Chuer Pan

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Education

2020.09 –
2022.08
MS in Robotics (MSR), *Robotics Institute*, **Carnegie Mellon University**.
GPA: 3.95, Advisor – David Held

2015.09 –
2020.04
BASc in Engineering Science, *Robotics Engineering Major*, **University of Toronto**.
Graduated with Honours, Thesis Advisor – Frank Rudzicz

Publications

Conference Publications

Chuer Pan*, Brian Okorn*, Harry Zhang*, Ben Eisner*, David Held. TAX-Pose: Task-Specific Cross-Pose Estimation for Robot Manipulation. In *Conference on Robot Learning (CoRL)*, 2022.

Brian Okorn*, **Chuer Pan***, Martial Herbert, David Held. Deep Projective Rotation Estimation through Relative Supervision. In *Conference on Robot Learning (CoRL)*, 2022.

Zining Zhu, **Chuer Pan**, Mohamed Abdalla, Frank Rudzicz. Examining the rhetorical capacities of neural language models. In *Empirical Methods in Natural Language Processing (EMNLP) BlackboxNLP Workshop*, 2020.

Journal Publications

Yang Li, **Chuer Pan**, Yunfeng Li, Eugenia Kumacheva, Arun Ramachandran. An exploration of the reflow technique for the fabrication of an in vitro microvascular system to study occlusive clots. In *Biomedical Microdevices, 19:82*, 2017.

Research Experience

2020.10 –
2022.09,
2022.10–Now
Research Assistant, *Robotics Institute, Carnegie Mellon University*, Advisor: David Held.
- Developed novel learning-based intra-category generalizable 6D object pose estimator with self-supervision for robotic manipulation tasks.
- Developed a novel few-shot vision-based method that utilizes dense residual correspondences from point cloud data to estimate task specific object $SE(3)$ transformations that can be mapped to manipulator end effector to complete manipulation tasks, which generalize to novel objects from very few demonstrations. (CoRL 2022)
- Developed a self-supervised learning-based method to estimate object orientations using only relative pose via a novel application of stereographic projections over the rotation space of $SO(3)$. (CoRL 2022)

2019.09 –
2020.04
Research Assistant, *Department of Computer Science, University of Toronto*, Advisor: Frank Rudzicz.
- Worked on explainable AI for contextual language models, specifically researched on ways to understand the underlying training dynamics and resulting embeddings of different variants of BERT
- Developed probing model to understand the rhetorical capabilities of state-of-the-art contextualized and non-contextualized language models

2019.05 –
2019.09
Machine Learning Research Intern, *Vector Institute*, Host: Frank Rudzicz.
- Researched & developed attention-based machine learning model and algorithm to understand and explore correlations between multiple modes of sequential surgical data encompassing camera captured video, audio, text transcripts of conversation, as well as corresponding real-time vital signs, subsequently to make performance rating predictions for surgical personnel.

2016.05 –
2016.09
Research Assistant, *Department of Chemistry, University of Toronto*, Advisor: Eugenia Kumacheva.
- Designed and optimized a reflow fabrication protocol to produce nearly circular microchannels with different diameters from the same fabrication master. Experiment results validated the framework's competence in mimicking branched blood vessels for study of the process of embolism, the main cause for health emergencies of ischemic stroke and pulmonary embolism, and dissolution of embolic clots upon introduction of thrombolytic drug. (published paper in *Biomedical Microdevices* 2017)

Industry Experience

2018.05 – 2019.04   **Software Engineering Intern**, *Intel (Network and Custom Logic Group)*, San Jose, California, USA.
- Software development for Intel's FPGA product line
- Designed & implemented a new efficient and scalable automated regression testing infrastructure for Quartus (Intel's programmable logic device design software) GUI, which automatically checks verifies and validates the interface functionality between 1) different GUI modules; 2) GUI and FPGA design entry modules;
- Reduced manual effort required to maintain and handle code merge functionality conflicts by 70%.

Skills/Course Work

- **Computer Science:** Programming (Python, C++, C, Matlab, Verilog, Assembly, Perl, TCL, Julia, GO), Machine Learning (Pytorch, Tensorflow, JAX, Pytorch3d, Pytorch Geometric), Data Structures & Algorithms, Operating System, Natural Language Processing, Computer Vision, Convex Optimization, Meta Learning, Reinforcement Learning, Convex Optimization, Advanced ML Theories & Techniques, Others (Bash, Git, Linux)
- **Robotics:** Dynamics & Simulation, Computer Vision (traditional geometric-based & learning-based), Locomotion, Linear & Nonlinear Control (PID, Feedback Linearization, LTI, Optimal Control, etc), Localization, Mapping, Motion Planning, Navigation, Manipulators, ROS, worked with KUKA, Franka manipulator arms, Simulators (Gazebo, MuJoCo, V-REP, Gym)
- **Mathematics:** Calculus, Linear Algebra, ODE, Numerical Analysis, Probability & Statistics, First Order Logic, Topology
- **Physics & Engineering:** Control Systems, Dynamics, Classical and Quantum Mechanics, Electricity and Magnetism, Structural & Materials, Vector Calculus & Fluid Mechanics

