Xinghao Zhu

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EDUCATION

University of California Berkeley
California, USA

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

- Major: Control, Minors: Robotics, Learning, and Optimization, GPA: 4.0
- Research Interests: Robotic Manipulation, Human-Robot Interaction, Deformable Object Handling
- Research Advisor: Prof. Masayoshi Tomizuka (NAE Member)

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)

SELECTED RESEARCH EXPERIENCES

Robotic Assembly with In-Gripper Tool Slippage
Sep. 2022 - Present

Mechanical Systems Control Lab — California, USA

- Consider the slippage between the gripper and the tool during robotic assembly. Introducing observer, differentiable simulation, and contact mapping into the action planning

Allowing Safe Contact in Robotic Goal-Reaching
Mar. 2022 - Sep. 2022

Google X — California, USA

- Advocate generating and tracking compliance references in operational and null spaces. Optimize the references with a hybrid sampling- and gradient-based optimizer leverage differentiable simulations

Goal Conditioned Robotic Manipulation with Cumulative Offline RL
Mar. 2021 - Present

Mechanical Systems Control Lab — California, USA

- Consider goal-conditioned robotic pushing for planar objects with task-agnostic datasets. The policy is trained offline with Conservative Q-Learning and deployed to the real world after adaptation

Deformable Dress Pack Simulation with GNN
Nov. 2021 - Present

Mechanical Systems Control Lab — California, USA

- Consider volumetric mesh tracking and simulation for robotic dress packs. The algorithm leverages differentiable forward models, observation models and particle filters

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
- 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 goal-conditioned meta-RL with contextual encoders to manipulate the rope to a random shape
- Validated the algorithm with Fanuc LR Mate 200iD robot, recognized improvement in sim-to-real gap handling

6-DoF Contrastive Grasp Proposal Network
Mar. 2020 - Oct. 2020

Mechanical Systems Control Lab — California, USA

- Proposed a contrastive grasp proposal network (CGPN) to infer 6-DoF grasps from a single-view depth image
- 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

Robotic Bottle Flipping and Landing with TRPO and Adaptive MPC
Aug. 2019 - Dec. 2019

Co-advised by Prof. Pieter Abbeel — California, USA

- Introduced a robotic bottle flipping and landing framework using two Fanuc LR Mate 200iD manipulators
- Utilized 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 Aug. 2018 - June 2019

Mechanical Systems Control Lab California, USA
- Proposed an optimization model to solve the grasp planning problem with geometrical qualities and collisions
- Relaxed the optimization and solved with iterative palm pose optimization joint position optimization
- Validated the algorithm with BarrettHand, demonstrated effectiveness and robustness under noise

Publications and Patents

- **X. Zhu**, W. Lian, B. Yuan, D. Freeman, M. Tomizuka "Allowing Safe Contact in Robotic Goal-Reaching: Planning and Tracking in Operational and Null Spaces", submitted to *2023 IEEE International Conference on Robotics and Automation (ICRA)*
- **X. Zhu**, S. Jain, M. Tomizuka, J. Baar "Learning to Synthesize Volumetric Meshes from Vision-based Tactile Imprints", accepted by *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", accepted by *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[*], M. Tomizuka "6-DoF Contrastive Grasp Proposal Network", accepted by *2021 ICRA*
- **X. Zhu**, Y. Fan, C. Wang, M. Tomizuka "Why Does Robotic Dexterous Hand Grasp Fail?" accepted by *2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*
- **X. Zhu**[*], S. Jin[*], C. Wang[*], M. Tomizuka "Real-time State Estimation of Deformable Objects with Dynamical Simulation" accepted by *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", accepted by *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" accepted by *2022 ICRA*
- C. Wang, Y. Zhang, X. Zhang, Z. Wu, **X. Zhu**, S. Jin, T. Tang, M. Tomizuka "Offline-Online Learning of Deformation Model for Cable Manipulation with Graph Neural Networks" accepted by *RAL*
- C. Wang, H. Lin, S. Jin, **X. Zhu**, L. Sun, M. Tomizuka "BPOMP: A Bilevel Path Optimization Formulation for Motion Planning" accepted by *2022 ACC*
- **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 June 2019 - Aug. 2019

Robotic Research Intern California, USA
- Proposed an adaptive grasp planner for precise robotic pick-and-place with target pose constraints, deployed the algorithm to the industry with a 6% improvement in cycle time and filled a US Utility Patent

Mitsubishi Electric Research Lab May 2021 - Aug. 2021

Computer Vision Research Intern Massachusetts, USA
- Collaborated with full-time researchers and submitted a conference manuscript. Focused on learning to synthesize the volumetric mesh of the elastomer based on the image imprints acquired from visual-tactile sensors

Google X May 2022 - Sep. 2022

AI Resident Mountain View, USA
- Collaborated with full-time researchers and submitted a conference manuscript. Focused on allowing safe contact during robotic manipulation by planning and controlling in robotic operational and null spaces

Award

5th China "Internet Plus" Innovation and Entrepreneurship Competition Oct. 2019

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