Yuanjie Lu

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Education

- **George Mason University** *Aug. 2021 - Present*
  Ph.D. in Computer Science Fairfax, VA
  - GPA: 3.85/4.00
  - Research Focus: Deep Learning & Reinforcement Learning for Autonomous Robot Navigation; AI-driven Decision-Making for Motion Planning and Control

- **George Mason University** *Aug. 2019 - May 2021*
  M.S. in Computer Science Fairfax, VA
  - GPA: 3.73/4.00
  - Coursework: Machine Learning, Deep Learning, Foundations of Planning, Natural Language Processing

Research Experience

- **Research Assistant, George Mason University & University of South Florida** *Fairfax, VA*
  Advisors: Prof. Xuesu Xiao (GMU), Prof. Xiaomin Lin (USF) Oct. 2025 - Present
  Project: Adaptive Planner Parameter Learning from Large Language Model (LLM)
  - Developing an LLM-guided adaptive planner that uses reasoning to tune parameters in real-time, addressing limitations of traditional and RL-based methods.
  - Leveraging **ChatGPT-4o** and locally deployed **Llama 3** to learn ROS navigation stack structure (global planner, local planner, costmap, and recovery behaviors), enabling reasoning-driven parameter tuning and adaptive module selection.
  - Optimizing LLM inference latency to achieve **1–10** Hz real-time performance for onboard robot navigation.

  Project: Reasoning and Planning for Autonomous Underwater Monitoring from Vision Language Model (VLM)
  - Designing a VLM-guided autonomy framework for underwater navigation, addressing perception noise, semantic ambiguity, and planning inconsistency.
  - Integrated VLM with chain-of-thought reasoning for global planning and optimized local planners (DWA, TEB, E-Band) for obstacle avoidance.
  - Achieved **1–5** Hz VLM reasoning and at least **20** Hz control frequency for real-time underwater navigation.

- **Research Assistant, George Mason University** *Fairfax, VA*
  Advisors: Prof. Xuesu Xiao Aug. 2025 – Oct. 2025
  Project: Adaptive Dynamics Planning (ADP) for Robot Navigation
  - Enabled collision-free navigation in narrow corridors, hospital hallways, and warehouse environments for **delivery** and **service robots** under tight spatial constraints.
  - Designed a dual-system architecture combining classical motion planning with **TD3-based reinforcement learning** for real-time dynamics adaptation, addressing rigidity in traditional navigation systems.
  - Developed distributed training pipeline integrating Gazebo simulations with Slurm HPC and Condor synchronization, achieving **89% reduction** in training time and enabling scalable policy optimization across hundreds of environments.
  - Achieved **99% success rate** and **1st place** on BARN Challenge benchmark with **30% faster** traversal time compared to baselines; validated on Clearpath Jackal robot; paper submitted to **IEEE ICRA 2026**. [paper]

- **Research Assistant, George Mason University & Oxford Robotics Institute** *Fairfax, VA*
  Advisors: Prof. Xuesu Xiao (GMU), Prof. Nick Hawes (ORI) Nov. 2025 – May 2025
  Project: Decremental Dynamics Planning (DDP) for Robot Navigation

- Enabled **high-speed** autonomous navigation for ground robots in **unknown** and **unstructured** environments, including off-road fields, urban alleys, and indoor obstacle-rich areas.
- Re-architected ROS move_base system in C++ with hierarchical dynamics modeling across global and local planners (DWA, MPPI, Log-MPPI), and implemented custom recovery behaviors to handle stalling and deadlock under real-time constraints.
- Achieved **2nd place** in 2025 BARN Challenge; validated on Clearpath Jackal robot and published at **IEEE IROS 2025**. [paper] [video]

