Mateusz Jaszczuk

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Education

University of Pennsylvania *Aug 2024 – Present*
M.S. in Mechanical Engineering and Applied Mechanics *Philadelphia, PA*
with a concentration in Mechatronic and Robotic Systems

- **Thesis** Learning to Feel: Force-Aware Data-Driven Estimation and Control for Fluid Physical Interactions
  Committee Prof. Nadia Figueroa (Advisor), Prof. Paris Perdikaris (Committee Chair)
- **GPA** 4.00/4.00
- **Relevant Coursework** Adaptive and Reactive Control, Data-driven Modeling and Probabilistic Scientific Computing, Machine Learning, Distributed Robotics, Optimal Control, Design of Mechatronic Systems

Purdue University *Aug 2020 – May 2024*
B.S. in Aeronautical and Astronautical Engineering *West Lafayette, IN*
with a specialization in Autonomy and Control

- **GPA:** 3.71/4.00
- **Coursework:** Applied Optimal Control and Estimation, Linear Systems Analysis and Synthesis, Spacecraft Attitude Dynamics, Control Systems Analysis, Signal Analysis, Structural Analysis

Research Experience

Figueroa Robotics Lab (GRASP) *Jan 2025 – Present*
Graduate Research Assistant *Philadelphia, PA*

- Developed a passive impedance controller with a Dynamical System-based motion policy for Franka Emika 7-DoF manipulator arm, allowing safe and robust physical Human-Robot interactions (pHRI).
- Created Rapid Mismatch Estimation, a novel, data-driven adaptation framework that allows robotic manipulators to adapt to unknown heavy objects in real time, ensuring safe pHRI and effective task execution.
- Implemented real-time compensation module leveraging Machine Learning architectures with variational inference optimization and integrated the model into a custom ROS package for efficient system integration.
- Validated proposed approach through simulation and hardware testing, showcasing the model's robustness.
- Lead writing academic publication and presented the work at the 9th Conference on Robot Learning (CoRL).

Composite Manufacturing & Simulation Center *Oct 2022 – May 2024*
Undergraduate Research Assistant *West Lafayette, IN*

- Developed a Bayesian model to predict the conductivity of additively manufactured short fiber-reinforced composites; supported the development of Gaussian Process surrogates of the micromechanics model.
- Implemented a probabilistic Physics-Guided Transfer Learning framework in Python; automated results post-processing pipeline from Abaqus FEA simulations for effective model evaluation.
- Conducted experimental characterization of the anisotropic thermal conductivity of 3D printed, carbon-reinforced samples, providing reliable verification of the developed Bayesian framework.
- Co-authored an academic publication and designed visualizations to demonstrate the model's evaluation.

Air Force Research Lab - Purdue UAS Research and Test Facility *Aug 2023 – Dec 2023*
Undergraduate Research Assistant, Project Lead *West Lafayette, IN*

- Developed autonomous fixed-wing aircraft for enclosed hangar-flight with Windracers, UK, including aircraft sizing code, motion simulations, prototyping, and experimental validation.
- Supported the development of the autopilot software using pseudo-GPS signals generated via motion capture cameras, enabling reliable indoor navigation, providing the client with the platform to test aircraft systems.
- Managed communication with the project coordinator and client, presented work progress during monthly meetings, discussed the budget and development cycle, ensuring alignment with the client's requirements.

Publications and Presentations

[1] **M. Jaszczuk** and N. Figueroa, "Rapid mismatch estimation via neural network informed variational inference," in *9th Conference on Robot Learning (CoRL)*, 2025.

[2] A. J. Thomas, **M. Jaszczuk**, E. Barocio, G. Ghosh, I. Bilionis, and R. B. Pipes, "Probabilistic physics-guided transfer learning for material property prediction in extrusion deposition additive manufacturing," *Computer Methods in Applied Mechanics and Engineering*, vol. 419, p. 116660, 2024.

[3] A. J. Thomas, **M. Jaszczuk**, E. Barocio, I. Bilionis, and R. B. Pipes, "Physics-guided transfer learning for property prediction in composite additive manufacturing." SAMPE Japan, 2023.

[4] **M. Jaszczuk**, "A bayesian framework for transfer of process-dependent material properties." Purdue Fall Undergraduate Research Expo, November 2023. West Lafayette, IN, USA.

Project Experience

Small-Scale Transformer for Text Generation - Graduate Course Project *Aug 2024 – Dec 2024*
Student Researcher, Developer *Philadelphia, PA*

- Implemented a lightweight GPT-inspired transformer neural network to generate coherent artificial text.
- Designed multi-head attention, positional encoding, and MLP modules in PyTorch, trained the model on small datasets (books, screenplays) to demonstrate artificial text generation and performance evaluation.
- Conducted ablation on regularization (dropout, layer normalization) to evaluate the impact on performance.

Autonomous Mobile Battle Robot - Graduate Course Project *Aug 2024 – Dec 2024*
Robotics Engineer, Team Member *Philadelphia, PA*

- Designed a mobile robot for autonomous competition task execution (wall-following, navigation, attack) across a full project lifecycle: concept design, prototyping, integration, testing, and final competition.
- Integrated mechanical and electronic subsystems (platform, motors, ultrasonic/ToF sensors, ESP32 microcontroller, custom circuits) and programmed an Arduino-based embedded system for real-time control.

NOAA Wind Tracking Satellite Constellation - Senior Design Project *Aug 2023 – Dec 2023*
Attitude Dynamics and Control Engineer, Team Member *West Lafayette, IN*

- Developed a MATLAB 6-DOF model to simulate satellite attitude dynamics across multiple orbital planes.
- Coordinated system integration and designed active/passive attitude control strategies, ensuring the spacecraft met stability and maneuverability requirements for long-duration Earth's surface monitoring.

Purdue Space Program NASA Student Launch *Aug 2021 – May 2023*
Project Manager (2021-2022), Launch Vehicle Construction Engineer (2022-2023) *West Lafayette, IN*

- Managed project workflow and resources for a 100-member interdisciplinary team, ensuring sub-systems met mission and top-level assembly requirements for NASA Student Launch competition.
- Coordinated deliverables and communications with NASA and NAR, including mission design, flight simulations (6-DOF Simulink model), competition reports, and team logistics for competition-related events.
- Designed and analyzed launch vehicle structures (motor mount, fin support, airframe), performing FEA, CFD, and physical tests to optimize strength, mass, cost, and vehicle performance.
- Led manufacturing and assembly of precision aluminum components using CNC milling and laser cutting, coordinating a student team in fabrication and integration.

Skills

Programming & Tools - Python (PyTorch, JAX), C, C++, MATLAB, ROS, PyBullet, Gazebo, Ubuntu

Machine Learning - Neural Networks (MLP, CNN, Transformers, PINNs), Optimization (Adam, Gradient-Based), Probabilistic Modeling (Bayesian, Variational Inference), Sampling, Regularization (Dropout/BatchNorm)

Control & Estimation - Impedance Control, Optimal Control, System Identification, Kalman Filtering

Hardware - Franka Research 3 7-DoF Manipulator, Sensor Integration, OptiTrack Motion Capture, Embedded Prototyping (Arduino), Additive Manufacturing (FDM, EDAM), CNC Manufacturing, Laser Cutting

Documentation & Workflow Tools - LaTeX, Overleaf, Git/GitHub, Jira, Confluence, Slack