

# Chang Shi

[chang.shi@austin.utexas.edu](mailto:chang.shi@austin.utexas.edu) · (310)-500-6806 · [linkedin.com/in/chang-shi/](https://www.linkedin.com/in/chang-shi/) · [changshiraine.github.io](https://changshiraine.github.io)

## EDUCATION

### The University of Texas at Austin

Ph.D. of Mechanical Engineering (Advisor: Prof. Ann Majewicz Fey and Prof. Peter Stone)

Austin, TX

Starting Aug 2021

Research Interest: Reinforcement Learning; Multi-agent Systems; Robotics; Statistical Machine Learning

Selected Coursework: Reinforcement Learning: Theory/Practice; Robot Learning; Numerical Optimization: Graphics/AI; Time Series Analysis

### Carnegie Mellon University

Pittsburgh, PA

May 2021

Master of Robotics System Development (Advisor: Prof. John Galeotti and Prof. Howie Choset)

Selected Coursework: Deep Reinforcement Learning and Control; Robot Autonomy; Robot mobility; Multimodal Machine Learning; Simultaneous Localization and Mapping; Probabilistic Graphical Models; Computer Vision; Medical Image Analysis; Manipulation, Estimation and Control

### Renmin University of China

Beijing, China

June 2019

Bachelor of Engineering in Computer Science (Advisor: Prof. Xinqi Gong)

Selected Coursework: Algorithm Design and Analysis; Data Structure; Computer Graphics; Computer Vision; Game Theory

## PUBLICATIONS

**Chang Shi, Ann Majewicz Fey. Haptic Guidance using a Transformer-Based Surgeon-Side Trajectory Prediction Algorithm for Robot-Assisted Surgical Training.** Submitted to International Conference on Robotics and Automation (ICRA 2023).

**Chang Shi, Zheng Yi, Ann Majewicz Fey. Recognition and Prediction of Surgical Gestures and Trajectories Using Transformer Models in Robot-Assisted Surgery.** International Conference on Intelligent Robots and Systems (IROS 2022).

**Chang Shi, Dustin P DeMeo, Emma L. Larson, John M. Galeotti, Bryan T. Carroll. Non-rigid cutaneous tissue deformation estimation with iterative RANSAC and TPS from digital images over semi-ambiguous artificial markings.** Computer Assisted Radiology and Surgery (CARS 2021).

**Yiling Qiao, Chang Shi, Chenjian Wang, Hao Li, Matt Haberland, Xiyang Luo, Andrew M. Stuart, Andrea L. Bertozzi. Uncertainty quantification for semi-supervised multi-class classification in image processing and ego-motion analysis of body-worn videos.** Electronic Imaging (EI 2019).

## ACADEMIC EXPERIENCE

### Learning Agents Research Group, UT Austin

Austin, TX

(Coadvisor: Prof. Peter Stone)

Aug 2022 - present

- Set up Surgical Robot Learning (SuRoL) simulation environment for testing autonomous bimanual peg transfer and needle regrasp algorithms
- Trying to propose bimanual collaboration models that surpass Multi-Agent Deep Deterministic Policy Gradient (MADDPG) and Multi-Agent Proximal Policy Optimization (MAPPO) on task success rate

### Human-Enabled Robotic Technology Lab, UT Austin

Austin, TX

Research Assistant (Advisor: Prof. Ann Majewicz Fey)

Aug 2021 - present

- Implemented trajectory prediction for da Vinci robot manipulators during surgical task operation based on time-series modeling and transformer models, trained on the JHU-ISI Gesture and Skill Assessment Working Set (JIGSAWS)
- Designed haptic guidance for surgical tasks and carried out preliminary human subject study on guidance training effect

### Biomedical Image Guidance Lab, CMU

Pittsburgh, PA

Research Assistant (Advisor: Prof. John Galeotti)

May 2020 - present

- Tuned customized calibration on Realsense D430 to get point cloud data for dermatological tissue samples 15cm away from the camera
- Operated iterative optimization of bidirectional blob matching and thin plate spline warping for 2D non-rigid registration on images of tissue with artificial pigment markers
- Fusing 2D non-rigid registration with 3D point cloud to construct a deformation model of tissue before and after slicing and cryostat freezing

### Biorobotics Lab, CMU

Pittsburgh, PA

MRS project leader (Advisor: Prof. Howie Choset)

Sept 2019 - Present

- Designed a stiffness-based automatic tumor localization system for minimally invasive surgery on da Vinci Surgical System
- Used PCA and FFT for liver motion estimation, processed point cloud from depth camera and laser sensor to get organ surface information
- Developed customized dVRK robot control code with limited workspace and wrist constraints
- Merged motion compensation with robot control to avoid collisions during robot surgery
- Designed an intelligent palpation planner based on history stiffness feedbacks, successfully achieved 100% recall on tumor identification and only 1.69% of healthy tissue misclassification within 5min 27s