- **Research Assistant, George Mason University** *Fairfax, VA*
Advisors: Prof. Xuesu Xiao Jan. 2024 – Apr. 2024
Project: Multi-goal Motion Memory for Robot Navigation
  - Implemented **task-level autonomous navigation** for **warehouse** and **hospital robots** performing delivery and retrieval missions in dynamic environments without prior map knowledge.
  - Integrated a CNN-based trajectory predictor (PyTorch) into a memory-augmented motion planning framework (C++ backend) that reuses prior path planning experiences through incremental graph construction, enabling robots to rapidly generate dynamics-feasible global paths from **camera or LiDAR-based maps**.
  - Achieved up to **90% faster planning speed** while maintaining path quality, demonstrating robust multi-goal navigation performance across simulation and benchmark evaluations; paper accepted by **IEEE ICRA 2025**. [paper] [video]

- **Research Assistant, George Mason University** *Fairfax, VA*
Advisors: Prof. Erion Plaku Aug. 2021 – Apr. 2023
Project: Machine learning-based Motion Planning & Multi-Goal Motion Planning
  - Addressed the computational inefficiency of traditional motion and multi-goal planning algorithms, aiming to balance **planning accuracy and onboard computation constraints** for real-time navigation.
  - Engineered a **modular 2D/3D motion planning simulator** in **C++** with embedded support for sampling-based algorithms (**PRM, RRT, DROMOS**); redesigned the Roadmap representation and **Dijkstra** algorithm for improved scalability and runtime efficiency.
  - Designed high-performance **machine learning models** (**MLP, XGBoost, LightGBM**) trained on traditional motion planner data to enable predictive cost estimation and path feasibility learning. Implemented distributed data generation and training pipelines on a **Slurm-managed HPC cluster**, and integrated the trained models into the motion planning pipeline.
  - Demonstrated consistent performance gains—achieving up to **10× computational efficiency** with negligible loss in path optimality—and enabled deployment on resource-constrained robotic systems; papers accepted by **IEEE IROS 2022**, **IEEE IROS 2023**, and **IEEE ICRA 2024**. [paper] [paper] [paper]

- **Research Assistant, George Mason University** *Fairfax, VA*
Advisors: Prof. David Lattanzi & Prof. Amarda Shehu Aug. 2019 – Jan. 2021
Project: Data-Driven Modeling and Anomaly Forecasting for Autonomous Systems
  - Improved traffic flow forecasting under **dynamic disruptions** (e.g., road work zones and lane closures), addressing instability of conventional models in irregular conditions.
  - Engineered a high-performance Graph Convolutional Network to capture spatiotemporal correlations across heterogeneous traffic networks, integrating flow dynamics, topological structure, and disruption indicators.
  - Designed a multi-head attention fusion mechanism ("speed-wave fusion") to enhance robustness against sparse and noisy data, achieving a **25% reduction in RMSE** compared to baseline forecasting models.
  - Developed transferable graph-based modeling techniques for dynamic environments, contributing to later applications in autonomous robotic perception, high-level decision-making, and navigation control [paper].

Work Experience

- **Research Engineer, Johns Hopkins University** *Baltimore, MD*
  Advisors: Prof. Tinoosh Mohsenin May 2025 - Aug. 2025
  Project: Autonomous Navigation for Legged Robots in Complex Environments
  - Investigated autonomous quadruped navigation in disaster and unstructured environments, focusing on mobility challenges beyond wheeled platforms.
  - Enabled stable wireless ROS2 communication on the Unitree Go2, achieving fully untethered real-time control and telemetry over Wi-Fi.
  - Integrated 3D LiDAR point-cloud processing with YOLO-based visual detection, achieving real-time obstacle recognition at **15 Hz** with end-to-end latency under **65 ms**.
  - Prototyped a reinforcement-learning-based navigation framework in **Isaac Gym**, unifying locomotion and planning modules for end-to-end quadruped autonomy.
  - Designed and tested a PPO-based adaptive policy for waypoint tracking and terrain-aware navigation; ongoing work aims to improve training stability and sim-to-real transfer performance [video].

