Zhiting (May) Mei

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My research approaches robotics through the perspective of fundamental science and aims to address the gap between specialist and generalist robots by establishing upper and lower bounds on robotics.

Upper Bound: I find fundamental limitations in robotics that plays a similar role as information theory and complexity theory. These upper bounds hold regardless of the advance of robot algorithms and therefore serve as an important guideline in improving robotics.

Lower Bound: I construct guarantees and assurances on safety and performance of specific robotics problems and generalize them to broader scenarios. I achieve this by rigorous uncertainty quantification.

EDUCATION

Princeton University **Princeton, NJ**
Ph.D., Mechanical and Aerospace Engineering Expected May 2027
Francis Robins Upton Fellowship

Duke University **Durham, NC**
B.S.E, Mechanical Engineering
B.S., Physics
Certificate, Innovation and Entrepreneurship May 2022
Magna Sum Laude and Graduation with Distinction

RESEARCH EXPERIENCE

Princeton Intelligent Robot Motion (IRoM) Lab **Princeton, NJ**
Advisor: Anirudha Majumdar
Research Assistant Jun. 2022 — Present

- Derive an information theoretic fundamental upper bound on robot performance, given the robot's task and sensing capabilities. Generalize and tighten this bound with f-divergence. Show that the fundamental bound holds for robot systems of increasing complexity and intelligence.
- Prove an upper limit for language-instructed autonomy. Show that the ambiguity in language itself would lead to imperfect behavior, regardless of scaling of the large language models leveraged. Estimate the upper limit on realistic home robot scenarios.
- Establish end-to-end safety assurances on robot navigation with learned perception modules, by performing rigorous uncertainty quantification. Use conformal prediction to calibrate the learned perception module. Apply safe motion planning algorithms to achieve end-to-end safety guarantee. Extend bounding box representations for obstacles to occupancy grids for more generality. Implement the framework on a quadruped hardware and show its advantages with experiments.
- Using uncertainty quantification, guide active perception and exploration while maintaining safety.

Duke Pratt Fellows **Durham, NC**
Advisor: Stefan M. Goetz
Undergraduate Research Assistant Dec. 2020 — May. 2022

- Develop theories and simulations on control and optimization of lattice modular multilevel converters with serial and parallel connectivity.
- Obtain most efficient control algorithms for lattice converters under requirements including converter size, input/output terminals, and output voltage/current.

Duke Neutrino & Cosmology Group **Durham, NC**
Advisor: Kate Scholberg
Undergraduate Research Assistant Nov. 2019 — Feb. 2021

- Work on SNEWS (Supernova Early Warning System), produce sky maps with predicted supernova location and uncertainty intervals.
- Analyze neutrino events detected at the Super-Kamiokande Detector.

PUBLICATIONS

[3] Anushri Dixit, **Zhiting Mei**, Meghan Booker, Mariko Storey-Matsutani, Allen Z. Ren, and Anirudha Majumdar. "Perceive With Confidence: Statistical Safety Assurances for Navigation with Learning-Based Perception." *In 8th Annual Conference on Robot Learning. 2024.*

[2] Anirudha Majumdar, **Zhiting Mei**, and Vincent Pacelli, "Fundamental Limits for Sensor-Based Robot Control", *The International Journal of Robotics Research* (2023), 42, no. 12: 1051-1069.

[1] **Zhiting Mei**, Jingyang Fang, Stefan M. Goetz, "Control and Optimization of Lattice Converters", *Electronics* 2022, *11*, 594.

AWARDS AND HONORS

Graduate

- Harari Post-generals Fellowship (2024)
- Phillips Second Year Fellowship (2023)
- Francis Robins Upton Fellowship (2022)

Undergraduate

- Graduation with Distinction (2022)
- Dean's List with Distinction (2018, 2019, 2021)
- Engineering Honor Societies: Tau Beta Pi, Pi Tau Sigma

TALKS AND WORKSHOPS

Robotics: Science and Systems, 2024 Workshops Delft, Netherlands

- Talk, "Perceive With Confidence: Statistical Safety Assurances for Navigation with Learning-Based Perception." *Towards Safe Autonomy: Emerging Requirements, Definitions, and Methods*
- Poster, "How Much Help Does My Robot Need?" *Robots that help and ask for help.*

TEACHING EXPERIENCE

- Introduction to Robotics (MAE 345/549), Princeton MAE — Fall 2024
- Control Systems (ME 344), Duke ME — Fall 2021, Fall 2022
- Solid Mechanics (EGR 201), Duke CEE — Fall 2020, Fall 2021, Spring 2022
- Introductory Physics (Physics 141), Duke Physics — Spring 2020
- Linear Algebra (Math 221), Duke Math — Spring 2021
- Multivariable Calculus (Math 212), Duke Math — Spring 2019, Fall 2020, Spring 2021