Xinghao Zhu

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EDUCATION

University of California Berkeley
California, USA

PhD Student — Aug. 2018 - May 2023 (Anticipated)

- Major: Control, Minors: Robotics, Learning, and Optimization, GPA: 4.0, PhD Prelim Score: 98/100
- Research Interests: Robotic Grasping and Manipulation, RL, Deep Learning, Optimization, Motion Planning
- Research Advisor: Prof. Masayoshi Tomizuka

Xi'an Jiaotong University (XJTU)
Xi'an, China

BEc. Major in Electrical Engineering & the Honors Youth Program — Sep. 2012 - July 2018

- Best Undergraduate Thesis Paper of XJTU in 2018 (awarded to top 1% of 4000)

SKILLS

- **Languages**: Python, MATLAB, C/C++, Verilog HDL, Karel
- **Developer Tools**: Ubuntu, MuJoCo, Bullet, Kinect, RealSense, Ensenso, Arduino, 3D Printing
- **Control**: PID, LQR/LQG, MPC, Control Barrier, Impedance/Preview/Adaptive/Repetitive/Feedforward Control, Inverse Dynamics Control, Zero Phase Error Tracking Control, Disturbance Observer
- **Robotic**: ROS, Fanuc Robot Controller, Kinematics, Dynamics, Motion Planning Algorithms (RRT, TrajOpt, CFS, etc), Robotic Grasp Planning and Manipulation (GPD, GQCNN, GraspNet, etc), HRI, Soft Robot
- **Learning**: SVM, GDA, GMM, Search, PCA/CCA, Kalman/Particle Filter, Decision Tree, RL Algorithms (PPO, Q-Learning, SAC, Offline RL, etc), Meta Learning, Deep Models (Fast-RCNN, Transformers, GNN, etc)

SELECTED RESEARCH EXPERIENCES

Goal Conditioned Robotic Manipulation with Offline RL
Mar. 2020 - Present

Mechanical Systems Control Lab — California, USA

- Considered goal-conditioned robotic pushing for planar objects with pre-collected datasets
- The policy takes depth images as observations and decides the pushing primitives. The policy is trained offline with Conservative Q-Learning and directly deployed to the real world

Learning to Synthesize Volumetric Meshes from Tactile Imprints
May 2021 - Sep. 2021

Mitsubishi Electric Research Lab — Cambridge, USA

- Focused on learning to synthesize the volumetric mesh of the elastomer based on the image imprints acquired from vision-based tactile sensors (GelSlim)
- A graph neural network (GNN) is introduced to learn the image-to-mesh mappings with supervised learning. A self-supervised adaptation method and image augmentation techniques are proposed to transfer networks from simulation to reality, from primitive contacts to unseen contacts, and from one sensor to another

Learn to Grasp with Less Supervision
Mar. 2021 - Sep. 2021

Mechanical Systems Control Lab — California, USA

- Proposed a maximum likelihood grasp sampling loss (MLGSL) to learn robotic grasping from sparsely labeled datasets. MLGSL is used to train networks that evaluates thousands of grasp candidates simultaneously
- A novel variant of loss and model architectures are presented and compared to predict planar grasps with a single-view depth image. A cluttered dataset is constructed to improve models' collision avoidance ability
- Results suggest that models based on MLGSL are 8x more data-efficient than current state-of-the-art techniques with a similar performance in physical experiments at a 91.8% grasp success rate

Robotic Rope Manipulation using Meta Reinforcement Learning
Aug. 2020 - Dec. 2020

Co-advised by Prof. Sergey Levine — California, USA

- Proposed an interpretable rope state estimator with gaussian mixture model (GMM) and coherent point drift
- Designed a meta-RL algorithm, includes a pre-trained contextual task encoder and a soft actor-critic (SAC), to manipulate the rope to a randomly given shape
- Validated the algorithm with Fanuc LR Mate 200iD robot, recognized improvement in sim-to-real gap handling

