Andrew Masker

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Summary

Mechanical engineering PhD student and NSF Graduate Research Fellow working on learned dynamics and physics-informed machine learning for robots. Builds models in JAX and PyTorch on top of differentiable simulation (MuJoCo MJX), and brings up real hardware end to end, from PCB and firmware to closed-loop control. Seeking roles in robot learning, especially vision-language-action and world action models.

Education

University of Pennsylvania, on medical leave; returning Fall 2027 — Philadelphia, PA
Ph.D. Mechanical Engineering and Applied Mechanics, 3.80/4.00 — August 2025 – Present
M.S.E. Robotics — August 2025 – Present

Pennsylvania State University, Schreyer Honors College — State College, PA
B.S. Mechanical Engineering, 3.97/4.00 — August 2021 – May 2025
Thesis: *Neural Optical Flow*

Experience

ScalAR Lab, University of Pennsylvania — Philadelphia, PA
Graduate Research Assistant — August 2025 – Present (on medical leave; returning Fall 2027)
PI: Ani Hsieh

- Built a learned dynamics model of a Franka Emika Panda manipulator operating underwater: a knowledge-based neural ODE (KNODE) that combines rigid-body dynamics from MuJoCo with a neural network that learns the residual fluid torques.
- Trained the hybrid model end to end through a differentiable simulator on GPU in JAX, MJX, Equinox, and Diffrax.
- On simulated underwater trajectories, the KNODE's predictions nearly overlapped the ground truth, while Fourier-basis SINDy, Gaussian process, and fluid-free nominal models drifted away from it.

Grauer Lab, Pennsylvania State University — State College, PA
Undergraduate Research Assistant — January 2024 – May 2025
PI: Samuel Grauer

- Developed neural optical flow, which estimates dense velocity fields from images of particle-laden flows for planar and stereo PIV and handles particle displacements of 15+ pixels; published in *Experiments in Fluids* (J1).
- On synthetic turbulence, cut velocity error to 0.07 NRMSE, versus 0.23 for cross-correlation and 0.09–0.10 for leading optical flow methods; in stereo, cut velocity error to 0.28, versus 0.36–0.38.
- Built physics into the learned model: a divergence-free condition as a hard constraint and Navier–Stokes residuals as a soft constraint, which let it recover pressure directly from images (0.08 NRMSE); implemented with automatic differentiation in PyTorch.

SHAPE Lab, Pennsylvania State University — State College, PA
Undergraduate Research Assistant — September 2023 – May 2024
PI: Guha Manogharan

- Characterized how interlocking material interfaces affect part strength in multi-material laser powder bed fusion.

Projects

LMM Metal 3D Printer, Personal Project 2026 – Present

- Designing and building a low-cost Lithography-based Metal Manufacturing printer end to end: a three-axis machine in Onshape and a KiCad carrier PCB (Teensy 4.0, Raspberry Pi Zero W, stepper drivers, heaters, sensors), assembled and brought up by hand.
- Wrote C++ firmware for motion, homing, and PID heater control with hard safety cutoffs, plus a Python print stack on the Pi; closed the loop on slurry temperature with IR sensing across three heating designs and seven material formulations.

Bashputer, Personal Project 2026 – Present

- Built a 64-bit RISC virtual machine and its assembler entirely in Bash, with each hardware component running as its own process, and made it playable in the browser through a fork of WebVM.

Publications

Journal Articles

J1. **A. Masker**[*], K. Zhou[*], J. Molnar, S. Grauer, "Neural Optical Flow for Planar and Stereo PIV," *Experiments in Fluids*, vol. 66, no. 6, p. 129, 2025, https://doi.org/10.1007/s00348-025-04058-1

[*]Equal contribution.

Conference Papers

C1. J. Griffis, **A. Masker**, J. Schreiber, G. Manogharan, "Site-Specific Property Informed Interface Design of Multi-Material Laser Powder Bed Fusion," *Manufacturing Science and Engineering Conference (MSEC)*, June 2024

Conference Presentations

P1. **A. Masker**, K. Zhou, J. Molnar, S. Grauer, "Neural Optical Flow Velocimetry," *American Physical Society Division of Fluid Dynamics Meeting*, November 2024

Technical Skills

Programming: Python, C++ (Teensy, Arduino), MATLAB
Machine Learning: PyTorch, JAX, Equinox, Diffrax, physics-informed machine learning, neural ODEs
Robotics & Simulation: MuJoCo/MJX, differentiable simulation, rigid-body dynamics, PID control
Hardware & Embedded Systems: KiCad, Teensy, Arduino, Raspberry Pi and Linux, I2C/SMBus, SPI, UART, soldering
CAD: Onshape, SOLIDWORKS
Tools: Git, GitHub, Microsoft Office, Google Workspace

Awards

- NSF Graduate Research Fellowship (GRFP), 2026 $159,000
- Penn State Provost Award $24,000
- Third Place, Poster Presentation Competition, MSEC/NAMRC 2024
- Dean's List 8/8 Semesters