Organizations

2019.08– 2020.03   **Planning & Control Team Member**, *aUToronto, University of Toronto Student Self-Driving Car Team competing in SAE AutoDrive Challenge*.
- Developed vehicle's local planner behavioural layers as part of the lattice graph search for the planner system, to handle static and dynamic obstacles, as well as detected traffic signs. (C++, ROS)
- Implemented A*, D*, RRTs variants & conformal lattice planner during the prototyping stage in search of a new global planner architecture

2017.01– 2018.04   **Co-founder & VP External**, *University of Toronto Machine Intelligence Student Team*.
- Co-built a platform that connects undergraduates to machine learning graduate and industry communities through educational hands-on workshops and research talk series. The club has now expanded with more than 1000 club members, serve and connect more than 800 students annually through our weekly events.
- Started the club's AI Academic Talk Series; Organized and hosted academic and industry talk events.
- Contacted and secured industry partnership, organized multiple AI technical workshops with Intel AI Academy (Intel Nervana). `http://utmist.sa.utoron` (First year archives); `https://utmist.github.io/`

2017.08– 2018.04   **Business & Outreach Associate** , *aUToronto*.
Media outreach; Marketing; Sponsorship; *Social Responsibility Report for Autonomous Vehicles*

2017.06 –2018.04   **Professional Development Operations Director**, *Women in Science and Engineering, University of Toronto*.
Organized and hosted all professional development events, including interview preps, round table discussions, panel talks, professional social dinner, in collaboration with tech companies and consulting firm partners.

Robotic Projects

2020   **Perception/Navigation/Control for Turtlebot2**.
- Implemented the full perception, planning and control algorithm stack to enable Turtlebot2 autonomously navigate, localize & map a set up unseen maze patterns within a time limit.

2019   **Computer Vision**, *Computer Vision for Robotics Course Projects*.
- Implemented algorithms for Image Transformations, Camera Pose Estimation, Stereo Correspondence, Stereo Visual Odometry.
- Implemented CNN, trained on KITTI datasets to predict direction of Sun in images to help robots localize.

2019 **Motion Planning & Collision Avoidance for KUKA Robotic Manipulator Arm**, *Robotic Modeling and Control Course Project*.

- Implemented Artificial Potential Fields based motion planning algorithms to successfully find a feasible path satisfying a set of parameter threshold requirements, from a given initial pose to a destination pose in the task space while avoiding known obstacles, using gradient descent algorithm.
- Tested the algorithm in simulation and applied the algorithm on the physical KUKA robotic arm to navigate from a start pose to a final pose while picking up specified objects from the ground and dropping it off at specified positions.

2019 **Inverted Pendulum on a Cart**, *Linear Control Course Project*.

- Implemented algorithms to successfully control a physical inverted pendulum on a cart system using simple PD controller, as well as pole placement optimal control theories.

2018 **Machine Learning Projects**, *Machine Learning Course Projects*.

- Built & trained CNN for hand digit recognition
- Built & trained CNN for identity recognition and gender classification from facial data
- Built & trained a decision tree model for detection of fake news headlines
- Trained a deep neural network to play Tic-Tac-Toe

2018 **Vertical Plotting Robot**, *Microcontrollers course project*.

- Designed and built a vertical plotting microcontroller system capable of taking user-uploaded hand-drawn/digital images, converting them into traceable lines to be drawn out on paper by a plotting Arduino-based robot.

2017 **Maze-navigating Robot**, *Robotic course project*.

- Designed and created a robot that is capable of autonomously navigating between a given start and end pose in a known 5x5 feet map, with implemented path planning (A*), path control and pose estimation strategies.

2017 **Fully Autonomous Can Sorting Robot**, *Engineering Design course project*.

- Designed and constructed a fully functional autonomous can sorting robot that is capable of sorting incoming soda cans based on sizes and with/without tabs under a set of requirements and resource constraints.

Awards/Scholarships

- **University of Toronto Applied Science and Engineering Dean's List** - University of Toronto, 2015-2018,2019-2020
- **University of Toronto Scholar** - University of Toronto, 2015 (Scholarship)
- **Faculty of Applied Science & Engineering Award** - University of Toronto, 2015 (Scholarship)
- **Dean's Merit Award** - University of Toronto, 2015 (Scholarship)