Wenliang Liu

Boston, MA, USA

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EDUCATION

Boston University **Boston, MA, USA**
Ph.D. in Mechanical Engineering *Expected May 2024*
M.S. in Mechanical Engineering *Jan 2023*

- GPA: 3.93/4.0

Beihang University **Beijing, China**
Bachelor in Technology and Apparatus of Measuring and Control *Jul 2019*
Second Major in Mathematics *Jul 2019*

- GPA: 3.95/4.0

RESEARCH INTERESTS

Machine Learning, Robotics, Control Systems, Formal Methods.

RESEARCH EXPERIENCE

Robotics Lab, Boston University **Boston, MA, USA**
Doctoral Research Assistant *Sep 2019 - Present*
Advisor: Professor Calin Belta

- Proposed data-driven control algorithms for training neural network controllers in robotic systems subject to temporal logic specifications, utilizing techniques such as imitation learning, model predictive control, system identification, model-based and model-free reinforcement learning (published in ICRA, L4DC, L-CSS).
- Designed a novel temporal logic language, called capability temporal logic plus (CaTL+), for large heterogeneous multi-agent systems, and developed a framework of learning distributed coordination and communication policies under the new logic specification (published in ACC and L4DC).
- Developed an algorithm for integrating trainable control barrier functions into neural network controller such that the controller is guaranteed to satisfy given safety and temporal logic requirements (accepted by CDC).
- Tested the proposed algorithms on real unmanned ground vehicles and manipulators (Baxter) using ROS.

Distributed Cooperative System Lab, University of Notre Dame **Notre Dame, IN, USA**
International Summer Undergraduate Research Experience (iSURE) Program *Jul 2018 - Oct 2018*
Advisor: Professor Hai Lin

- Collected and labeled data from the camera on a Baxter robot's hand to train a CNN for instance segmentation.
- Designed and implemented a system for a Baxter robot to grasp objects using visual information.

Intelligent Integration and Nanotechnology Lab, Beihang University **Beijing, China**
Undergraduate Research Assistant *Nov 2018 - May 2019*
Advisor: Professor Guangcun Shan

- Studied and implemented deep learning-based visual localization algorithms for self-driving vehicles.

INTERNSHIP EXPERIENCE

Symbotic LLC **Wilmington, MA, USA**
Robot Control Intern *May 2023 - Aug 2023 (expected)*

- Develop a temporal logic guided reinforcement learning algorithm for warehouse mobile robots to pick and rotate cases in arbitrary orientation.
- Implement the algorithm using C++ (Behavior Tree) and Python, and test it in Gazebo and on real robots.

PUBLICATIONS

- **Wenliang Liu**, Noushin Mehdipour, Calin Belta *"Recurrent Neural Network Controllers for Signal Temporal Logic Specifications subject to Safety Constraints"*, IEEE Control Systems Letters (L-CSS) 2021 (presented at American Control Conference (ACC) 2021).
- Ningyuan Zhang, **Wenliang Liu**, Calin Belta *"Distributed Control using Reinforcement Learning with Temporal-Logic-Based Reward Shaping"*, Learning for Dynamics and Control (L4DC) 2022.
- **Wenliang Liu**, Mirai Nishioka, Calin Belta *"Model-Based Safe Policy Search from Signal Temporal Logic Specifications Using Recurrent Neural Networks"*, IEEE International Conference on Robotics and Automation (ICRA) 2023.
- **Wenliang Liu**, Kevin Leahy, Zachary Serlin, Calin Belta *"Robust Multi-Agent Coordination from CaTL+ Specifications"*, IEEE American Control Conference (ACC) 2023.
- **Wenliang Liu**, Kevin Leahy, Zachary Serlin, Calin Belta *"CatlNet: Learning Communication and Coordination Policies from CaTL+ Specifications"*, Learning for Dynamics and Control (L4DC) 2023.
- **Wenliang Liu**, Calin Belta, Wei Xiao *"Learning Robust and Correct Controllers from Signal Temporal Logic Specifications Using BarrierNet"*, IEEE Conference on Decision and Control (CDC) 2023.

REVIEW ACTIVITIES

Reviewer for the following conferences and journals:
- IEEE Conference on Decision and Control (CDC).
- IEEE Control System Letters (L-CSS).
- IEEE Robotics and Automation Letters (RA-L)
- IEEE American Control Conference (ACC)

TEACHING EXPERIENCE

Automation and Manufacturing Methods **Boston University**
Graduate Teaching Assistant, Mechanical Engineering Department *Fall 2020*
- Taught undergraduate students automation and manufacturing experiments, including the usage of manipulators (Universal Robots UR5), milling machines, etc.
- Supervised students' projects and graded students' experiment reports.

Instrumentation Laboratory **Boston University**
Graduate Teaching Assistant, Mechanical Engineering Department *Spring 2021*
- Mentored undergraduate students on experiments about electrical and mechanical systems, data measuring and analysis, and writing technical reports.

SKILLS

- **Software:** Python (PyTorch), MATLAB, ROS, Gazebo, Simulink, C/C++, Behavior Tree, CUDA, Linux, etc.
- **Hardware:** iRobot Create 2 ground robots, Baxter robot, Universal Robot 5 (UR5), driver license, etc.

HONORS & AWARDS

First prize in China College Physics Contest (top 1%), China 2017
Scholarship for academic excellence, Beihang University 2017
GUANGHUA Scholarship, Beihang University 2016