Yuchen XIAO

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EDUCATION

Northeastern University, Boston, U.S. Ph.D. in Computer Sciences *Aug. 2022*

- Thesis: Macro-Action-Based Multi-Agent/Robot Deep Reinforcement Learning under Partial Observability
- Committee: Christopher Amato (Advisor), Leslie Kaelbling (MIT), Robert Platt (NU), Lawson Wong (NU)

Columbia University, New York City, U.S. M.S. in Mechanical Engineering *Dec. 2015*

Dalian University of Technology, Dalian, China M.Eng. in Mechanical Engineering *Jun. 2014*

Kunming University of Science and Technology, Kunming, China B.S. in Mechanical Engineering *Jul. 2012*

PUBLICATIONS

- **Y. Xiao**, W. Tan and C. Amato. "Asynchronous Actor-Critic for Multi-Agent Reinforcement Learning", *The Thirty-Sixth Conference on Neural Information Processing Systems (NeurIPS)*, 2022.
- X. Lyu, A. Baisero, **Y. Xiao** and C. Amato. "A Deeper Understanding of State-Based Critics in Multi-Agent Reinforcement Learning". *The Thirty-Sixth AAAI Conference on Artificial Intelligence,* 2022
- **Y. Xiao**, X. Lyu and C. Amato. "Local Advantage Actor-Critic for Robust Multi-Agent Deep Reinforcement Learning". *International Symposium on Multi-Robot and Multi-Agent Systems (MRS),* 2021. ***Best Paper Finalist***
- X. Lyu, **Y. Xiao**, B. Daley and C. Amato. "Contrasting Centralized and Decentralized Critics in Multi-Agent Reinforcement Learning". *International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS),* 2021 ***Best Paper Finalist***
- **Y. Xiao**, J. Hoffman, T. Xia and C. Amato. "Multi-Agent/Robot Deep Reinforcement Learning with Macro-Actions". *The Thirty-Fourth AAAI Student Abstract and Poster Program*, 2020
- **Y. Xiao**, J. Hoffman, T. Xia and C. Amato. "Learning Multi-Robot Decentralized Macro-Action-Based Policies via a Centralized Q-Net". *IEEE International Conference on Robotics and Automation (ICRA),* 2020
- **Y. Xiao**, J. Hoffman and C. Amato. "Macro-Action-Based Deep Multi-Agent Reinforcement Learning". *Conference on Robot Learning (CoRL),* 2019
- **Y. Xiao**, S. Katt, A. ten Pas, S. Chen and C. Amato. "Online Planning for Target Object Search in Clutter under Partial Observability". *IEEE International Conference on Robotics and Automation (ICRA),* 2019
- N. Hoang*, **Y. Xiao***, K. Sivakumar and C. Amato. "Near-Optimal Adversarial Policy Switching for Decentralized Asynchronous Multi-Agent Systems". *IEEE International Conference on Robotics and Automation (ICRA), 2018*
- P. Piacenza*, **Y. Xiao***, S. Park, I. Kymissis and M. Ciocarlie. "Contact Localization through Spatially Overlapping Piezoresistive Signals". *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2016*
- S. Park, L. Bishop, T. Post, **Y. Xiao**, J. Stein and M. Ciocarlie. "On the Feasibility of Wearable Exotendon Networks for Whole-Hand Movement Patterns in Stroke Patients". *IEEE International Conference on Robotics and Automation (ICRA), 2016*

RESEARCH EXPERIENCE

Northeastern University *Sep. 2016 - present*

Research Assistant ▪ Lab for Learning and Planning in Robotics *Boston, U.S.*

Multi-Agent/Robot Deep Reinforcement Learning with Asynchronous Macro-Action Execution

