Pradyunn Kale

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Education

Purdue University — West Lafayette, IN
Bachelor of Science in Computer Engineering — *Aug. 2025 – May 2029*
Faculty GPA: 3.91/4.0
Relevant Coursework: Electrical Engineering Fundamentals, Digital System Design, Advanced C Programming

Harvard Extension School — Cambridge, MA
Dual Enrollment — *Sep. 2024 – May 2025*
Faculty GPA: 3.5/4.0
Relevant Coursework: Linear Algebra and Differential Equations, Introduction to Computer Science with Python

Experience

Flight Dynamics & Controls Lead Engineer – Liquids — Dec. 2025 – Present
Purdue Space Program (A SEDS Chapter) – Purdue University — *West Lafayette, IN*

- Defined embedded system architecture for attitude estimation on Copperhead and a subscale active-control rocket
- Included sensor models, state representation, and update cadence to ensure accurate real-time estimation
- Designed estimation framework using quaternion kinematics and error-state Kalman filtering on SO(3), accounting for large-angle maneuvers and sensor bias
- Leading avionics bring-up for the subscale active-control rocket, specifying requirements, sensor selection, and real-time task architecture
- Using the subscale rocket as a flight test platform to validate a custom MATLAB-based 6-DOF dynamics model, Copperhead attitude dynamics, and sensor models against measured flight data
- Developed MATLAB-based test cases to verify flight logic, including sensor noise injection for robustness testing
- Established a reaction-wheel inverted pendulum (RWIP) testbed to support onboarding and hands-on training in embedded control and avionics development

Avionics Engineer – Liquids — Jul. 2025 – Present
Purdue Space Program (A SEDS Chapter) – Purdue University — *West Lafayette, IN*

- Developed low level drivers for avionics telemetry (IMU, magnetometer, 16-bit ADC) using embedded C/C++
- Implemented FreeRTOS on STM32, ensuring deterministic performance and peripheral detection
- Performed board bringup for IMU and magnetometer peripherals, including power sequencing, communication verification, and test firmware execution on Raspberry Pi 4B using a custom Buildroot environment
- Co-designed avionics software architecture to meet real-time requirements of the attitude estimation and control pipeline

Projects

Reaction Wheel Inverted Pendulum (GitHub) | *C, Python, SMC, FreeRTOS, ESP32* — Oct. 2025 – Present

- Derived nonlinear equations of motion for the reaction wheel inverted pendulum
- Derived transformation matrices linking reaction wheel torque to motor driver voltage, and encoder measurements
- Designed a robust HITL (Hardware-in-the-loop) test suite, allowing for verification of embedded C code
- Designed and tuned a Sliding Mode Controller (SMC) for stabilizing the nonlinear inverted pendulum dynamics, achieving robustness against model uncertainty, disturbances, and actuator saturation
- Implemented an EKF (Extended-Kalman Filter) to fuse noisy incremental encoder data into smooth state estimates for pendulum angle, angular velocity, and wheel dynamics
- Implemented a real-time control loop on ESP32 under FreeRTOS with deterministic 100 Hz timing, integrating motor actuation, state estimation, and SMC law in a resource-constrained embedded environment

Technical Skills

Languages: C/C++, Python, MATLAB
Modeling & Controls: Simulink, State-Space Modeling, Discrete-Time Systems
Embedded Platforms: STM32, ESP32, RP2040
Hardware & Debug: Oscilloscope, Logic Analyzer, JTAG/SWD, Multimeter
EDA & CAD: KiCAD, Altium Designer, Fusion360
Build & Developer Tools: Git, Make, CMake, Linux, FreeRTOS