XUSHENG LUO

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ACADEMIC EMPLOYMENT

Carnegie Mellon University Pittsburgh, PA

- *Postdoctoral Fellow* at the Robotics Institute, School of Computer Science 2023 – Present
- Advisor: Changliu Liu

EDUCATION

Duke University Durham, NC

- *Ph.D. in Mechanical Engineering (Robotics)* 2017 – 2020
- *M.S. in Mechanical Engineering (Robotics)* 2017 – 2020
- Advisor: Michael M. Zavlanos
- Dissertation: Scalable Control Synthesis for Multi-Robot Systems under Temporal Logic Specifications

Harbin Institute of Technology Harbin, China

- *M.S. in Aerospace Engineering* 2015 – 2017
- *B.S. in Aerospace Engineering* 2011 – 2015
  - Formerly majored in Computer Science (2011–2012); transitioned to Aerospace Engineering

PUBLICATIONS

* indicates equal contribution.

I have published **7** peer-reviewed journal papers, **7** peer-reviewed conference papers, and **4** peer-reviewed workshop papers in top robotics, control and system venues, such as T-RO, RA-L, Automatica, RSS, CDC, T-CPS, ICCPS.

Refereed Journal Publications

[1] **Xusheng Luo**, Changliu Liu, "Simultaneous Task Allocation and Planning for Multi-Robots under Hierarchical Temporal Logic Specifications". *arXiv:2401.04003*, *IEEE Transactions on Robotics* (to appear), 2025. **(IF=10.5)**

[2] Shaojun Xu*, **Xusheng Luo***, Yutong Huang, Letian Leng, Ruixuan Liu, Changliu Liu, "NL2HLTL2PLAN: Scaling Up Natural Language Understanding for Multi-Robots Through Hierarchical Temporal Logic Task Representation". *arXiv:2408.08188*, *IEEE Robotics and Automation Letters* (to appear), 2025, **(IF=5.3)**.

[3] **Xusheng Luo**, Tianhao Wei, Simin Liu, Ziwei Wang, Luis Mattei-Mendez, Taylor Loper, Joshua Neighbor, Casidhe Hutchison, and Changliu Liu. "Certifying Robustness of Learning-Based Keypoint Detection and Pose Estimation Methods". *ACM Transactions on Cyber-Physical Systems* 9, no. 2 (2025): 1-26. **(IF=2.0)**

[4] **Xusheng Luo**, Shaojun Xu, Ruixuan Liu and Changliu Liu. "Decomposition-based Hierarchical Task Allocation and Planning for Multi-Robots under Hierarchical Temporal Logic Specifications". *IEEE Robotics and Automation Letters*, 2024, with presentation at ICRA 2025. **(IF=5.3)**

[5] **Xusheng Luo** and Michael M Zavlanos. "Temporal Logic Task Allocation in Heterogeneous Multi-robot Systems". *IEEE Transactions on Robotics*, 38(6):3602-3621, 2022. **(IF=10.5)**

[6] **Xusheng Luo**, Yiannis Kantaros, and Michael M Zavlanos. "An Abstraction-Free Method for Multirobot Temporal Logic Optimal Control Synthesis". *IEEE Transactions on Robotics*, 37(5):1487–1507, 2021. **(IF=10.5)**

[7] **Xusheng Luo**, Miroslav Pajic, and Michael M. Zavlanos. "An Optimal Graph-Search Method for Secure State Estimation". *Automatica* 123 (2021): 109323. **(IF=5.9)**

Refereed Conference Proceedings

[8] Zhongqi Wei*, **Xusheng Luo***, Changliu Liu, "Hierarchical Temporal Logic Task and Motion Planning for Multi-Robot Systems". *Robotics: Science and Systems*, 2025.

[9] Tianhao Wei, Luca Marzari, Kai Yun, Hanjiang Hu, Peizhi Niu, **Xusheng Luo** and Changliu Liu. "ModelVerification.jl: a Comprehensive Toolbox for Formally Verifying Deep Neural Networks". *International Conference on Computer Aided Verification*, 2025.

[10] Shiqi Sun, Yan Zhang, **Xusheng Luo**, Panagiotis Vlantis, Miroslav Pajic, and Michael M. Zavlanos. "Formal Verification of Stochastic Systems with ReLU Neural Network Controller". *IEEE 39th International Conference on Robotics and Automation (ICRA)*, Philadelphia, USA, 2022.