- Formulated the first set of actor-critic frameworks to learn asynchronous macro-action-based policies
- Developed the first set of value-based algorithms to learn asynchronous macro-action-value functions
- Designed and programmed long-horizon macro-action-based OpenAI Gym environments
- Trained policies with a recurrent layer (LSTM/GRU) to deal with partial observability
- Conducted experiments on both AWS and a computer cluster using Slurm scheduling
- Deployed learned policies on real robots (one Fetch Robot and two Turtlebots) in warehouse domains

Multi-Agent Deep Reinforcement Learning

- Developed a Robust Local Advantage Actor-Critic (ROLA) algorithm outperforming a group of SOTA methods

- Applied Python multiprocessing module to have a number of parallel environments for training
- Edited the published code of SOTA methods to accept OpenAI and other multi-agent benchmark domains
- Theoretically analyzed the variance and bias of using centralized and decentralized *history-based* critics
- Theoretically analyzed the variance and bias of using a *state-based* critic for updating decentralized policies

Online Planning for Robotic Manipulation

- Formulated the target object search problem as a Partially Observable Markov Decision Process
- Developed an online planning method to find a hidden target object via mobile manipulation
- Programmed a simulator in OpenRave to interact with the planning algorithm
- Trained an object recognition model using TensorFlow Object Detection API
- Created grasping pose database using a PointCloud-based Grasping Detector
- Conducted experiments both in Gazebo simulator and on a real Fetch Robot with YCB objects

Multi-Robot Planning

- Formulated Capture-The-Flag game as Macro-Action Decentralized Partially Observable Markov Decision Process
- Developed a planning method to learn switching policies for a team of robots against the opponents' strategy changes
- Programmed six Turtlebots to run the learned controllers in real-world

Honda Research Institute *Sep. 2020 - Nov. 2020*
Research Intern ▪ Robotics *San Jose, U.S.*

Task and Motion Planning for Robotic Manipulation

- Proposed a new Task and Motion Planning framework incorporated with dynamics and action prediction models
- Programmed a Pybullet environment for a target object retrieval task on a cluttered tabletop
- Collected image-based expert data from the simulator while solving the task
- Trained an image autoencoder to learn the latent representation using GPU
- Trained a dynamics model and an action prediction model (a CVAE) in the latent space using GPU

Columbia University *Jan. 2015 - Dec. 2015*
Research Assistant ▪ Robotic Manipulation and Mobility Lab *New York City, U.S.*

Robotics Tactile Sensing

- Designed a soft tactile sensor consisting of a volume of piezoresistive elastomer with four embedded electrodes
- Built a C++ library to control Märzhäuser measuring stage and Mercury DC-Motor probe for indentation test

Force-Controlled Tendon-Driven Mechanisms

- Designed a force and impedance PID controller for a tendon driven glove to help stroke patients with grasping
- Programmed the control system on Baby Orangutan B-328 microcontroller with FUTEK force sensor feedback

Robotic Teleoperation and Motion Planning

- Designed an interface to teleoperate a PR2 Robot's dual-arm based on Kinect sensor
- Implemented RRT and PRM motion planning algorithms to manipulate Baxter Robot's arm

TECHNICAL SKILLS

- Programming Language: Python, C/C++, MATLAB
- Software: PyTorch, TensorFlow, OpenAI Gym, Pybullet, OpenRave, AWS, Slurm, Robot Operating Systems (ROS), MoveIt, Vim (proficient), LaTeX, Solidworks
- Robot Platform: Fetch Robot, Turtlebot, Baxter Robot, PR2 Robot

INVITED TALKS

- "Macro-Action-Based Multi-Agent Deep Reinforcement Learning", *Stanford Intelligent Systems Laboratory*, 2020

PROFESSIONAL SERVICES

- Senior PC Member, *International Joint Conference on Artificial Intelligence (IJCAI)*, 2021
- PC Member, *International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS)*, 2021-2022
- Reviewer, *IEEE International Conference on Robotics and Automation (ICRA)*, 2018-2022
- Reviewer, *Conference on Neural Information Processing Systems (NeurIPS)*, 2022
- Reviewer, *IEEE Transactions on Robotics*, 2022