ZACHARY KUSHNIR

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https://scholar.google.com/citations?user=sYw2nlwAAAAJ&hl=en

Education

Carnegie Mellon University Pittsburgh, PA
Master of Science in Mechanical Engineering - Research April 2026
Current Relevant Coursework – Robot Planning and Decision Making, Optimization, Mechatronic Design, Bioinspired Robot Design, Biomechanics and Motor Control of Legged Locomotion, Computer Vision for Engineers

University of Pittsburgh Pittsburgh, PA
Bachelor of Science in Mechanical Engineering April 2024
Featured Coursework – Adaptive Controls, Machine Learning, Mechatronics, Automatic Controls, Finite Element Analysis, Numerical Methods, Mechanical Design, Dynamics, Fluid Mechanics, Materials

Skills

Mechanical - Mechatronic Design, CAD (Inventor, CATIA, Solidworks), CNC machining, 3D Printing, PCB Design, GD&T, MPC
Computer - Python, C/C++, MATLAB/Simulink, ROS, SLAM, OpenCV, FEA, Git, Linux

Research Experience

Carnegie Mellon University Pittsburgh, PA
Graduate Research – Dr. Webber – NeuroMechatronics Lab August 2024 – Present
- Designed, prototyped, and iterated a hand exoskeleton for SCI motor-function studies using multi-material mechanical design, wearable ergonomics, and actuator-sensor integration.
- Conducted human-participant testing with SCI individuals; collected and analyzed performance data for manuscripts currently in preparation.

University of Pittsburgh Pittsburgh, PA
Undergraduate Research – Dr. Velankar – Mechanical Engineering lab April 2021 – April 2024
- Developed sample-prep procedures and experimental setups for studies on aluminum-plastic morphing composites and rubber-laminate fracture mechanics.
- Performed mechanical tests (tensile testing, crack-propagation imaging, localized stress mapping) and contributed figures and analysis to peer-reviewed publications.

University of Pittsburgh Pittsburgh, PA
Undergraduate Research – Dr. Mao – Machine Learning Lab August 2023 – April 2024
- Prepared instructional modules and chapter summaries for the ECE "Introduction to Machine Learning" course; delivered technical presentations to student groups.
- Investigated ensemble-learning approaches for user-specific sleep-stage detection and presented model-performance analysis to the research group.

Publications

- Ramachandran, Rahul & Kushnir, Zach & Langhe, Deepak & Velankar, Sachin & Maiti, Spandan. (2025). Ductile fracture of HDPE thin films: failure mechanisms and tuning of fracture properties by bonding a rubber layer. 10.48550/arXiv.2509.16731.
- Nguyen, C., Ramalingam, K., Kushnir, Z., Rouhani, F. and Velankar, S.S. (2023), Mechano-Activated Shape Morphing of Aluminum–Plastic Laminate Composites. Adv. Eng. Mater., 25: 2301111.

Projects

Retriever – Quadruped Robot Inspired by Spot – Personal Project
- Designed a fully 3D-printable quadruped platform around 12 high-torque BLDC actuators with modular assembly and serviceability.
- Developed the full power-distribution architecture for BLDC drivers and an onboard Jetson computing unit.
- Implemented JST-based CAN communication, motor-control firmware, leg inverse kinematics, and a remote-control gait.

Dr. Bot – Autonomous Liver Biopsy 5 DOF Robot Arm – Mechatronics Class

- Designed a 3D-printed needle-insertion mechanism enabling controlled insertion, sampling, and retraction.
- Assisted with 5-DOF inverse-kinematics implementation and precision repeatability testing.
- Contributed to SLAM-based vision processing and system integration.

Smart Door – Dual Module AI Door Lock – Personal Project

- Designed an automated mechanical lock driven by an internal servo system for remote and local control.
- Built an external doorbell module supporting image capture, Raspberry Pi-based facial recognition, and secure inter-module communication.
- Designed and soldered custom PCBs for power management and communication interfaces.

Practical Experience

Clean Plate Innovations - Startup Pittsburgh, PA
Director Hardware Engineering November 2024 – Present

- Defined hardware specifications in coordination with software and product teams for early-stage prototype development.
- Performed component selection, performance-cost tradeoff analysis, and reliability optimization for electromechanical subsystems.

Acutronic USA Inc Pittsburgh, PA
Mechanical Engineering Co-op September 2021 – August 2023

- Designed precision mechanical components, produced GD&T-compliant manufacturing drawings, and executed FEA verification on custom systems.
- Developed a bearing-load calculation model applicable across three-axis motion platforms.
- Trained in high-precision mechanical drafting and manufacturing documentation workflows.

University of Pittsburgh Pittsburgh, PA
First Year Engineering Teaching Assistant August 2020 – April 2024

- Provided instruction to 80+ students per semester in MATLAB, C programming, Excel, and introductory engineering design.
- Held weekly office hours to support assignments, exam prep, and project development.

EAG Laboratories | A Eurofins Company Syracuse, NY
Analyst/Maintenance Engineer Intern December 2020 – January 2021

- Created CAD models and engineering drawings for mass-spectrometer components sent to external manufacturers.
- Performed instrument maintenance, upgrades, and spares tracking to support analytical equipment uptime.

Extracurricular Activities

USA Karate Athlete August 2015 – Present

- USA Karate Nationals 2025 – -84kg category – 5th
- Qualified for Team USA National Team Trials 2024 – Colorado Springs, Olympic Training Center
- USA Karate Nationals 2023 & 2022 – -84kg category – 3rd place