[11] Yijie Zhou, Yan Zhang, **Xusheng Luo**, and Michael M. Zavlanos. "Human-in-the-loop Robot Planning with Non-Contextual Bandit Feedback". In *2021 60th IEEE Conference on Decision and Control (CDC)*, pp. 2848-2853. IEEE, 2021

[12] **Xusheng Luo***, Yan Zhang*, and Michael M. Zavlanos. "Socially-aware Robot Planning via Bandit Human Feedback". In *2020 ACM/IEEE 11th International Conference on Cyber-Physical Systems (ICCPS)*, pp. 216-225. IEEE, 2020.

[13] Le, Duc M., **Xusheng Luo**, Leila J. Bridgeman, Michael M. Zavlanos, and Warren E. Dixon. "Single-Agent Indirect Herding of Multiple Targets using Metric Temporal Logic Switching". In *2020 59th IEEE Conference on Decision and Control (CDC)*, pp. 1398-1403. IEEE, 2020.

[14] **Xusheng Luo**, and Michael M. Zavlanos. "Transfer Planning for Temporal Logic Tasks". In *2019 IEEE 58th Conference on Decision and Control (CDC)*, pp. 5306-5311. IEEE, 2019.

Refereed Workshop Publications

[15] **Xusheng Luo**, Tianhao Wei, Simin Liu, Ziwei Wang, Luis Mattei-Mendez, Taylor Loper, Joshua Neighbor, Casidhe Hutchison, Changliu Liu, "Certifying Robustness of Learning-Based Keypoint Detection and Pose Estimation Methods". Workshop on *Public Trust in Autonomous Systems*, *IEEE International Conference on Robotics and Automation (ICRA)*, 2025.

[16] **Xusheng Luo** and Changliu Liu. "Hierarchical Temporal Logic Specifications for Abstract Safety Tasks". Workshop on *Robot safety under uncertainty from "intangible" specifications*, *IEEE International Conference on Robotics and Automation (ICRA)*, 2025.

[17] **Xusheng Luo***, Shaojun Xu* and Changliu Liu. "Obtaining Hierarchy from Human Instructions: an LLMs-based Approach". Workshop on *Learning Effective Abstractions for Planning (LEAP)*, *Conference on Robot Learning (CoRL)*, 2023.

[18] **Xusheng Luo**, Shaojun Xu, Ruixuan Liu and Changliu Liu. "Robotic Planning under Hierarchical Temporal Logic Specifications". Workshop on *Formal Methods Techniques in Robotics Systems: Design and Control*, *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2023.

Preprints

[19] Ruixuan Liu, Alan Chen, **Xusheng Luo** and Changliu Liu. "Simulation-aided Learning from Demonstration for Robotic LEGO Construction". *arXiv:2309.11010*, 2023.

AWARDS AND HONORS

- **Dynamic Systems & Control Division (DSCD) Rising Star** ASME, 2025
- **Cyber-Physical System (CPS) Rising Star (16.4%=36/220)** NSF, 2024
  "36 outstanding PhD students and postdocs in Cyber-Physical Systems (CPS)".
- **CDC Travel Grant** IEEE Control Systems Society, 2020
- **Outstanding Graduate** Harbin Institute of Technology, 2015, 2017
- **The Samsung Scholarship** Harbin Institute of Technology, 2016
- **Summer School Scholarship** Technion, Israel, 2016
- **National Endeavor Fellowship** Harbin Institute of Technology, 2012, 2014
- **Third Prize in the 9th National Zhou Peiyuan Mechanics Competition** CSTAM, China, 2013

WORK AND RESEARCH EXPERIENCE

Intelligent Control Lab, Carnegie Mellon University 2023 – Present
Postdoctoral Fellow, supervised by Prof. Changliu Liu Pittsburgh, PA

DJI 2021 – 2023
Autonomous Driving Research Engineer, Decision Making and Planning Shenzhen, China

Zavlanos's Lab, Duke University 2017 – 2020
Research Assistant, supervised by Prof. Michael M. Zavlanos Durham, NC

TALKS

Refereed Conference and Workshop Presentations

- Decomposition-based Hierarchical Task Allocation and Planning for Multi-Robots under Hierarchical Temporal Logic Specifications 2025
  – In 2025 *IEEE International Conference on Robotics and Automation (ICRA)*
- Certifying Robustness of Learning-Based Keypoint Detection and Pose Estimation Methods 2025
  – Workshop on *Public Trust in Autonomous Systems, IEEE International Conference on Robotics and Automation (ICRA)*
- Hierarchical Temporal Logic Specifications for Abstract Safety Tasks 2025
  – Workshop on *Robot safety under uncertainty from "intangible" specifications, IEEE International Conference on Robotics and Automation (ICRA)*
- Integrating Autonomy with Formal Methods 2024
  – Workshop on *2024 NSF CPS Rising Stars*
- Obtaining Hierarchy from Human Instructions: an LLMs-based Approach 2023
  – Workshop on *Learning Effective Abstractions for Planning, Conference on Robot Learning (CoRL)*

