# NATHAN LUDLOW

nludlow@andrew.cmu.edu   linkedin.com/in/nathan-ludlow   natelud.github.io

## Education

**Carnegie Mellon University**                                            **Expected Jul. 2026**
*Masters of Science in Robotics*                                                  *Pittsburgh, PA*
   *Advised by Dr. Katia Sycara*                                         GPA: 4.00/4.00

**Brigham Young University**                                                        **Apr. 2024**
*Bachelor of Science in Mechanical Engineering*                                      *Provo, UT*
   *Emphasis in Dynamic Systems, Controls, and Robotics*                 GPA: 3.79/4.00
*Minor in Computer Science*
*Minor in Mathematics*

## Research Experience

**CMU Advanced Agent Robotics Technology (AART) Lab**     **September 2024 – Present**
*Research Assistant (with Dr. Katia Sycara)*                                       *Pittsburgh, PA*

- Developed Knowledge Graph-Augmented Reinforcement Learning (KG-RL) methods that leverage semantic relationships to improve agent learning efficiency on complex tasks.
- Investigating Temporal Knowledge Graph representations for reinforcement learning, enabling agents to reason over dynamic state evolutions and temporal dependencies.

**BYU Crop Biomechanics Laboratory**                          **September 2023 – April 2024**
*Capstone Research Project Team Lead (with Dr. Douglas Cook)*                        *Provo, UT*

- Led research team developing automated robotic system for measuring maize stalk stiffness. Designed novel strain gauge sensor package and data processing algorithms to convert strain measurements into stiffness metrics. Implemented autonomous navigation and data collection control algorithms for robotic platform. *Publication at MDPI Sensors 2025.*

**CMU Driverless Intelligent Vehicles Lab (DRIVE) Lab**     **August 2023 – August 2024**
*Research Assistant (with Dr. John M. Dolan)*                               *Pittsburgh, PA/Remote*

- Developed risk-aware Voronoi cell approach inspired by control barrier functions for safe multi-agent navigation under motion uncertainty. Enables collision-free path planning around dynamic obstacles including humans, unknown agents, and moving objects with uncertain trajectories.

**CMU Robotics Institute Summer Scholars (RISS)**            **June 2023 – August 2023**
*RISS Research Fellow (with Dr. John M. Dolan)*                                     *Pittsburgh, PA*

- Developed behavioral model for simulating human drivers in autonomous vehicle testing frameworks. Introduced forward-looking Gaussian risk metric incorporating social pooling-based trajectory prediction with learned parameters. *RISS Fellowship project; first-author publication at ICRA 2024.*

**BYU Robotics And Dynamics (RAD) Laboratory**          **February 2022 – June 2023**
                                                                              **August 2023 – June 2024**
*Research Assistant (with Dr. Marc Killpack and Dr. John Salmon)*                     *Provo, UT*

- Developed dynamic control methods for physical human-robot co-manipulation enabling cooperative swinging, throwing, and tossing of large objects.
- Designed ROS software architecture and implemented robust control algorithms for omnidirectional mobile platform for safe human-robot interaction and physical co-manipulation. *UCUR 2023 workshop presentation.*
- Built VR experimental platform with force/torque sensing for analyzing human-human interaction dynamics during cooperative manipulation tasks.

## Publications and Presentations

### Conference Publications

- **N. Ludlow**, Y. Lyu and J. Dolan, "Hierarchical Learned Risk-Aware Planning Framework for Human Driving Modeling," 2024 IEEE International Conference on Robotics and Automation (ICRA), Yokohama, Japan, 2024, pp. 2223-2229, doi: 10.1109ICRA57147.2024.10610354

### Journal Publications

- C. Noh, K. Smith, C. Shamo, J. Porter, K. Steele, **N. Ludlow**, R. Hall, M. Holst, A. Williams, D. Cook, "Measurement of Force and Position Using a Cantilever Beam and Multiple Strain Gauges: Sensing Principles and Design Considerations." MDPI Sensors 2025, 25, 6561. PMID: 41228787

### Workshop Presentations

- **N. Ludlow**, M. D. Killpack, J. L. Salmon, "Mobile Base for Physical Human-Robot Interaction and Co-manipulation," *2023 Utah Conference for Undergraduate Research (UCUR)*, 2023

## Professional Experience

### Altitude AI                                    **May 2022 – June 2023**
                                                  **August 2023 – September 2023**

*Robotics Software Engineer*                      *Salt Lake City, UT*

- Designed perception, path planning, and control algorithms for automated pork belly skin removal using industrial robotic arms with electric cutting tools.
- Developed domain-specific programming language enabling LLMs to generate executable code for industrial robotic arms from natural language instructions, enabling rapid prototyping of manipulation tasks.

## Technical Skills

**Programming:** Python, C++, C, MATLAB, Java, Julia, Rust
**Robotics:** ROS, Gazebo, MuJoCo, PyBullet, OpenCV, RealSense SDK
**ML/RL:** PyTorch, TensorFlow, RLlib, Weights & Biases, OpenAI Gym
**Robot Platforms:** Yaskawa, XArm, Universal Robots, Franka Panda, KUKA, Farm-ng
**Tools:** Linux, Git, Docker, LaTeX
**Languages:** English (Native), Spanish (Fluent)

## Service and Leadership

### Ecclesiastical Leader for Church of Jesus          **Oct 2025 – Current**
### Christ of Latter–day Saints

- Coordinate volunteer programs including youth activities, missionary support, and community outreach for 150+ member congregation.

### Carnegie Mellon University Robotics Institute     **August 2023 – February 2024**
### RoboLaunch Outreach Program

- Participated in outreach with students in Chile and the US to promote RoboLaunch and RISS.
- Managed email campaign and website for the 2023 CMU RoboLaunch program.

### BYU Mechatronics Club Team Lead                   **September 2021 – April 2022**

- Designed competition materials for club competitions.
- Led trainings in software, electrical, and mechanical design for robotic systems and controls.

### Full Time Volunteer Representative for The Church   **May 2019 – May 2021**
### of Jesus Christ of Latter-day Saints