

# Chang Shi

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## EDUCATION

<b>The University of Texas at Austin</b> <i>Ph.D. of Mechanical Engineering (Advisor: Prof. Amy Zhang)</i> <i>Research Interest: Reinforcement Learning; Robotics; Computer Vision; Machine Learning</i>	Austin, TX Started Aug 2021
<b>Carnegie Mellon University</b> <i>Master of Robotics System Development (Advisor: Prof. John Galeotti and Prof. Howie Choset)</i> <i>Selected Coursework: Deep RL and Control; Robot Autonomy; Computer Vision; Multimodal ML; SLAM; Manipulation, Estimation and Control</i>	Pittsburgh, PA May 2021
<b>Renmin University of China</b> <i>Bachelor of Engineering in Computer Science (Advisor: Prof. Xinqi Gong)</i> <i>Selected Coursework: Computer Vision; Computer Graphics; Image Processing; Deep Learning; Game Theory</i>	Beijing, China June 2019

## PUBLICATIONS

Chang Shi, Ann Majewicz Fey. **Haptic Guidance Using a Transformer-Based Surgeon-Side Trajectory Prediction Algorithm for Robot-Assisted Surgical Training.** International Symposium on Robot and Human Interactive Comm (RO-MAN 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

<b>Machine Intelligence through Decision-making and Interaction Lab, UT Austin</b> <i>(Advisor: Prof. Amy Zhang)</i>	Austin, TX Aug 2023 - present
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- Designed decomposition methods for reward ambiguity in inverse reinforcement learning for skill transfer among multiple robotics tasks
- Working on Few-Shot representation learning for imitation learning

<b>Austin Villa Robocup@Home Team, UT Austin</b> <i>Teammember (Advisor: Prof. Peter Stone, Prof. Justin Hart)</i>	Austin, TX Jan 2022 - present
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- Trained object detection models for grocery storage and human tracking
- Wrote state machines for receptionist and restaurant tasks

<b>Human-Enabled Robotic Technology Lab, UT Austin</b> <i>Research Assistant (Advisor: Prof. Ann Majewicz Fey)</i>	Austin, TX Aug 2021 - Dec 2023
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- Developed an optical flow-based method for surgical tool tracking on operation videos and conducted motion analysis
- 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

<b>Biomedical Image Guidance Lab, CMU</b> <i>Research Assistant (Advisor: Prof. John Galeotti)</i>	Pittsburgh, PA May 2020 - May 2021
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- 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

<b>Biorobotics Lab, CMU</b> <i>MRSD project (Advisor: Prof. Howie Choset)</i>	Pittsburgh, PA Sept 2019 - Jan 2021
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- 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**

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

Los Angeles, CA

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

**INDUSTRIAL EXPERIENCE****Amazon Robotics**

Applied Scientist Intern

Boston, MA

May 2023 - Aug 2023

- Optimized the robot-automated package consolidation planning procedure
- Validated the optimized solution both in simulation and on real robots

**NEC Laboratories America**

Research Intern

Princeton, NJ

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 counterfactual reasoning and video question answering on collision events

**Cisco**

Research Intern

San Jose, CA

Sept 2018 - July 2019

- 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
- 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