

Raaghav Thirumaligai

Controls, Optimization & Physical Systems

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PROFILE

Controls-focused mechanical engineer with an M.S. focus in thermofluids and ongoing Ph.D. training in control theory. Models physical systems from experimental data, formulates constrained objectives, and implements feedback and estimation on real hardware. Experience spans MPC, optimal control, system identification, LQR/LQG, Python/OpenCV data pipelines, MATLAB/Simulink/QUARC, and electromechanical prototyping.

TECHNICAL SKILLS

- Control & Optimization** – MPC, economic MPC, finite-horizon and constrained optimization, optimal control, LQR/LQG, nonlinear, robust, and hybrid control
- Modeling & Estimation** – State-space and distributed-parameter modeling, system identification, finite-difference discretization, balanced truncation, observers, Kalman filtering, model validation
- Data & Machine Learning** – Python, OpenCV, MATLAB; sensor and experiment-log analysis; classifier training/tuning; vision-based event detection and automation
- Embedded & Real-Time** – Simulink/QUARC, Raspberry Pi, Arduino, DAQ, sensor/actuator integration, state-machine logic
- Physical Systems** – Mechatronics, Formula SAE EV systems, instrumentation, design-build-test, Solid-Works/Fusion 360, fabrication

EDUCATION

- **University of California, Santa Barbara – Ph.D. Mechanical Engineering** **Projected Jun 2029**
GPA 3.92/4.0 | Control Theory | Year 1 completed; available to take academic leave for full-time work
- **University of California, Santa Barbara – M.S. Mechanical Engineering** **Jul 2025**
GPA 3.90/4.0 | Thermofluids | Experimental modeling, instrumentation, and data analysis
- **University of California, Santa Barbara – B.S. Mechanical Engineering** **Jun 2025**
GPA 3.76/4.0 | Product Design | Capstone: [600 V Vehicle Battery Container](#)

SELECTED CONTROL & ML PROJECTS

Reduced-Order LQG Control of a Distributed-Parameter System (MATLAB) Apr 2026 – Jun 2026

- Built a 99-state finite-difference model of a boundary-actuated damped-wave PDE; augmented it with frequency-shaped disturbances and measurement noise for LQG output-feedback design.
- Designed LQR/Kalman controllers for three disturbance bandwidths, then used balanced truncation to test reduced-order controllers (orders 1–10) on the full plant across damping regimes.

Constrained Satellite Rendezvous with MPC (MATLAB/MPCTools) Jan 2026 – Mar 2026

- Built a zero-order-hold Hill–Clohessy–Wiltshire model; implemented saturated LQR, state-focused constrained MPC, and economic MPC with different state, actuator, and fuel priorities.
- Evaluated convergence, feasibility, and a fuel proxy over randomized initial conditions; communicated the resulting speed-versus-energy tradeoffs.

Inverted Pendulum on Cart: System ID, Estimation & Hybrid Control Apr 2025 – Jun 2025

- Collected logarithmic sine-sweep data on a physical system; identified linear models around stable and unstable equilibria and checked them with frequency-response and root-locus analysis.
- Implemented energy-based swing-up, LQR/LQG balance and catch, Kalman-filter estimation, and state-machine mode switching in MATLAB/Simulink with QUARC real-time hardware execution.

Autonomous Can-Collection Robot (C.L.E.A.N.): Team Lead Apr 2024 – Jun 2024

- Led a five-person team through weekly design-build-test cycles to deliver a robot that found, approached, identified, grasped, and lifted aluminum cans.
- Trained and tuned an OpenCV cascade classifier on approximately 1,500 custom images; converted detections into Raspberry Pi steering commands and integrated Arduino motor control, sensors, and a 2-DOF arm/claw.

RESEARCH & EXPERIMENTAL SYSTEMS

Biological Control Lab, Yeung UCSB – *Research Assistant*

Jan 2025 – Jan 2026

- Co-developed a control-oriented model of genome-wide transcription coupled to DNA-supercoiling dynamics regulated by topoisomerases.
- Analyzed stochastic and nonlinear population models using stability and sensitivity methods to identify parameters that shape transcription and growth; co-author on an accepted manuscript (Jan 2026), [preprint](#).

M&M Flow Lab, Sauret UCSB – *Master's Researcher*

Aug 2024 – Jun 2025

- Studied clogging dynamics in particle-laden suspensions, where stochastic events, changing material conditions, and limited observability complicated measurement.
- Prototyped a Python vision detector using a rolling brightness/windowed-visibility metric to identify occlusion events and support experiment logging and post-analysis.
- Presented the work at the November 2024 APS Division of Fluid Dynamics meeting.

M&M Flow Lab, Sauret UCSB – *Undergraduate Researcher*

Jan 2023 – Aug 2024

- Designed and built an instrumented annular shear cell for granular-material experiments.
- Developed an Arduino–MATLAB DAQ, calibration, and filtering workflow for strain-gauge measurements and repeatable experiments; presented results at the Southern California Flow Physics Symposium.

Fluid Energy Science Lab, Luzzatto-Fegiz UCSB – *Undergraduate Researcher*

Jun 2023 – Oct 2023

- Collected wind-tunnel data for wake-model verification and built an Arduino–MATLAB DAQ system and app.
- Fabricated laser-cut and 3D-printed annuli for repeatable wind-energy experiments.

ENGINEERING & LEADERSHIP EXPERIENCE

Gaucha Racing Formula SAE EV – *Vehicle Systems Lead / Vice President*

Aug 2021 – Jun 2025

- Four-year contributor on an electric race-car design-build-test team; led work across vehicle systems and coordinated teammates through build cycles.
- Designed and built a 600 V accumulator container using an adhesive-first joining strategy; produced CAD, drawings, and structural checks.
- Led braking-system design, manufacturing, testing, and reliability work; separately led a funded study of brake-fluid viscosity.

UCSB Mechanical Engineering – *Teaching Assistant*

Apr 2024 – Present

- Taught laboratory methods, dynamics, vibrations, and fluids through lab sections, office hours, assessment, and technical coaching.

HONORS

Engineering Honors Program | Dean's Honors, 5 quarters | 2 Undergraduate Research Awards (\$3,750; \$2,500)