# Xinyi Liu

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## Education

**University of North Carolina – Chapel Hill** *Chapel Hill, NC*
Ph.D. Biomedical Engineering, Robotics *Aug 2024 – Now*

**University of Michigan – Ann Arbor** *Ann Arbor, MI*
M.S. Electrical & Computer Engineering, Robotics *Aug 2021 – May 2023*
Coursework: Experimental Unmanned Robotics, Linear Systems, Machine Learning, Information Theory

**University of California, Berkeley** *Berkeley, CA*
Exchange Student *(GPA: 3.96/4.00)* *Sep 2019 – May 2020*
Coursework: Artificial Intelligence, Experimental Control Design, Optimization Models in Engineering, 3D Vision

**ShanghaiTech University** *Shanghai, China*
B.E. Electrical Engineering *(Major GPA: 3.9/4.0 Rank: 2/66) Outstanding Graduates* *Sep 2017 – Aug 2021*

## Publications

- **X. Liu**, T. Zhang, M. Johnson-Roberson, W. Zhi "SplaTraj: Camera Trajectory Generation with Semantic Gaussian Splatting" 2025 IEEE International Conference on Robotics and Automation (ICRA) (submitted) [arxiv]
- J. Li, **X. Liu**, J. Li, B. Zhu, J. Jiao, M. Tomizuka, C. Tang, and W. Zhan "Guided Online Distillation: Promoting Safe Reinforcement Learning by Offline Demonstration" 2024 IEEE International Conference on Robotics and Automation (ICRA) [arxiv, website]
- D.Isele, P. Gupta, **X. Liu**, S. Bae "Gaussian Lane Keeping: A Robust Prediction Pipeline" International Conference on Intelligent Transportation Systems, 2024 [arxiv, website].
- **(Best Paper)** S. Danforth, **X. Liu**, M. Ward, P. Holmes, and R. Vasudevan "Predicting Sagittal-Plane Swing Hip Kinematics in Response to Trips", RA-L and BioRob for the IEEE Robotics and Automation Letters, 2022 [DOI, video]
- S. Danforth, P. Holmes, **X. Liu**, M. Ward, and R. Vasudevan "Real-Time Trip-Recovery Planning in Robotic Prostheses using Predicted Sets of Human Motion", IEEE Transactions on Robotics, 2022.

## Research Experience

**Camera Trajectory Generation with Semantic Gaussian Splatting** *Pittsburgh, PA*
Research Assistant at Group of Dr. Matthew Johnson-Roberson (Drop Lab) at CMU *April 2024 – Sep 2024*

- Developed **SplaTraj**, a novel framework for generating semantically-aware camera trajectories using Gaussian splatting.
- Developed methods for querying photorealistic representations with language embeddings and formulated the camera trajectory generation as a continuous-time trajectory optimization problem.
- Successfully generated Radial Basis Function-based (RBF) camera trajectories that match user-specified language instructions with the ability to isolate and project specified spatial regions dynamically.
- First Authorship: Submitted to ICRA 2025.

**Safe Reinforcement Learning Fine-Tuning in Driving Scenarios** *Berkeley, CA*
Research Assistant at Group of Dr. Masayoshi Tomizuka (MSC Lab) at UC Berkeley *June 2023 – Sep 2024*

- Developed a versatile driving simulation platform capable of replaying real-world datasets and facilitating online training.
- Specified problem formulation and configuration spaces. Conducted offline training of a transformer model as a baseline.
- Implemented an online distillation procedure within the driving simulator, successfully extracting lightweight policies from the transformer model.
- We achieved approximately a 15% improvement in success rates for real-world traffic-driving tasks.

**Swing Hip Recovery Behavior Modeling and Safe Planning** *Ann Arbor, MI*
Research Assistant at Group of Dr. Ram Vasudevan (ROAHM Lab) at UMich *Sep 2021 – Dec 2022*

- Planned and executed human subject experiments to develop a trip-recovery dataset to analyze prosthetic wearers' responses following unexpected trips.

- Developed three distinct models to forecast hip trip-recovery behavior: a multi-output Gaussian process regression (Bayesian) model, a NARX (neural network) model, and a pendulum dynamics model.
- Designed and implemented a scuff-free trip-recovery planner, and compared its performance to a clinically utilized nominal phase-based controller. Demonstrated empirical superiority of our planner in terms of trip-recovery performance.
- **Best Paper** of BioRob for the IEEE Robotics and Automation Letters, 2022

### Autonomous Mid-Air Docking of Drones

*Berkeley, CA*

Research Assistant at Group of Dr. Mark Mueller (HiPeR Lab) at UC Berkeley *Nov 2019 – Oct 2020*

- Conducted thorough calibration and error analysis of the onboard positioning system's sensors (cameras and IMU units).
- Collaborated with a team to build simulation platform development, providing tests and extensions for real-world experiments.
- Implemented an onboard closed-loop control approach on simulated drones, enabling mid-air docking in simulation.

## Work Experience

### Honda Research Institute USA, Inc.

*San Jose, CA*

Research Intern, Autonomous Driving & Interactive Decision Making *Sep 2022 – Apr 2023*

- Developed a C++-based obstacle-avoidance planning module to identify and correct unsafe or infeasible trajectories generated by the behavior planner. Successfully decreased the collision rate in simulation from 30% to less than 3%.
- Designed and Implemented multiple standard trajectory prediction modules and integrated them into the ROS-Carla simulator.
- Implemented robust Gaussian-based trajectory prediction predictor, the paper has been accepted by ICITS, 2024.

### Rimble Inc.

*Berkeley, CA*

Software Engineer Intern, Computer Vision Applications on E-sports Analytics *May 2021 – Aug 2021*

- Prototyping a real-time Python pipeline for acquiring keyframes from ongoing e-sports events and streaming videos on Twitch.
- Designed and developed real-time game status tracker and odds analysis modules for e-sport interactive user interface.

## Skills

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|---|---|
| Programming: | Python, C/C++, MATLAB, R, LaTeX |
| Framework: | PyTorch, TensorFlow, ROS, ROS2 |
| Simulation: | Carla, Gym, IsaacSim, Mujoco, OpenSim |
| Languages: | English (Proficient), Chinese (Native), Cantonese (Intermediate), French (Intermediate) |

## Project Experience

### Event-Based Corner Detection and Tracking

*Shanghai, China*

Graduate Thesis on Event Camera, State estimation *Mar 2021 – May 2021*

- Developed a novel strategy of corner feature extraction from the input of an event camera.
- Proposed a new loss function D2D with an exact solver for fitting the spatial-temporal manifold.
- Built a C++ pipeline for corner detection and tracking to test the D2D loss function in simulation and real-world datasets.

### Depth Estimation from a Single City-Scene Image

*Berkeley, CA*

Course Project on Computer Vision, Depth Estimation *Mar 2020 – May 2020*

- Applied Manhattan assumption and vanishing point (VP) constraints to improve single-image depth estimation in city scenarios.
- Demonstrated improved depth estimation performance by 5% on average and enhanced depth estimate on edges and corners.