Alvin Shek

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EDUCATION

CARNEGIE MELLON UNIVERSITY
MS in Robotics | 2021 - August 2022
Cum. GPA: 4.0 / 4.0
BS in Electrical and Computer Engineering | 2017 - 2021
Cum. GPA: 3.92 / 4.0

CONCENTRATIONS
Visual Imitation Learning
Reinforcement Learning
Human Robot Interaction
Motion Planning and Controls

LINKS
Github:// **Alvinosaur**
LinkedIn:// **alvinshek**
Portfolio: alvinosaur.github.io/**AboutMe**

COURSEWORK

MACHINE LEARNING
Deep Reinforcement Learning
Intro to Deep Learning
Probabilistic Graphical Models
Convex Optimization*
Introduction to Machine Learning

ROBOTICS AND CONTROLS
Provably Safe Robotics
Adaptive Control and Reinforcement Learning
Planning Techniques for Robotics
Computer Vision
Robot Kinematics and Dynamics

COMPUTER SCIENCE
Introduction to Embedded Systems
Parallel Computer Architecture and Prog.
Introduction to Computer Systems
Fundamentals of Imperative Computation

SKILLS

PROGRAMMING
Python • C++ • Julia • Matlab • Java

SOFTWARE
Pytorch • Tensorflow • CUDA • ROS

* Denotes current semester

RESEARCH

LEARNING FROM PHYSICAL HUMAN FEEDBACK: OBJECT-CENTRIC ONE-SHOT ADAPTATION
Alvin Shek , Rui Chen, Changliu Liu
(Submitted to IROS 2022) | Link Here
- Interpret human intentions and physical feedback on robot as object-centric using a Graph NN
- Online adaptation requiring only one correction (One-Shot) to learn drastically different behavior
- Learn object-relative behavior to enable (Zero-Shot) transfer to new environments of rearranged objects
- Novel separation of pre-trained network vs adaptation of compact latent space features using Graph NN

REAL-TIME COLLABORATIVE ROBOT HANDLING
Rui Chen, **Alvin Shek** , Changliu Liu
(Submitted to IEEE Transactions on Robotics (T-RO) 2022) | Link Here
- Human-robot collaborative framework for material handling
- Formulated as probabilistic generative process to handle uncertainty in human motion
- Trained with human-human collaboration demonstration data
- Multi-Head Attention for each of dimension of translation and rotation data
- LSTM-based Encoder-Decoder to generate smooth, continuous motions
- Built data collection setup and controller interface with Kinova robot arm
- User studies to analyze ease of interaction with robot gesture

WORK EXPERIENCE

TEACHER ASSIST. - DEEP REINFORCEMENT LEARNING
August 2021 – December 2021 | Carnegie Mellon University
- Led recitations on: MCTS planning, Policy Gradients, Evolutionary Search, Sim2Real transfer and Domain Randomization, Graph Neural Networks
- Created HW assignment on LQR with Taylor-approximated linear dynamics
- Debugged student code on DQN, Model-based RL, CMA Evolutionary Search, Goal-Conditioned BC vs DAGGER

UBER ATG | Software Engineering Intern on Motion Planning
May 2020 – August 2020 | Remote from Pittsburgh, PA
- Optimized GPU runtime of expensive cost functions
- Built full pipeline and interface using CUDA and Tensorflow in C++
- Achieved 238x speedup to make costing real-time
- Presented 1-hour talk comparing different algorithms in GPU occupancy and memory constraints to 60+ people

CANVAS CONSTRUCTION | Robotics Software Intern
May 2019 – August 2019 | San Francisco, CA
- Compared LiDAR accuracy with point-to-plane projections in Python
- Developed point cloud feature extractor for obstacle avoidance in C++
- Designed 2D, grid-based path planner for max area coverage with obstacle avoidance in Python and C++
- Integrated feature detection and path planning with global map association into fully functional system
- Presented results to entire company, including non-technical audience

PROJECTS

LEARNED GRAPH STRUCTURE FOR ROBOT DYNAMICS
January 2021 - May 2021 | More Details: learned_dynamics

- Learn complex dynamics simulation using Graph Neural Networks
- Learn underlying graph structure as edge probabilities through message passing
- Compared performance with similar model but fixed, apriori known graph
- Implemented with Pytorch and MuJoco simulator

META-LEARNING FOR ROBOTICS
September 2020 - December 2020 | More Details: idl_project

- Compared performance of popular Meta-Learning algorithms (MAML, Reptile) with classic algorithms (PPO)
- Proposed new modification to MAML, analyzed its poor performance
- Goal to train robot arm to reach a target location
- Gained experience in reward-shaping and debugging RL algorithms

HIGH-SPEED DRONE FOLLOWING
September 2020 - December 2020 | More Details: drone_controls

- Explored minimum snap(4th derivative of position) trajectory generation
- Implemented LQR and MPC for drone controls and compared performance
- Learned how and when to apply differential flatness to solve nonlinear controls with linear systems

AUTOMATIC SCORING FOR AXE-THROWING
September 2019 – May 2020 | More Details: axe_detection

- Explored three approaches to locate and score axe tip in images for a local business under Dr. George Kantor
- Classical CV with image difference, blob detection, principal axis
- Single layer NN with vectorized image as input
- MaskRCNN for end-to-end detection and scoring

ROBOTIC AIR HOCKEY TABLE
December 2018 - January 2019 | More Details: robotic_air_hockey

- Designed system architecture and state machine ranging from user interaction to sensor communications
- Built two 2 Degree-of-freedom robot arms to play against people with only camera feedback, no sensors
- Puck trajectory prediction and velocity kinematics for motion planning
- Track puck with color-filtering and Kalman Filter