# XUSHENG LUO

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**Work Authorization:** Currently on H-1B (transferable); EB-1A I-140 approved, priority date 11/10/2023

## RESEARCH INTERESTS

**Overview:** My research agenda centers on **building assured autonomy at scale** by unifying principles from robotics, artificial intelligence, machine learning, systems and control, and formal methods. I develop *safe*, *reliable*, and *explainable* AI-driven robotic systems capable of operating in *dynamic* and *human-centered* environments, with applications spanning mobile, aerial, and manipulator platforms.

## ACADEMIC AND PROFESSIONAL EMPLOYMENT

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

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

## 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". *IEEE Transactions on Robotics*, 2025. **(IF=10.5)** DOI: 10.1109/TRO.2025.3598139

[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". *IEEE Robotics and Automation Letters*, 2025, **(IF=5.3)**. DOI: 10.1109/LRA.2025.3598648

[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)** DOI: 10.1145/372836

[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)** DOI: 10.1109/LRA.2024.3412589

[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)** DOI: 10.1109/TRO.2022.3181948

[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)** DOI: 10.1109/TRO.2021.3061983

[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)** DOI: 10.1016/j.automatica.2020.109323

**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 (to appear)*, 2025. [link]

[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*, pp. 395-408. Cham: Springer Nature Switzerland, 2025. DOI: 10.1007/978-3-031-98679-6_18

[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. DOI: 10.1109/ICRA46639.2022.9811866

[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. DOI: 10.1109/CDC45484.2021.9683023

[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. DOI: 10.1109/ICCPS48487.2020.00033

[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. DOI: 10.1109/CDC42340.2020.9304233

[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. DOI: 10.1109/CDC40024.2019.9030087

**Refereed Workshop Publications**

[15] **Xusheng Luo**\*, Zhongqi Wei\*, Changliu Liu, "Integrated Temporal Logic Task and Motion Planning for Multi-Arms". Workshop on *Frontiers in Dynamic, Intelligent, and Adaptive Multi-Arm Manipulation*, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2025.

[16] **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. [link]

[17] **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. [link]

[18] **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. [link]

[19] **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. [link]

**Preprints**

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

[21] **Xusheng Luo** and Changliu Liu. "From Decoupled to Coupled: Robustness Verification for Learning-based Keypoint Detection with Joint Specifications". *under review at Transactions on Machine Learning Research*, 2025.

## GRANT AND PROPOSALS

- **Co-Author, Multidisciplinary University Research Initiative (MURI) Proposal led by Professor Katia Sycara** – Led one research thrust, including problem formulation, technical writing, and coordination with collaborators. 2025

## AWARDS AND HONORS

- **Dynamic Systems & Control Division (DSCD) Rising Star** ASME, 2025
- **Multi-Robot Systems (MRS) Young Pioneer** (declined due to visa issues) IEEE, 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

## TALKS

**Refereed Conference and Workshop Presentations**

- Integrated Temporal Logic Task and Motion Planning for Multi-Arms                           2025
  – Workshop on *Frontiers in Dynamic, Intelligent, and Adaptive Multi-Arm Manipulation (FDIAMM), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*

- Building Assured Autonomy at Scale                                                          2025
  – Special Session on *ASME DSCD Rising Stars*

- Building Assured Autonomy at Scale                                                          2025
  – In 2025 *Northeast Robotics Colloquium (NERC)*

- 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**

- Building Assured Autonomy at Scale: Logical Specification, Provable Control, and Verified Learning
  – Artificial Intelligence for Robot Coordination at Scale (ARCS) Lab at CMU                  2025
    ◦ Host: Professor Jiaoyang Li
  – Computational Robotics, AI & Biomedicine (Kavraki) Lab at Rice University                  2025
    ◦ Host: Professor Lydia E. Kavraki
  – Center for Autonomy at University of Texas, Austin                                         2025
    ◦ Host: Professor Ufuk Topcu
  – Resilient Cyber-Physical Systems Lab at University of California, Irvine                   2025
    ◦ Host: Professor Yasser Shoukry
  – Riverside Artificial Intelligence Research and Education Institute (RAISE) Seminar at University of California, Riverside                                                                  2025

