XINGHAO ZHU

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EDUCATION

University of California Berkeley (Mechanical Engineering Department) California, USA
PhD Student Aug 2018 - Present

- Major: Control **GPA: 4.0** (PhD Prelim Score: 98/100); Minor: Robotics and Learning
- Research Interests: Robotic Dexterous Manipulation, Motion Planning, RL, Neural Network
- 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)

SELECTED RESEARCH EXPERIENCES

University of California, Berkeley (Mechanical Systems Control (MSC) Laboratory) California, USA
Graduate Student Researcher to Prof. Masayoshi Tomizuka (Director of the MSC Lab)
Robotic Manipulation of Deformable Objects with Real-Time Tracking Apr 2017 – Aug 2017

- The aim of the project was to enable robots to accurately manipulate a deformable object (ropes) using complex motions; manipulation of deformable objects is a challenge in robotics because deformable objects have high degree of freedom and mutable shapes, which makes the position of the object and the trajectory of the robot difficult to calculate mathematically
- Used an observer to track the rope in real-time and to provide the estimated states to a trajectory planner; the trajectory planner generated motions for robots to enable them to manipulate the rope to a randomly given shape
- Implemented the observer in Ubuntu 14.04 LTS with C++ using Robot Operation System; constructed a virtual rope in the observer as a set of connected nodes with Bullet Physic Engine; used Gaussian Mixture Model (GMM) with Coherent Point Drift (CPD) algorithm to update the physics engine
- Introduced GMM and CPD into the trajectory planner to recognize the shape of the real rope; programmed the trajectory planner in MATLAB to generate the motions for the robots based on the estimated states and the given shape

Optimization Model for Planning Precision Grasps with Multi-Fingered Hands Aug 2018 – June 2019

- Grasp planning for multi-fingered hands are challenging due to the high-dimensionality, collision and sensing/actuation uncertainties. This work proposed an optimization model to solve the grasp planning problem. The optimization considered several geometric related qualities and collisions, and was relaxed with the proposed optimization modeling method. The relaxed optimization was solved by the proposed iterative PPO-JPO. PPO stands for the palm pose optimization while JPO stands for the joint position optimization
- The proposed optimization model took noisy point cloud of the object as input and optimized the grasp quality by iteratively searching for the palm pose and finger joints positions
- The algorithm was able to locate collision-free optimal precision grasps efficiently. The average computation time was 0.50 sec/grasp. The searching was robust to the incompleteness and noise of the point cloud

Xi'an Jiaotong University (Department of Automation) Xi'an, China
Motor Imagery Based Electroencephalogram (EEG) Classification (Undergraduate Thesis) Jan 2018 – June 2018
Research Assistant to Prof. Zuren Feng (Research Supervisor, Professor of Automation)

- Motor Imagery based Brain-Computer Interface (BCI) system has been widely put into application due to its convenience in obtaining brain signal. Motor Imagery Classification intended to classify a period of recorded brain signal as left or right, which stands for imagine moving the left arm or the right arm
- The aim of this project was to design and implement a BCI to classify motor imagery EEG. Filter Bank Common Spatial Pattern algorithm was utilized to extract the features of the signal, and Supported Vector Machine was used to classify the features
- The algorithm was able to classify motor imagery signal with the accuracy of 82% in the self-obtained signal sets

Xi'an Jiaotong University (Department of Automation) Xi'an, China
Power line carrier communication (PLC) May 2016 – Aug 2016
Research Assistant to Prof. Aimin Zhang (Research Supervisor, Professor of Automation)

- PLC has many applications for commercial use but is rarely applied in industrial control; the aim of this project was to build a PLC system appropriate for use in industry, and to deal with the block of signals caused by electronic devices

- Developed a demonstration system for a PLC communication system, based on micro controller AT89C51, and programmed it to enable the reception and sending of signals through I/O ports and UART, as well as decoding the signal and execution commands
- Constructed a brief master-slave communication protocol to enable signal transference in the power line with high frequency, including a power line with electronic devices
- Designed and soldered PCBs for each micro controller

Xi'an Jiaotong University (State Key Laboratory for Manufacturing System Engineering) Xi'an, China
Application of Inkjet Technology in 3D Printing Oct 2015 – Apr 2016
Research Assistant to Prof. Li Wang (Research Supervisor, Professor of Mechanical Engineering)

- Inkjet printers are widely used in the print industry and its technology can be further applied in 3D printing by re-designing the inkjet printer structure
- Identified major challenges of the 3D inkjet printer including the high viscosity of the 3D print material (jams the print-head), the wave of the fluid (affects the speed of the print process), and the surface tension of the print-head (reduces printing accuracy)
- Analyzed the structure of existing inkjet printers and proposed requirements for 3D inkjet printers including the material for the print-head and the print material jet frequency
- Analyzed proposed methods to overcome above-mentioned challenges, including the introduction of a thin film to diminish the material's movement in the supply tank, the use of a new print-head structure to reduce the effects of surface tension, and the optimization of the print material jet frequency
- Assisted in testing of the newly-designed 3D inkjet printer and quantitatively analyzed the results

SELECTED COURSE PROJECTS

University of California, Berkeley California, USA
Robotic Bottle Flipping and Landing with TRPO and Adaptive MPC Aug 2019 – Dec 2019
Team Leader under the supervision of Prof. Pieter Abbeel (Course instructor)

- Bottle flipping and landing is a popular task. Enabling robots to do the same task, however, is challenging due to the various kinds of uncertainties
- In this work, we introduced a robotic bottle flipping and landing framework using two high degrees of freedom manipulators with customized grippers. Trust Region Policy Optimization (TRPO) and Adaptive Model Predictive Control (MPC) are used to throw and catch the bottle. A three-layer Long Short-Term Memory (LSTM) network is utilized to approximate the dynamics of the flying bottle

Reshaping Soft Objects with Multi-fingered Hand Jan 2019 – May 2019
Team Leader under the supervision of Prof. Ruzena Bajcsy (Course instructor)

- Robots that are able to reshape and mold soft objects can be a valuable asset in many different industries and workplaces, including bio-medical processing, the food processing industry, service robotics, robotized surgery
- In this work, we proposed a method in which a robotic-hand could reshape a dough into the desired shape. In the teaching scenario, the robot tried to find a mapping from the reshaped point cloud to the applied force. In the testing scenario, given a goal shape's point cloud, the robot tried to find the required force based on the prior knowledge

WORK EXPERIENCE

Fanuc America Company (Fanuc Advanced Research Laboratory) California, USA
Robotics Research Intern June 2019 – Aug 2019

SELECTED PUBLICATIONS AND PATENT

[1] Yongxiang Fan, **Xinghao Zhu** and Masayoshi Tomizuka "Optimization Model for Planning Precision Grasps with Multi-Fingered Hands", accepted by *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).*
[2] Xinghao Zhu and Fanuc. 2019. *Adaptive Grasp Planning*. Submitted to U.S. Patent.

SELECTED AWARDS AND HONORS

- Siyuan Scholarship (awarded to top 4 of 21 in recognition of academic excellence) 2015 – 2017

ADDITIONAL INFORMATION

Computer Skills

- Coding in C/C++; MATLAB; Python; Verilog HDL
- Familiar with Ubuntu; the Robot Operating System (ROS); MuJoCo; Bullet; Arduino UNO; 3D Printing

Languages

- Chinese (Native); English (GRE: V160 Q169; TOEFL: 105)