

Aditya Deole

aditya.158@gmail.com | (206)-604-9123 | Personal Webpage

Summary

Control theorist (PhD, University of Washington) specializing in closed-loop control of neural systems. I design real-time, robust feedback controllers and estimators that read population neural activity and steer it toward physiologically meaningful targets, across optogenetic and electrical stimulation and multiple recording modalities (widefield imaging, μ ECoG). My work brings a rigorous control- and estimation-theoretic foundation — controllability, observability, robust synthesis under uncertainty — to the design of neural interfaces and stimulation therapies.

Research Experience

Postdoctoral Researcher — Closed-Loop Neural Control

Dec 2025 – Present

Steinmetz Lab & NERD Lab (Yazdan), University of Washington

Seattle, WA

- Built a real-time, low-latency closed-loop optogenetic controller for mesoscale cortical population dynamics in mice: widefield calcium imaging as online state readout, feedback controller driving a steerable stimulation laser as a function of dynamic (motor/arousal) brain state.
- Performed system identification of the neural plant, fitting low-order dynamical models to stimulation-evoked cortical responses to enable control-theoretic controller design (PI / feedforward) with quantified end-to-end latency.
- At the NERD Lab (PI: Azadeh Yazdan), designed dynamical models and closed-loop stimulation strategies from network-level μ ECoG recordings over M1/S1 in non-human primates; ran reachability and controllability analysis to identify which cortical nodes a stimulation site can drive across electrical and optogenetic stimulation.
- Built real-time, multi-threaded image- and signal-processing pipelines in Python for stable online feedback; currently extending the closed-loop framework from imaging to electrophysiology (electrode-recorded signals).

Graduate Research Assistant — Robust Control & Estimation

Sep 2020 – 2025

RAIN Lab (Advisor: Mehran Mesbahi), University of Washington

Seattle, WA

- PhD dissertation: robust control and estimation methodologies for systems with modeling and set-valued measurement uncertainties — directly transferable to partially-observed, imperfectly-modeled systems such as neural circuits.
- Designed estimation-aware trajectory optimization that explicitly plans for observability, using successive convexification and trust-region methods — the same design principle that governs where to sense and stimulate in a closed neural loop.
- Synthesized robust feedback controllers that remain stable under ML-driven and set-valued uncertainty, integrated with learning-based state estimation.
- Supervised and built educational hardware testbeds for aerial and ground robots (ROS2, embedded systems), integrating navigation with trajectory-optimization layers.

Systems Engineer — Sensing Hardware for Physiological Signals

Oct 2025 – Present

Nanosync Labs

Seattle, WA

- Developing a non-invasive, capacitive-sensing wearable that recovers signals correlated with intracranial pressure and relates them to cardiac, respiratory, and slow-wave-sleep dynamics — real-time signal extraction from a minimally-invasive device.
- Designed capacitive-sensor integrations including gesture-recognition fixtures, liquid-level sensing, and velocity estimation.

Graduate Research Assistant — State Estimation

Summer–Fall 2019

MAPLE Lab, University of Washington

Seattle, WA

- Designed nonlinear state-estimation algorithms (MHE, EKF, particle filters) for high-order battery dynamics; MPC-based controller for optimal discharge. Prototyped PCB housing (SolidWorks, AutoCAD).

Skills

Programming: Python, MATLAB/Simulink, C/C++, SQL.

Tools & Frameworks: PyTorch, CVXPY, ROS2, Gazebo, Git, SolidWorks.

Education

University of Washington

Sep 2020 – 2025

PhD, Control Theory — Dept. of Aeronautics & Astronautics (Advisor: Mehran Mesbahi)

Seattle, WA

University of Washington

Sep 2017 – Jun 2020

MS, Mechanical Engineering — Thesis: Model-Free Control with Application to UAVs

Seattle, WA

Visvesvaraya National Institute of Technology

Aug 2012 – May 2016

B.Tech, Mechanical Engineering

Nagpur, MH, India

Publications

- Ziyu Lu, **A. Deole**, et al. "Benchmarking Probabilistic Time Series Forecasting Models on Neural Activity," NeurIPS 2025 Workshop.
- A. Deole**, N. Steinmetz, et al. "Towards Data-driven Feedback for Cortical Activity," NeuroAI 2025.
- A. Deole**, M. Mesbahi. "Estimation-Aware Trajectory Optimization with Set-Valued Measurement Uncertainties," Journal of Guidance, Control, and Dynamics (JGCD), 2025.
- A. Deole**, et al. "MPC-based Estimation-Aware Trajectory Generation for Uncontrolled Satellite Pose Tracking," AIAA 2024-0947, AIAA SciTech 2024.
- A. Deole**, et al. "Multi-Agent Passivity-based Control for Perception-based Guidance," AIAA 2023-2156, AIAA SciTech 2023.
- S. Bandyopadhyay, **A. Deole**, et al. "Vision-based Distributed Pose Estimation using a Spacecraft Constellation," AIAA 2023-2506, AIAA SciTech 2023.
- J. Beckett, **A. Deole**, et al. "Robust Vision-based Multi-spacecraft Guidance, Navigation and Control using CNN-based Pose Estimation," IEEE Aerospace Conference (AERO), 2022.
- N. Rahimi, **A. Deole**, et al. "Robust Controller Synthesis for Vision-based Spacecraft Guidance and Control," AIAA 2022-2213, AIAA SciTech 2022.
- P. Dubey, **A. Deole**, et al. "FM-based Indoor Localization and Mapping System with Real-time Implementation on FPGA," ICTC 2015.

Service & Awards

- Reviewer**, Journal of Guidance, Navigation and Control (AIAA), eISSN 1533-3884.
- S. Rao and Usha Varanasi Endowed Fellowship** in Aeronautics & Astronautics, University of Washington (2020).

Teaching Experience

- | | |
|---|--------------------|
| Pre-Doctoral Instructor — AA101, Intro to Air & Space Vehicles | Fall 2022 |
| <i>University of Washington</i> | <i>Seattle, WA</i> |
| <ul style="list-style-type: none">Designed and delivered lectures, lab content, and quizzes for a non-STEM-focused audience; organized a graduate seminar series for the Aerospace department. | |
| Instructor — Fundamentals of Robotics & AI | Summer 2018 |
| <i>UW Continuum College / STEMSub</i> | <i>Seattle, WA</i> |
| <ul style="list-style-type: none">Developed and taught introductory robotics courses (path planning, manipulator kinematics, AI) for international students and for students from lower socio-economic backgrounds. | |