### James Carter PIC Lab, UCLA

Los Angeles, CA

Research Assistant (Advisor: Prof. Andrea Bertozzi) | CSST Research Program

June 2018 - Sept 2018

- Optimized feature extraction and change point detection based on video motion on LAPD body-worn camera videos
- Introduced Uncertainty Quantification for graph-based semi-supervised multi-class classification problems, designed a human-in-the-loop system to improve classification accuracy

### Mathematical Intelligence Application Lab, Renmin University

*Research Assistant (Advisor: Prof. Xinqi Gong)*

Beijing, China

Feb 2017 - Dec 2017

- Applied cluster analysis and neural networks to hot spot prediction of multimeric protein binding site

### INDUSTRIAL EXPERIENCE

#### NEC Laboratories America

*Research Intern*

Priceton, New Jersey

May 2021 - Aug 2021

- Operated object detection and key frame detection using DEtection TRansformer (DETR) model on CoLLision Events for Video REpresentation and Reasoning (CLEVRER) dataset
- Designed a transformer style model for inter-object relational reasoning and video question answering on collision events

#### ENB CTO Innovation Labs, Cisco

*Research Intern*

San Jose, CA

Sept 2018 - July 2019

- Implemented an ios phone SDK to get phone IMU sensor data and location estimation from Access Point(AP) signals while ensuring user information security based on access control
- Developed novel fusion algorithms to combine AP data with phone IMU data to do path-matching for Connected Mobile Experiences (CMX) Indoor Location, improved indoor localization accuracy
- Set up hardware chips, simulation environment and light-weighted real-time data pipelines to get TB magnitudes of data on physical layer of wireless data transmission
- Designed a deep learning model deepPHY, to surpass Bit and Package Error Rate(BER & PER) of 802.11ax PHY baseline from traditional channel estimation methods, especially on low SNR cases

### PROJECTS

#### Deep Graph Network (DGN) for Multi-agent Cooperation on StarCraft II 25 vs 25 Battle Game

UT Austin | Spring 2022

- Formulated the problem as a Decentralized Partially Observable Markov Decision Process (Dec-POMDP) and compared the performance of DGN and Deep Q Network in StarCraft II game setting
- Did Ablation study on DGN with epsilon-greedy action selection and preference-based action selection

#### Collaborative Robot Manipulation over Two-arm Handover Problem in Robosuite Simulation

UT Austin | Fall 2021

- Approached the multi-robot collaboration problem through imitation learning and reinforcement learning perspectives
- Compared the performance of Behavior Cloning (BC), Hierarchical Behavior Cloning (HBC), Implicit Reinforcement without Interaction at Scale (IRIS) and Batch Constrained Deep Q-learning(BCQ) on two-arm object handover problem
- Formulated the problem as a Centralized Training Decentralized Execution (CTDE) reinforcement learning paradigm. Tested Independent Soft Actor-Critic (ISAC) and Multi-Agent Deep Deterministic Policy Gradient (MADDPG) algorithms

#### May I See Your Face? Automatic Face Mask Removal using Generative Adversarial Networks

Carnegie Mellon | Spring 2021

- Tested CycleGAN, Pixel2Pixel and several versions of StyleGAN2 on Flickr-Face-HQ (FFHQ) and MaskedFace-Net dataset. Used Poisson blending for further image generation improvement.

#### Multimodal Graph-structured Trajectory Prediction with Spatio-temporal Attention Mechanism

Carnegie Mellon | Fall 2020

- Explored Trajectron++ model on NuScenes autonomous vehicle trajectory prediction task, proposed improvements by fusing Lidar data, LaneGCN and Spatial-temporal attention Mechanism

#### Autonomous Bin Picking in RLBench Simulation

Carnegie Mellon | Spring 2020

- Implemented a state-machine for both forward and resetting process of moving objects between containers for bin picking.
- Used Grasp Quality Convolutional Neural Networks (GQCNN) for optimal grasping pose prediction, and Rapidly-exploring Random Tree (RRT) for trajectory planning.

#### Arduino Car Based Auto Tracking & Guidance System for The Blind

Renmin University | Fall 2017

- Build a small Arduino car with functionality of voice control, obstacle avoidance and path tracking using real-time video processing, voice recognition and stereo system

### TEACHING

- 10-708: Probabilistic Graphical Models. Teaching Assistant, Carnegie Mellon, Fall 2020.
- 10-716: Advanced Machine Learning: Theory and Methods. Teaching Assistant, Carnegie Mellon, Spring 2021.

### SKILLS

- **Programming Languages:** Proficient - Python, C/C++, MATLAB; Intermediate - Javascript; Basic - Shell, Scala
- **Frameworks& Libraries:** Proficient - PyTorch, Keras, OpenCV, ROS; Intermediate - TensorFlow, Scikit-Learn
- **Others& Tools:** Docker, Git, Scrapy, Django, Arduino, Raspberry Pi

### AWARDS

- Meritorious Winner of the American Mathematical Contest in Modeling, COMAP 2017
- 1st Prize in National Mathematical Modeling Contest, China Capital Areas 2017
- Scholarship of Academic Excellence, Renmin University 2016, 2017 & 2018