Adam Nekolny

Ph.D. Student, Aerospace Engineering | University of Arizona

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Education

University of Arizona Aug 2026 – May 2029 (expected)
Ph.D. Student, Aerospace Engineering (Dynamics and Control) | *Advisor: Prof. Christopher K. Walker* Tucson, AZ

- Ph.D. aim: spacecraft-native neural optimization for on-orbit autonomy, replacing off-the-shelf PPO updates with physics-conditioned rules tuned to subsystem dynamics and environment, from LEO to interstellar.

University of Arizona Aug 2023 – Aug 2026
M.S., Aerospace Engineering (Dynamics and Control) | *Advisor: Prof. Christopher K. Walker* Tucson, AZ

- GPA 3.3/4.0. Thesis: *Multi-Objective Deep Reinforcement Learning for Aerodynamic Attitude Scheduling in Very Low Earth Orbit*. 2024 Outstanding Graduate Teaching Assistant Award (AME).

University of Arizona Honors College Aug 2020 – May 2024
B.S., Aerospace Engineering (Cum Laude) | *B.S., Mathematics (Cum Laude)* Tucson, AZ

- GPA 3.64/4.0 (both degrees). Highest Academic Distinction (2021); Academic Distinction (2022, 2023).

Experience

Mission Systems Architect, ADCS & Flight Software Lead 2025 – Present
SolarCat, University of Arizona Earth Cup RACE 1 Team Tucson, AZ

- Architect and ADCS/ECE/FSW lead for a hexagonal MembraneSat (MSat standard, Robonautics) sailcraft demonstrating autonomous drag-modulated lifetime extension in VLEO. 3rd place in Earth Cup RACE 1, earning a Step 2 flight-hardware award ($20,000 build budget plus a competition-funded launch). Co-authored the Step 1 white paper (May 2026); presented on the Earth Cup RACE 1 panel at SmallSat 2026.
- Own the avionics and flight-software architecture for autonomous operation: a 300 s PPO advisor over a 10 Hz quaternion-feedback PD inner loop on STM32U575/FreeRTOS, with B-dot detumble as the safe-mode fallback. Closed-loop plant is full 6-DoF, with magnetorquer torque checked against a realistic magnetic-dipole model. Onboard RL runs FP32 on the STM32 FPU; INT8 is the contingency if flash tightens.
- One modular flight-software design covers RACE 1 and RACE 0, and is the industry-process standard the student team is trained on: NASA cFS and JPL F Prime patterns, DO-178C-informed isolation of safety-critical tasks, and NPR 7150.2D practices. Modules fail over to a golden backup on internal error detection; STM32 ECC memory modes are enabled, trading capacity for on-orbit SEU tolerance. Lead a 9-person team (2 Ph.D. subsection leads; undergraduates on ECE, structures, systems, ground/comms, simulation, magnetorquers, and power).

ADCS, Avionics & Flight Software Lead 2026 – Present
Earth Cup RACE 0, University of Arizona (flight demonstrator) Tucson, AZ

- Lead ADCS, avionics, and flight software for a $5,000 chipsat demonstrator (prototype Oct 2026; funded Spring 2027 launch) on the same modular FSW as RACE 1. Custom magnetorquers and I^2C PWM driver, avionics and power PCBs, and a flight-proven chipsat-bus downlink; torque response checked against a dipole field model.
- Direct a mixed student team; field FI-ARLAMX for on-orbit data; benchmark PPO, SAC, and TD3 for STM32U575 deployment.

Graduate Research Assistant, Walker Group Aug 2024 – Present
University of Arizona, AME / Steward Observatory Tucson, AZ

- Fall 2026 RA on Prof. Walker's Meissner-effect transistor line (US 12,290,009 B2). Verified initial device values in PyTDGL and showed simulation viability of a neural-net MET formulation. An additional provisional is in progress: 3-D magnetic-field libraries for superconducting material and a neural-net translation layer into superconducting-regime weights. Hardware test follows once the simulation holds.