6-DoF Contrastive Grasp Proposal Network

Mechanical Systems Control Lab

Mar. 2020 - Oct. 2020

California, USA

- Proposed a contrastive grasp proposal network (CGPN) to infer 6-DoF grasps from a single-view depth image
- Introduced rotated grasp proposal network and grasp refinement network into the planning framework
- Utilized contrastive learning and depth image style-transfer techniques to bridge the sim-to-real gap
- Validated the algorithm with Fanuc LR Mate 200iD robot in cluttered scenes, demonstrated 3% improvement in grasp success rate and 75% in computation time compared with prior state-of-the-art (SOTA)

Robotic Bottle Flipping and Landing with TRPO and Adaptive MPC

Co-advised by Prof. Pieter Abbeel

Aug. 2019 - Dec. 2019

California, USA

- Introduced a robotic bottle flipping and landing framework using two Fanuc LR Mate 200iD manipulators
- Utilized trust region policy optimization (TRPO) and adaptive model predictive control (MPC) to throw and catch the bottle
- Designed a three-layer long short term memory (LSTM) network to approximate bottle's flying dynamics

Optimization Model for Planning Grasps with Multi-Fingered Hands

Mechanical Systems Control Lab

Aug. 2018 - June 2019

California, USA

- Proposed an optimization model to solve the grasp planning problem with geometrical qualities and collisions
- Relaxed the optimization with proposed models and solved with iterative palm pose optimization (PPO) joint position optimization (JPO)
- Proved the algorithm with BarrettHand, demonstrated effectiveness and robustness with noisy sensor readings

PUBLICATIONS AND PATENTS

- **X. Zhu**, S. Jain, M. Tomizuka, J. Baar "Learning to Synthesize Volumetric Meshes from Vision-based Tactile Imprints", submitted to *2022 IEEE International Conference on Robotics and Automation (ICRA)*
- **X. Zhu**, Y. Zhou, Y. Fan, J. Chen, M. Tomizuka "Learn to Grasp with Less Supervision: A Data-Efficient Maximum Likelihood Grasp Sampling Loss", submitted to *2022 ICRA*
- **X. Zhu**, Y. Fan, C. Wang, Y. Zhou, S. Jin, M. Tomizuka "Multi-Fingered Grasp Pose Detection using Point Cloud", submitted to *IEEE Robotics and Automation Letters (RAL)*
- **X. Zhu***, L. Sun*, Y. Fan, M. Tomizuka "6-DoF Contrastive Grasp Proposal Network", *2021 ICRA*
- **X. Zhu**, Y. Fan, C. Wang, M. Tomizuka "Why Does Robotic Dexterous Hand Grasp Fail?" *2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*
- **X. Zhu***, S. Jin*, C. Wang*, T. Tang, M. Tomizuka "Real-time State Estimation of Deformable Objects with Dynamical Simulation" *2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*
- Y. Fan, **X. Zhu**, M. Tomizuka "Optimization Model for Planning Precision Grasps with Multi-Fingered Hands", *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*
- S. Jin, **X. Zhu**, C. Wang, M. Tomizuka "Contact Pose Identification for Peg-in-Hole Assembly under Uncertainties" accepted by *2021 American Control Conference (ACC)*
- X. Zhang, S. Jin, C. Wang, **X. Zhu**, M. Tomizuka "Learning Insertion Primitives with Discrete-Continuous Hybrid Action Space for Robotic Assembly Tasks" submitted to *2022 ICRA*
- **X. Zhu**, T. Tang, T. Kato "Adaptive Grasp Planning for Bin Picking" *US Utility Patent* No. 61004-1/236264

WORK EXPERIENCES

Fanuc Advanced Research Lab

Robotic Research Intern

June 2019 - Aug. 2019

California, USA

Mitsubishi Electric Research Lab

Computer Vision Research Intern & Consultant

May 2021 - Present

Massachusetts, USA

AWARD

5th China "Internet Plus" Innovation and Entrepreneurship Competition

National Gold Award (rank 13/1,030,000 entrants)

Oct. 2019

Zhejiang, China

- Designed and manufactured a continuous spiral heat exchange device to achieve SOTA heat transform performance. Introduced optimal control and robust optimization to minimize energy consumption
- Received a $560,000 investment in the seed round