   ◦ Host: Professor Vassilis Tsotras
- Existential Robotics Laboratory (ERL) at University of California, San Diego    2025
   ◦ Host: Professor Nikolay A. Atanasov

- Scalable Control Synthesis for Multi-Robot Systems under Temporal Logic Specifications
  - Intelligent Control Lab (ICL) at CMU    2022
     ◦ Host: Professor Changliu Liu
  - Reliable Autonomous System (REALM) Lab at MIT    2021
     ◦ Host: Professor Chuchu Fan

## PROFESSIONAL SERVICE

### Professional Affiliations

- Institute of Electrical and Electronics Engineers (IEEE), Member

### Editorial Roles

- *Associate Editor* for Vision and Sensor-Based Control, IEEE International Conference on Robotics and Automation (ICRA)    2026

### Conference & Workshop Organization

- *Session Chair*, Verification and Formal Methods, ICRA    2025

- *Lead Organizer*, Foundation Models for Control (FM4Control): Bridging Language, Vision, and Control Workshop at Modeling, Estimation and Control Conference (MECC)    2025

- *Volunteer*, Modeling, Estimation, and Control Conference (MECC)    2025
  Supported onsite operations and technical sessions to ensure smooth conference execution

### 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, 2025
  - 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, 2026
  - 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, 2026

– IEEE International Conference on Ubiquitous Robots (UR)      2021
– ACM/IEEE International Conference on Cyber-Physical Systems (ICCPS)      2019, 2020

## PROFESSIONAL DEVELOPMENT

- **Future Faculty Program**, Carnegie Mellon University, Eberly Center for Teaching Excellence and Educational Innovation      2025–Present
  Selected participant in CMU's university-wide program preparing postdoctoral scholars and Ph.D. candidates for faculty careers through evidence-based pedagogy, inclusive mentoring, and academic leadership.

## TEACHING EXPERIENCE

### Teaching Assisant

- MATLAB for Engineering Applications      Harbin Institute of Technology, Fall 2016
  – Ins tructor: Changsheng Gao

### Guest Lecturer

- From Temporal Logic Specifications to Control Synthesis in Multi-Robot Systems
  – CSCE 689: Special Topics in Multi-Robot Systems      Texas A&M University, Fall 2025
  – Instructor: Yiwei Lyu

- System Properties: Controllability, Observability, and Stability
  – 16-714 Advanced Control for Robotics      Carnegie Mellon University, Fall 2025
  – Instructor: Changliu Liu

- Certification of Pose Estimation Models
  – Special Topics: Provably Safe Robotics      Carnegie Mellon University, Spring 2025
  – Instructor: Changliu Liu

- Formal Methods in Robotics
  – Special Topics: Provably Safe Robotics      Carnegie Mellon University, Spring 2024
  – Instructor: Changliu Liu

## MENTORING

- **CMU Paths to AI Research Program (PAIR)**      Fall 2025
  – Provide monthly guidance to four undergraduates exploring AI research: helping them identify research topics, connect with labs, and plan for internships/fellowships.

- **PhD students:**
  – RuiXuan Liu (CMU Robotics [2, 4, 20])
  – Zhongqi Wei (CMU ME [8])
  – Tianhao Wei (CMU ECE [3, 9])
  – Hanjiang Hu (CMU ECE [9])

- **Master's students:**
  – Yiyuan Pan (CMU CS)
  – 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 [2, 4])
  - Shuo Yang (visiting student at Duke → PhD student at University of Pennsylvania)
  - Daniel Jiang (CMU CS, Pair program)
  - Sudhir Chebiyyam (CMU CS, Pair program)

- **High school students:**
  - Alan Chan (visiting student at CMU → undergraduate at the University of Texas at Austin [20])

## 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.