

# Yaru Niu

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## EDUCATION

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### Carnegie Mellon University

*Ph.D. in Mechanical Engineering, Safe AI Lab*

*Advisor: Prof. Ding Zhao*

Pittsburgh, PA

*Aug. 2022 – Present*

### Georgia Institute of Technology

*M.S. in Electrical and Computer Engineering, CORE Robotics Lab*

*Advisor: Prof. Matthew Gombolay*

Atlanta, GA

*Aug. 2019 – April 2022*

### South China University of Technology (SCUT)

*B.Eng. in Intelligence Science and Technology*

*Advisor: Prof. Zhijun Zhang*

Guangzhou, China

*Sep. 2015 – June 2019*

### University of California, Irvine

*Visiting Student in Department of EECS*

Irvine, CA

*June 2018 – Aug. 2018*

### University of California, Berkeley

*Exchange Student, Concentration in Computer Science*

Berkeley, CA

*Aug. 2018 – Dec. 2018*

## PUBLICATIONS

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(\* indicates co-first authors)

1. **Yaru Niu**. Adaptable and Scalable Multi-Agent Graph-Attention Communication. *Master's Thesis, Georgia Institute of Technology*, 2022.
2. Rohan Paleja\*, **Yaru Niu**\*, Andrew Silva, Chace Ritchie, Sugju Choi, Matthew Gombolay. Learning Interpretable, High-Performing Policies for Autonomous Driving. *Robotics: Science and Systems (RSS)*, 2022.
3. **Yaru Niu**\*, Rohan Paleja\*, Matthew Gombolay. Multi-Agent Graph-Attention Communication and Teaming. *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2021 (**Oral**).
4. **Yaru Niu**\*, Rohan Paleja\*, Matthew Gombolay. MAGIC: Multi-Agent Graph-Attention Communication. *Mair2 Workshop at International Conference on Computer Vision (ICCV)*, 2021 (**Best Paper Award**).
5. Zhijun Zhang\*, **Yaru Niu**\*, Ziyi Yan, Shuyang Lin. Real-time Whole-body Imitation by Humanoid Robots and Task-oriented Teleoperation Using an Analytical Mapping Method and Quantitative Evaluation. *Applied Sciences (Special Issue Human-Friendly Robotics, Impact Factor: 2.217)*, 2018.
6. Zhijun Zhang, **Yaru Niu**, Shangen Wu, Shuyang Lin, Lingdong Kong. Analysis of Influencing Factors on Humanoid Robots' Emotion Expressions by Body Language. *International Symposium on Neural Networks (ISNN), Lecture Notes in Computer Science (LNCS)*, Springer, 2018.
7. Zhijun Zhang, Lingdong Kong, **Yaru Niu**. A Time-Varying-Constrained Motion Generation Scheme for Humanoid Robot Arms. *International Symposium on Neural Networks (ISNN), Lecture Notes in Computer Science (LNCS)*, Springer, 2018.

## PREPRINTS

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(\* indicates co-first authors)

1. Lingfeng Sun\*, Chen Tang\*, **Yaru Niu**, Enna Sachdeva, Chiho Choi, Teruhisa Misu, Masayoshi Tomizuka, Wei Zhan. Domain Knowledge Driven Pseudo Labels for Interpretable Goal-conditioned Interactive Trajectory Prediction. *arXiv Preprint*, 2022.
2. Zhijun Zhang (PI), Lingdong Kong, **Yaru Niu**, Ziyang Liang. Modification of Gesture-Determined-Dynamic Function with Consideration of Margins for Motion Planning of Humanoid Robots. *arXiv Preprint*, 2020.

## PATENTS

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1. Zhijun Zhang, **Yaru Niu**. A Mapping Method of Human Postures Applied to Motion Imitation by Humanoid Robots (Translated from Chinese). *Published Authorization Number: CN107953331B*.
2. Zhijun Zhang, **Yaru Niu**. A Similarity Evaluation Method of Imitation by Humanoid Robots (Translated from Chinese). *Published Authorization Number: CN107818318B*.
3. Zhijun Zhang, **Yaru Niu**, Hao Wang. A Mapping Method of Human Body's Rotation and Displacement Applied to Humanoid Robots (Translated from Chinese). *Published Authorization Number: CN108858188B*.
4. Zhijun Zhang, **Yaru Niu**, Hao Wang. An Evaluation Metric of Humanoid Robot and Human Posture Similarity (Translated from Chinese). *Published Application Number: CN109064486A*.

## RESEARCH EXPERIENCE

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### Baidu Research

Jan. 2022 – Present

*Research Intern, Robotics and Autonomous Driving Lab (RAL)*

*Advisor: Dr. Liangjun Zhang*

- Hierarchical Multi-Agent Reinforcement Learning
  - Designed a hierarchical multi-agent reinforcement learning algorithm for long-term heterogeneous tasks in construction scenarios.
- Reinforcement Learning for Excavation
  - Designed a reinforcement learning scheme for excavation behaviors with sparse rewards in SoftGym.

### University of California, Berkeley

July 2021 – Feb. 2022

*Research Intern, Mechanical Systems Control (MSC) Lab*

*Advisor: Prof. Masayoshi Tomizuka*

- Project: Incorporating Logical Prior Knowledge into Goal-conditioned Interactive Trajectory Prediction
  - Processed and visualized data from the Waymo Open Dataset, implemented VectorNet from scratch with PyTorch Geometric to encode contextual and agent information on the map, and built out the goal-based interactive motion prediction model revised from DenseTNT.
  - Incorporated logical rule (e.g., speed limit in stop regions) regularization into the motion prediction model.
  - Prepared a second-author paper to be submitted to *RA-L* (with IROS option).

