Tong Xu

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EDUCATION

George Mason University — Fairfax, USA
Ph.D. in Computer Science — *Aug. 2023 - Present*

University of Southern California — Los Angeles, USA
M.S. in Computer Science — *Aug. 2021 - May 2023*

Nanjing University of Information Science & Technology — Nanjing, China
B.E. in Network Engineering — *Sep. 2017 - Jun. 2021*

RESEARCH STATEMENT

Research Interests: My research lies at the intersection of *robotics*, *motion planning*, *reinforcement learning*, and *foundation models*. I am particularly passionate about robotic high-fidelity simulation and hardware systems.

Research Questions: How can we robustly deploy intelligent mobile robots in *unstructured, real-world environments* and leverage *physical configurations* to enable knowledge transfer across heterogeneous platforms?

RESEARCH EXPERIENCE

George Mason University — Fairfax, USA
Research Assistant, RobotiXX Lab — *Aug. 2025 - Present,*
Advisor: *Xuesu Xiao* — *Summer 2026, 2025, 2024*

Verti-Bench: A General and Scalable Off-Road Mobility Benchmark

- Created a general off-road mobility benchmark *Verti-Bench* on vertically challenging terrain with 100 off-road environments and 1000 navigation tasks scalable to various vehicle types
- Incorporated millions of off-road terrain features including geometry, semantics (rigid and deformable), and obstacles
- Provided various datasets and a RL interface to facilitate data-driven off-road mobility
- Implemented ten different off-road mobility systems based on benchmark

CAR: Cross-Vehicle Kinodynamics Adaptation via Mobility Representation

- Presented a cross-vehicle mobility representation framework that employs a Transformer encoder with Adaptive Layer Normalization to embed trajectory transitions and physical configurations into a structured, shared latent space
- Proposed an efficient selection strategy that identifies relevant mobility neighbors within the shared latent space to extract transferable kinodynamics knowledge in order to minimize data overhead on new vehicles
- Developed a rapid adaptation mechanism that integrates weighted dataset aggregation, weighted loss optimization, and regulated gradient update to transfer mobility knowledge to new vehicles using only one minute of trajectory data
- Achieved up to 67.2% reduction in prediction error compared to direct neighbor transfer across diverse new vehicle configurations

VertiAdaptor: Online Kinodynamics Adaptation for Vertically Challenging Terrain

- Presented a unified terrain representation using the Sliced Wasserstein Autoencoder (SWAE) to efficiently obtain elevation and semantic embeddings beneath the vehicle
- Proposed *VertiAdaptor*, the first $\mathbb{SE}(3)$ kinodynamics online adaptation framework based on complex off-road elevation and semantics that enables rapid kinodynamic model updates through least-squares optimization
- Improved prediction accuracy by up to 23.9% and achieved a 5X faster adaptation time compared with Multi-Layer Perceptron fine-tuning, Model-Agnostic Meta-Learning, and neural Ordinary Differential Equation

VertiSelector: Automatic Curriculum Learning (ACL) for Wheeled Mobility

- Presented the *VW-Chrono* simulator, designed for wheeled mobility on vertically challenging terrain to

algorithmically generate varied vertically challenging terrain for ACL

- Proposed *VertiSelector*, a novel ACL framework that samples training terrain based on estimates of future learning potential (TD-error)
- Combined Proximal Policy Optimization (PPO) with the SWAE structure to efficiently learn wheeled mobility in *VW-Chrono*
- Improved navigation performance by 23.08% in terms of success rate compared against a manually designed curriculum, vanilla RL, a hybrid (classical and learning) method and two classical baseline approaches

Boston University Boston, USA
Research Intern, H2X Lab, Advised by *Eshed Ohn-Bar* *May 2022 - Aug. 2022*

- Research Topics: deep visual odometry, motion estimation

Nanjing University of Information Science & Technology Nanjing, China
Research Assistant, Advised by *Xiaorui Zhang* *Oct. 2019 - May 2021*

- Research Topics: domain adaptation, emotion recognition

PUBLICATIONS

(* indicates equal contribution)

Journal

[J4] X. Xiao, Z. Xu, S. A. Ghani, A. Datar, D. Song, P. Stone, A. Mazen, K. Yazdipaz, I. Mateyaunga, M. Faied, Y. Lu, **T. Xu**, N. Mahammad, W. Kim, J. Reasoner, and N. Bezzo. Autonomous Ground Navigation in Highly Constrained Spaces: Lessons Learned from The Forth BARN Challenge at ICRA 2025. *IEEE Robotics & Automation Magazine (RAM)*, Vol. 33, Iss. 1: 186-196, March 2026..

[J3] Z. Hu, **T. Xu**, X. Xiao, and X. Wang. CARoL: Context-aware Adaptation for Robot Learning. *IEEE Robotics and Automation Letters (RA-L)*, Vol. 10, No. 11: 12063-12070, November 2025.

