Andrew Masker

Curriculum Vitae

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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*

Research Interests

Robot Learning, World Models and Learned Dynamics, Vision-Language-Action Models, Physics-Informed Machine Learning, Manipulation

Research Experience

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

- Researched learned dynamics models for underwater robotic manipulators, toward model-based controllers that anticipate environment forces rather than relying on stiff, power-hungry high-gain control.
- Built a knowledge-based neural ODE (KNODE) model of a Franka Emika Panda arm 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.
- Compared KNODE with Fourier-basis SINDy, Gaussian process, and nominal physics models on simulated underwater trajectories.

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

- Applied scientific machine learning to inverse problems: estimating physical state from optical measurements.
- Developed neural optical flow, which estimates dense motion fields from image sequences of particle-laden flows for planar and stereo PIV (J1, P1).
- Embedded a divergence-free condition as a hard constraint on the learned flow field, using automatic differentiation in PyTorch.
- Added Navier–Stokes residuals as a soft constraint, letting the model infer unobserved fields such as pressure.

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

- Investigated material interfaces in multi-material laser powder bed fusion and characterized how interlocking material regions affect part strength (C1).

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

Fellowships and Awards

Fellowships

- NSF Graduate Research Fellowship (GRFP), 2026 — $159,000

Awards and Honors

- Third Place, Poster Presentation Competition, MSEC/NAMRC 2024
- Academic Achievement in Engineering Award
- President Walker Award
- Dean's List 8/8 Semesters

Scholarships

- Penn State Provost Award — $24,000
- Dandrea Trustee Scholarship — $4,400
- Harding Louis Memorial Scholarship — $4,000
- Happel Scholarship in Engineering — $3,124
- Goodheart Scholarship in Mechanical Engineering — $2,500
- Penn State Mont Alto Alum Trustee Scholarship — $1,986
- Henry E. Clepper Memorial Scholarship — $1,922
- Hubler Civil Engineering Scholarship — $1,722

Projects

LMM Metal 3D Printer, Personal Project — 2026 – Present

- Designing and building a low-cost Lithography-based Metal Manufacturing (LMM) printer: a top-down DLP machine that cures a heated slurry of metal powder in a wax and photopolymer binder layer by layer.
- Designed the three-axis machine (reservoir piston, build platform, and heated recoater) in Onshape, and a KiCad carrier PCB for a Teensy 4.0, Raspberry Pi Zero W, stepper drivers, heater outputs, and sensors; assembled and brought up the board.
- Wrote C++ firmware for motion, homing, PID heater control with hard safety cutoffs, and a bit-banged SMBus driver for an IR thermometer, plus a Python print stack on the Pi with a command line and an on-machine GUI.
- Closed the loop on slurry temperature with IR sensing, iterating through three heating designs and seven copper slurry formulations.

Bashputer, Personal Project 2026 – Present

- Built a 64-bit, register-based RISC virtual machine entirely in Bash, with each hardware component (CPU, bus, memory, screen, keyboard, timer, and cartridge loader) running as its own process.
- Wrote Bassm, an assembly language and assembler for the machine, and made it playable in the browser through a fork of WebVM.

Eulerian Fluid Simulator, Schreyer Honors Project January 2024 – February 2024

- Interactive, GPU-accelerated fluid simulator written in PyTorch.

Teaching Experience

Thrive Scholars Amherst, MA
Summer Academy Teaching Assistant Summers 2022 and 2023

- Assisted in teaching Calculus I and Algebra to high-achieving students of color from economically under-resourced communities during the Summer Academy.
- Planned and taught lectures on limits, derivatives, parametric equations, and other fundamental mathematical concepts.

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