### Georgia Institute of Technology

Jan. 2020 – May 2022

*Graduate Research Assistant, Cognitive Optimization and Relational Robotics Lab*

*Advisor: Prof. Matthew Gombolay*

- Project: Multi-Agent Graph-Attention Communication
  - Proposed a fully differentiable scalable multi-agent communication protocol in which we learn 1) a Scheduler to decide when to communicate and whom to address messages to, and 2) a Message Processor using a designed Graph Attention Networks (GATs) with differentiable dynamic graphs to deal with communication signals.
  - Implemented the proposed method with PyTorch in Google Research Football, Traffic Junction and Predator-Prey environments, compared to the baselines such as CommNet, IC3Net, TarMAC and GA-Comm.
  - Completed a first-author paper published in *AAMAS 2021 (Oral Presentation)* and presented at ICCV 2021 Mair2 Workshop (**Best Paper Award**).
- Project: Continuous Differentiable Decision Trees
  - Proposed a differentiable crispification method to train interpretable crisp decision trees with sparse linear sub-models in general reinforcement learning frameworks.
  - Implemented the proposed method with SAC and TD3 in continuous domains including Cart Pole, Lunar Lander and several autonomous driving scenarios with PyTorch; implemented imitation learning baselines on decision trees including CART and DAGGER.
  - Completed a co-first-author paper published in *RSS 2022*.

### South China University of Technology

Aug. 2016 – June 2019

*Undergraduate Researcher, Bionic Intelligent Robot (BIR) Lab*

*Advisor: Prof. Zhijun Zhang*

- Project: Whole-Body Imitation by Humanoid Robots and Task-Oriented Teleoperation
  - Designed a novel whole-body imitation and teleoperation system on humanoid robots, and proposed an analytical motion mapping method called Geometrical Analysis Based on Link Vectors and Virtual Joints.
  - Designed gesture imitation learning methods on our proposed system using Dynamic Time Warping, Gaussian Mixture Model, Gaussian Mixture Regression and Semi-Hidden Markov Model.
  - Completed a co-first-author paper published in *Applied Sciences*, and three authorized patents.

- Project: Analysis of Influencing Factors on Humanoid Robots’ Emotion Expressions by Body Language
  - Designed the pilot study and experiment to investigate people’s perception of the emotions conveyed by body language, and tested the hypothesis using two-sample T test and Mann-Whitney U test.
  - Completed a second-author paper (PI as the first author) published in *ISNN 2018*.

## University of California, Irvine

Summer 2018

*Undergraduate Researcher, Advanced Integrated Cyber-Physical Systems (AICPS) Lab*

*Advisor: Prof. Al Faruque*

- Project: DietMate – A Multimodal Diet Monitoring System
  - Collected, processed and extracted features from the time-series data obtained from the piezo sensor, the strain sensor and the microphone, using NumPy, SciPy, and Pandas libraries.
  - Trained classification models to estimate human behaviors using Scikit-learn and Tensorflow.

## TEACHING EXPERIENCE

### CS 4731/7632 Game Artificial Intelligence

June 2020 – Dec. 2020

*Graduate Teaching Assistant, Georgia Institute of Technology*

*Instructor: Dr. Stephen Lee-Urban*

### CS 4641 Machine Learning

Jan. 2021 – May 2021

*Graduate Teaching Assistant, Georgia Institute of Technology*

*Instructor: Dr. Nakul Gopalan*

## RELEVANT GRADUATE COURSES

<b>Statistical Machine Learning</b> , Georgia Tech, A (score 99.06%)	Spring 2021
<b>Human-Robot Interaction</b> , Georgia Tech, A (score 99.80%)	Fall 2020
<b>Deep Learning</b> , Georgia Tech, A (score 100.68%)	Spring 2020
<b>Probabilistic Graphical Models in Machine Learning</b> , Georgia Tech, A (score 95.34%)	Spring 2020
<b>Interactive Robot Learning</b> , Georgia Tech, A (score 97.38%)	Fall 2019
<b>Game Artificial Intelligence</b> , Georgia Tech, A (score 98.28%)	Fall 2019
<b>Advanced Programming Techniques</b> , Georgia Tech, A (score 104.48%)	Fall 2019

## HONORS

<b>Best Paper Award</b> , ICCV 2021 Mair2 Workshop (top 1)	Oct. 2021
<b>National Endeavor Scholarship</b> , awarded by Ministry of Education of China (rank 2/51)	Nov. 2016, Nov. 2018
<b>The Jetta Scholarship</b> , awarded by Jetta Company Limited (rank 3/51)	Dec. 2017
<b>2<sup>nd</sup> Prize in China Undergrad. Math. Contest in Modeling (CUMCM)</b> (top 5% in SCUT)	Oct. 2017
<b>1<sup>st</sup> Prize of Guangdong Province in CUMCM</b> (top 5% in SCUT)	Oct. 2017

## ACADEMIC SERVICE

**Reviewer:** AISTATS 2022, WAFR 2022, IROS 2022

## SKILLS

**Programming Languages:** Python, C/C++, Matlab, Java

**Open Source Libraries:** PyTorch, Tensorflow, PyTorch Geometric, OpenAI Gym, Stable Baselines3, MuJoCo, Scikit-learn, OpenGL, OpenCV