[J2] X. Cai, J. Queeney, **T. Xu**, A. Datar, C. Pan, M. Miller, A. Flather, P. R. Osteen, N. Roy, X. Xiao, and Jonathan P. How. PIETRA: Physics-Informed Evidential Learning for Traversing Out-of-Distribution Terrain. *IEEE Robotics and Automation Letters (RA-L)*, Vol. 10, No. 3: 2359-2366, March 2025. (Video)

[J1] X. Zhang, **T. Xu**, W. Sun, and A. Song. Multiple source domain adaptation in micro-expression recognition. *Journal of Ambient Intelligence and Humanized Computing,* Vol. 12, No. 8: 8371–8386, 2021.

Conference

[C8] Y. Lu, M. Mao, **T. Xu**, L. Wang, X. Lin, and X. Xiao. Adaptive Dynamics Planning for Robot Navigation. *Accepted by IEEE International Conference on Robotics and Automation (ICRA)*, 2026.

[C7] H. Chen, A. Datar, **T. Xu**, F. Cancelliere, H. Rangwala, M. B. Rao, D. Song, D. Eichinger, and X. Xiao. Verti-Arena: A Controllable and Standardized Indoor Testbed for Multi-Terrain Off-Road Autonomy. *IEEE International Symposium on Safety Security Rescue Robotics (SSRR)*, 2025. (Video)

[C6] L. Wang*, **T. Xu***, Y. Lu, and X. Xiao. Reward Training Wheels: Adaptive Auxiliary Rewards for Robotics Reinforcement Learning. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, October 2025. (Video)

[C5] **T. Xu**, C. Pan, and X. Xiao. VertiSelector: Automatic Curriculum Learning for Wheeled Mobility on Vertically Challenging Terrain. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, October 2025. (Video)(Code)

[C4] Y. Lu, **T. Xu**, L. Wang, N. Hawes, and X. Xiao. Decremental Dynamics Planning for Robot Navigation. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, October 2025. (Video)

[C3] **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. *Robotics: Science and Systems (RSS)*, June 2025. (Website)(Video)(Code)

[C2] **T. Xu**, C. Pan, and X. Xiao. Reinforcement learning for wheeled mobility on vertically challenging terrain. *IEEE International Symposium on Safety Security Rescue Robotics (SSRR)*, pp. 125-130, November 2024. hyperref

[C1] **T. Xu**. Single-view and multi-view methods in marker-less 3d human motion capture. *Journal of physics: conference series*, pp. 012022, 2019.

Preprint

[P3] **T. Xu***, C. Pan*, and X. Xiao. CAR: Cross-Vehicle Kinodynamics Adaptation via Mobility Representation. *under review*, 2026.

[P2] **T. Xu**, C. Pan, A. Datar, and X. Xiao. VertiAdaptor: Online Kinodynamics Adaptation for Vertically Challenging Terrain. *under review*, 2026.

[P1] C. Pan, A. Datar, A. Pokhrel, M. Choulas, M. Nazeri, **T. Xu**, and X. Xiao. Traverse the Non-Traversable: Estimating Traversability for Wheeled Mobility on Vertically Challenging Terrain. *under review*, 2026.

PROFESSIONAL SERVICE

Journal Reviewer

- IEEE Transactions on Robotics (T-RO)
- IEEE Robotics and Automation Letters (RA-L)
- IEEE Transactions on Vehicular Technology (TVT)

Conference Reviewer

- Robotics: Science and Systems (RSS)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR)
- AAAI Symposium on Unifying Representations for Robot Application Development (UR-RAD)
- IEEE Conference on Decision and Control (CDC)
- IEEE Conference on Control Technology and Applications (CCTA)

HONORS

- Doctoral Research Scholarship - Tier 1, George Mason University (05/2026)
- IROS-SDC 2025 Travel Award (08/2025)
- 2nd Place, IEEE ICRA 2025 Competition The Benchmark Autonomous Robot Navigation (BARN) Challenge (05/2025)
- The Outstanding Graduate of Jiangsu (06/2021)
- President's Scholarship of Nanjing University of Information Science & Technology (09/2020)
- China National Scholarship for Undergraduates (top 1%) (09/2020)

TEACHING EXPERIENCE

Graduate Teaching Assistant — George Mason University

CS 485: Autonomous Robotics — *Spring 2025*
CS 262: Introduction to Low-Level Programming — *Spring, Fall 2024*
CS 112: Introduction to Computer Programming — *Fall 2023*

- Designed student lab contents involving data structure, led weekly lab recitations and office hours
- Created grading scripts and managed a team of 8 undergraduate teaching assistants

SKILLS

Programming: Python, C++, LaTeX, Java, Node.js, SQL, Linux
Frameworks: Pytorch, Stable-Baselines3, Git, Slurm, ROS1, ROS2
Robots: Verti-Wheelers, Unitree G1, Unitree Go1, Unitree Go2