presentation on *Modeling and Analysis of Multiple Electrostatic Actuators on a Vibrotactile Haptic Device* (November 2022).
- **Graduate Research Forum 2022,** Miami University: Poster on *Modeling of Large Touch Surfaces with Electrostatic Actuators for Localized Haptic Feedback* (November 2022).

Teaching Experience

- **Teaching Assistant,** MME 321 (System Modeling, Analysis, & Control), Miami University (Spring 2023).
- **Teaching Assistant,** MME 315 (Mechanical Vibrations), Miami University (Winter 2023, Summer 2021, Spring 2021).
- **Teaching Assistant,** MME 436/536 (Control of Dynamic Systems), Miami University (Fall 2022, Spring 2022, Winter 2022, Fall 2021).
- **Teaching Assistant,** MME 437 (Manufacturing Automation), Miami University (Spring 2021).

Coursework

- **Doctoral:** MECHENG 8220 Optimal Control, MECHENG 8230 Nonlinear Dynamics, MECHENG 8518 Advanced Math Methods, ECE 6750 Nonlinear Systems.
- **Master's Level:** MME 621 Finite Element Analysis, ECE 514 Robotics: Design and Modeling, CSE 586 Intro to AI, STA 504 Advanced Data Visualization, MME 512 Advanced Mechanics of Materials, MME 595 Applied Nonlinear Dynamics, MME 612 Engineering Analysis, MME 536 Control of Dynamic Systems.

Awards and Achievements

- **GRA Award:** Full tuition waiver and competitive stipend for doctoral study, The Ohio State University (2023, 2024).
- **Summer Research Fellowship,** The Graduate School, Miami University (2022, 2023).
- **GSSA Award:** Full tuition waiver and stipend for Master's study, Miami University (2021–2023).
- Best Departmental Undergraduate Thesis Award (2017).

Article Reviewer

- American Control Conference (ACC)-2

Mentorship

- Mentored senior undergraduate Mechanical Engineering students at Miami University (Spring 2023): Nikita Shubin, Jake Zickerman, Charlie Clark, Neil Jain, Tung Ho, and Becca Wolfe.

Service

- **College of Engineering ULI,** The Ohio State University: Assisted with drone flight simulation demonstrations for high school students (June 2024).
- **2024 COSI Science Festival,** Columbus, OH: Represented SOAR Lab (May 2024).
- **Miami University Open House,** (September 2022): Participated in lab demonstrations.

Technical Skills

Programming & Simulation: MATLAB, Python, R, JavaScript, Simulink, LabVIEW

Libraries & Tools: PyTorch, CasADi, acados, ACADO Toolkit, OpenCV, pandas, tidyverse, ggplot2, R Shiny

Web Technologies: HTML5, CSS3, Bootstrap, VueJS

CAD & Analysis: Fusion 360, COMSOL

Prototyping & Testing: Milling, Lathe, Welding, 3D Printing, Universal Testing Machine

Operating Systems: Windows, macOS, Linux

Others: ROS, Arduino, Git, NI-cDAQ, LaTeX, MS Excel

References

Available upon request.