- Robotic Planning under Hierarchical Temporal Logic Specifications 2023
  – Workshop on *Formal Methods Techniques in Robotics Systems: Design and Control, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*
- Socially-aware Robot Planning via Bandit Human Feedback 2020
  – In *2020 ACM/IEEE 11th International Conference on Cyber-Physical Systems (ICCPS)*
- Transfer Planning for Temporal Logic Tasks 2019
  – In *2019 IEEE 58th Conference on Decision and Control (CDC)*

Invited Talks

- Scalable Control Synthesis for Multi-Robot Systems under Temporal Logic Specifications
  – Intelligent Control Lab at CMU 2022
  – Reliable Autonomous System Lab at MIT 2021

PROFESSIONAL SERVICE

Conference & Workshop Organization

- Lead Organizer, Foundation Models for Control (FM4Control): Bridging Language, Vision, and Control Workshop at Modeling, Estimation and Control Conference (MECC) 2025
- Session Chair, Verification and Formal Methods, ICRA 2025

Paper Review

- **Journals:**
  – IEEE Transactions on Pattern Analysis and Machine Intelligence (T-PAMI) 2025
  – IEEE Transactions on Mechatronics (T-MECH) 2025
  – IEEE Journal of Dynamic Systems, Measurement and Control 2025
  – IEEE Robotics and Automation Letters (RA-L) 2025
  – IEEE Transactions on Robotics (T-RO) 2022, 2023, 2024, 2025
  – IEEE Control Systems Letters (L-CSS) 2024
  – IEEE Transactions on Automation Science and Engineering (T-ASE) 2021, 2025
  – IEEE Transactions on Control of Network Systems (T-CNS) 2019, 2021
- **Conferences:**
  – Conference on Robot Learning (CoRL) Workshop Learning Effective Abstractions for Planning (LEAP) 2024, 2025
  – IEEE Conference on Decision and Control (CDC) 2025
  – Robotics: Science and Systems (R:SS) 2024, 2025
  – IEEE International Conference on Robotics and Automation (ICRA) 2024, 2025
  – AACC/IFAC Conference on Modeling, Estimation and Control Conference (MECC) 2024, 2025
  – IEEE International Conference on Intelligent Robots and Systems (IROS) 2022, 2025
  – IEEE American Control Conference (ACC) 2022
  – IEEE International Conference on Ubiquitous Robots (UR) 2021
  – ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS) 2019, 2020

TEACHING EXPERIENCE

Teaching Assisant

- Linear System Theory (graduate) Duke University, Fall 2019
  – Instructor: Michael M. Zavlanos
- MATLAB for Engineering (undergraduate) Harbin Institute of Technology, Fall 2016
  – Instructor: Changsheng Gao

Guest Lecturer

- Certification of Neural Certificates and Certification of Pose Estimation Models
  – Special Topics: Provably Safe Robotics Carnegie Mellon University, Spring 2025
  – Instructor: Changliu Liu
- On the Application of Formal Methods to Robotics
  – Special Topics: Provably Safe Robotics Carnegie Mellon University, Spring 2024
  – Instructor: Changliu Liu

MENTORING

- **PhD students:**
  – Zhongqi Wei (CMU ME [8])
- **Master's students:**
  – Yutong Huang (CMU ME [2])
  – Letian Leng (CMU ME [2])
  – Shiqi Sun (Duke ME → PhD student at Northwestern Polytechnical University [10])
  – Yijie Zhou (Duke ME → PhD student at the Chinese University of Hong Kong [11])
- **Undergraduate students:**
  – Shaojun Xu (visiting student at CMU → PhD student at Tsinghua University [4, 2])
  – Shuo Yang (visiting student at Duke → PhD student at University of Pennsylvania)
- **High school students:**
  – Alan Chan (visiting student at CMU [19])

OPEN-SOURCE SOFTWARES

- **TLRRT-star**: Sampling-based temporal logic motion planner for satisfying LTL specifications.
- **LTL-MRTA**: Optimal task allocation and motion planning for multi-robot systems under global LTL task specifications.
- **Hierarchical-LTL**: A hierarchical framework for scalable LTL planning using decomposable specifications and local policies.
- **Hierarchical-LTL-STAP**: Extension of Hierarchical-LTL supporting simultaneous task allocation and planning (STAP) for large-scale teams.
- **Hierarchical-LTL-GCS**: High-level task and motion planning framework leveraging hierarchical LTL and geometric constraint satisfaction.
- **ModelVerification.jl**: A Julia-based toolbox for verifying properties of neural networks.