- Designed ARLAMX, a deep RL attitude advisor (PPO/SAC) exploiting drag and solar radiation pressure for on-orbit lifetime extension; the v8 PPO policy reaches median C_d 0.045 against the analytical MinDrag optimum of 0.035 in Basilisk with an 18-panel Sentman aerodynamic model.
- Advancing ARLAMX 2.0 as a multi-objective MRP feedback advisor for onboard use: PPO of ∼2,500–3,000 parameters, roughly 6× lower per-cycle cost than a comparable MPC loop, running FP32 on the STM32 FPU with a B-dot detumble fallback.

Systems and Automation Engineer Nov 2024 – Present
CatSat, University of Arizona CubeSat Program Tucson, AZ

- Maintain the multi-host Linux ground-station network (CLI, virtualization, Docker) supporting spacecraft operations, including deployment automation and hardware troubleshooting. Deployed ARLAMX as an indirect on-orbit mission planner, validated against >1 year of orbital-decay and quaternion telemetry.

Controls Engineer Contributor Nov 2024 – Apr 2025
University of Arizona & Freefall Aerospace Tucson, AZ

- Prototyped next-generation inflatable RF antennas under Dr. Aman Chandra and Prof. Walker: Arduino C++ firmware for differential-pressure sensor interfacing, Python telemetry recording, plus assembly and instrumentation in a Class 10,000 cleanroom and TVAC chamber.

Graduate Teaching Assistant Aug 2024 – Present
University of Arizona, AME / Astronomy Tucson, AZ

- TA for AME 321 Aircraft Controls, AME 557 Orbital Mechanics, AME 300 Instrumentation Lab, AME 302 Numerical Methods, and ASTR 202; co-teach the practical-application portion of *ASTR 496/596 Small Satellite Systems*. Five conference papers as an undergraduate researcher with SpaceTREx (AIAA ASCEND 2022, ISSC 2023, AAS GNC 2023, IAC 2024, ISSC 2024).

Selected Projects

AstroChymera: Flexible-Body Smallsat Astrodynamics (in development) 2026 – Present
C++ / Python; membrane solar sails and other spacecraft from STL/OBJ

- Building an astrodynamics tool for flexible-body membrane sats and other spacecraft, not a finished product: STL/OBJ plants with controlled simplification, free-molecular flow, solar radiation pressure, per-facet materials, and stacked perturbations, as the ARLAMX plant instead of a generic Gym task.

Hardware-in-the-Loop ADCS Testbed for the SolarCat Sailcraft Fall 2025 – Spring 2026
STM32U575 (Cortex-M33) and Python plant over USB-UART; ECE 542

- Jacobian-linearized 6-DoF quaternion plant, closed-form ZOH, and discrete full-state feedback via Kautsky-Nichols-Van Dooren on the z-plane. BIBO-stable across a 40× sample-rate sweep (5–200 ms) with near-invariant step response (15 s settling, ∼5% overshoot); 1000/1000 bit-exact UART trips and 512/512 CRC bit-flip rejections on hardware.

Technical Skills

Programming: Python, MATLAB, C/C++, Bash, Mathematica
Machine Learning / RL: PyTorch, Stable Baselines3, Gymnasium, CUDA; PPO, SAC, TD3; YOLO, OpenCV; FP32 on the STM32 FPU, INT8 (STM32Cube.AI) as a memory contingency
Estimation & Controls: EKF/IEKF, RTS smoother, batch least squares; LQR, sliding-mode, quaternion PD, B-dot; z-plane pole placement, ZOH
Aerospace Tools: Basilisk, GMAT, STK L2, FreeFlyer 7; MRP/DCM/quaternion, J2/J3, Sentman/FMF, magnetic-dipole torque; AstroChymera (in development)
Flight Software & Process: FreeRTOS; cFS and F Prime patterns; DO-178C-informed partitioning; NPR 7150.2D; ICDs; golden-backup failover; STM32 ECC modes
Embedded & Infrastructure: STM32U575, Arduino, Jetson Nano, VOXL; KiCad, SolidWorks; Linux CLI, virtualization, Docker, ROS; Git; Cursor, Claude Code, Grok Build