- **Digital Innovation Research Fellow, Institute for Digital Innovation (IDIA)** *Fairfax, VA*
  Advisors: Tong Yang (Unitree Robotics) and Kamaljeet Sanghera (IDIA) May 2024 - Aug. 2024
  Project: Vision-Driven Obstacle Avoidance for Quadruped Robot Navigation
  - Focused on improving **visual–LiDAR fusion for obstacle avoidance** on the **Unitree Go1** quadruped robot, enhancing navigation reliability in complex 3D environments.
  - Engineered a **YOLO-based real-time obstacle detection** module integrated with the **ROS1 move_base** framework, dynamically updating costmaps for reactive avoidance in dense environments.
  - Developed a reinforcement-learning-based **stair climbing policy** in **Isaac Gym**, constructing custom stair environments and training adaptive locomotion behaviors over uneven terrain [video].

Publications

C=Conference, J=Journal, S=Submission

[S.1] Y. Lu, L. Wang, T. Xu, and X. Xiao, **"Adaptive Dynamics Planning for Robot Navigation,"** under review at *IEEE International Conference on Robotics and Automation (ICRA)*, 2026.

[C.9] Y. Lu et al., **"Autonomous Ground Navigation in Highly Constrained Spaces: Lessons Learned from the Fourth BARN Challenge at ICRA 2025,"** *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA 2025)*, Competition Track (BARN Challenge), IEEE Robotics and Automation Society, 2025.

[C.1] Y. Lu, T. Xu, L. Wang, N. Hawes, and X. Xiao, **"Decremental Dynamics Planning for Robot Navigation,"** *2025 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, accepted, 2025.

[C.1] Y. Lu, D. Das, E. Plaku, and X. Xiao, **"Multi-goal Motion Memory for Robot Navigation,"** *2025 IEEE International Conference on Robotics and Automation (ICRA)*, pp. 8864–8871, 2025.

[J.6] T. Xu, C. Pan, M. B. Rao, A. Datar, A. Pokhrel, Y. Lu, and X. Xiao, **"Verti-bench: A General and Scalable Off-road Mobility Benchmark for Vertically Challenging Terrain,"** *IEEE Robotics and Automation Letters (RA-L)*, 2025.

[C.3] L. Wang, T. Xu, Y. Lu, and X. Xiao, **"Reward Training Wheels: Adaptive Auxiliary Rewards for Robotics Reinforcement Learning,"** *2025 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, accepted, 2025.

[C.2] D. Das, Y. Lu, E. Plaku, and X. Xiao, **"Motion Memory: Leveraging Past Experiences to Accelerate Future Motion Planning,"** *2024 IEEE International Conference on Robotics and Automation (ICRA)*, pp. 16467–16474, 2024.

[C.1] Y. Lu and E. Plaku, **"Leveraging Single-goal Predictions to Improve the Efficiency of Multi-goal Motion Planning with Dynamics,"** *2023 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 850–857, 2023.

[C.2] H. D. Bui, Y. Lu, and E. Plaku, **"Improving the Efficiency of Sampling-based Motion Planners via Runtime Predictions for Motion-planning Problems with Dynamics,"** *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 4486–4491, 2022.

[C.4] Y. Du, Y. Wang, F. Alam, Y. Lu, X. Guo, L. Zhao, and A. Shehu, **"Deep Latent-variable Models for Controllable Molecule Generation,"** *2021 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)*, pp. 1303–1310, 2021.

Professional Service

- **Journal/Conference Reviewer:**
  IEEE Robotics and Automation Letters (RA-L), IEEE International Conference on Robotics and Automation (ICRA), and IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2024–2025.
- **Leadership:** Team Lead, GMU BARN Challenge 2025 Team

Technical Skills

- **Programming Languages:** C++, Python, Java
- **AI Frameworks:** PyTorch, TensorFlow, Keras, Scikit-Learn
- **Cloud Computing:** AWS, Google Colab
- **Robotic tools:** ROS, Gazebo, Nvidia-Isaac Gym/Sim, OpenAI Gym
- **Other:** Linux, Git, Mac OS, Windows