Ruihan Gao

ruihang@andrew.cmu.edu | Google Scholar | Website | LinkedIn

EDUCATION

Carnegie Mellon University, *Pittsburgh, PA, USA*
Ph.D. in Robotics *Sep. 2021 – . Present*
- GPA: 4.00 / 4.00
- Advisor: Prof. Jun-Yan Zhu, Prof. Wenzhen Yuan

Nanyang Technological University (NTU), *Singapore*
B.Eng in Electrical and Electronic Engineering *Aug. 2016 – Jun. 2020*
- GPA: 4.99 / 5.00, Rank: 1 / $\sim$ 500, graduated with Honors (Highest distinction)
- Advisor: Prof. Zhiping Lin

University of Wisconsin-Madison, *Madison, WI, USA*
Semester exchange *Aug. 2017 – Dec. 2017*
- GPA: 3.92 / 4.00

PUBLICATIONS

[1] **Ruihan Gao**, Wenzhen Yuan, Jun-Yan Zhu, "Controllable Visual-Tactile Synthesis", arxiv 2023.

[2] **Ruihan Gao**, Tian Tian, Zhiping Lin, Yan Wu, "On Explainability and Sensor-Transferability of a Robot Tactile Texture Representation Using a Two-Stage Recurrent Networks", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2021.

[3] **Ruihan Gao**, Tasbolat Taunyazov, Zhiping Lin, Yan Wu, "Supervised Autoencoder Joint Learning on Heterogeneous Tactile Sensory Data: Improving Material Classification Performance", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020.

[4] Tasbolat Taunyazov, Yansong Chua, **Ruihan Gao**, Harold Soh, Yan Wu, "Fast Texture Classification Using Tactile Neural Coding and Spiking Neural Network", IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2020.

[5] Weichao Zhou, **Ruihan Gao**, BaekGyu Kim, Eunsuk Kang, Wenchao Li, "**Runtime-Safety-Guided Policy Repair**", International Conference on Runtime Verification (RV), pp. 131–150, Springer, 2020.

[6] **Ruihan Gao**, Jiawei Peng, Long Nguyen, Yunfeng Liang, Steven Thng, Zhiping Lin, "Classification of Non-Tumorous Facial Pigmentation Disorders using Deep Learning and SMOTE", IEEE/RSJ International Symposium on Circuits and Systems (ISCAS), 2019.

[7] Long Nguyen, **Ruihan Gao**, Dongyun Lin, Zhiping Lin, "Biomedical Image Classification Based on a Feature Concatenation and Ensemble of Deep CNNs", Journal of Ambient Intelligence and Humanized Computing, 2019.

[8] Jiawei Peng, **Ruihan Gao**, Long Nguyen, Yunfeng Liang, Steven Thng, Zhiping Lin, "Classification of Non-Tumorous Facial Pigmentation Disorders using Improved SMOTE and Transfer Learning", IEEE International Conference on Image Processing (ICIP), 2019.

RESEARCH

Controllable Visual-Tactile Synthesis for Haptic Rendering, *RoboTouch Lab and Generative Intelligence Lab, Carnegie Mellon University*
Ph.D. student, advised by Prof. Wenzhen Yuan and Prof. Jun-Yan Zhu *Oct. 2021 – . Present*
- Designed a conditional generative model that synthesizes visual and tactile outputs, given an input sketch.
- Collected a synchronized visual-tactile clothing dataset with a GelSight sensor that captures the local geometry.
- Introduced a pipeline to render the touch feeling on an electroadhesion-based haptic device using the synthesized tactile output while also displaying the visual output.

Efficient and transferrable learning across tactile sensors, *Agency for Science, Technology, and Research (A*STAR), Singapore*
Research Assistant, advised by Dr. Yan Wu *Aug. 2020 – Aug. 2021*
- Designed a two-stage recurrent network for texture classification that is transferrable across heterogeneous sensors with enhanced explainability.
- Developed spiking encoding and neural network for a collection of braille letter datasets.
- Created shaft pose estimation algorithm based on tactile sensor feedback, awarded finalist of 2021 KUKA Innovation Award in Hannover Messe.

Tactile data representation of heterogeneous datasets, *A*STAR & NTU, Singapore*
Final Year Project, advised by Prof. Zhiping Lin and Dr. Yan Wu *Aug. 2019 – May. 2020*
- Designed framework to extract spatial-temporal features of tactile sensor data.
- Decoupled sensor-specific processing from texture classification and enabled transfer learning between heterogeneous datasets, awarded FYP Excellence Award (top 5).

Improving Learning-based Controller with Model Predicative Safety, *Dependable Computing Laboratory*, Boston University
Research Assistant, advised by Prof. Wenchao Li   *Jun. 2019 – Aug. 2019*
  ○ Introduced safety to the evaluation matric of Imitation Learning.
  ○ Guaranteed safety boundary specification of a learning-based controller in CARLA simulator.

Classification of Biomedical Images by Deep Learning Methods, *Undergraduate Research Experience on Campus (URECA), NTU*

NTU President Research Scholar, advised by Prof. Zhiping Lin   *Jun. 2019 – Aug. 2019*
  ○ Realized automated diagnosis of facial pigmentation with deep Convoluted Neural Networks.
  ○ Qualified the algorithm for clinical application with data augmentation method using modified Synthetic Minority Oversampling Technique.
  ○ Received AY18-19 URECA Undergraduate Research Excellence Award.

PROJECTS / COMPETITION ACCOMPLISHMENTS

Haptic rendering of sloshing liquid in a bottle with Magnetic Levitation Device
16-855 Special Topic: Tactile Sensing and Haptics   *Sept. 2022 – Dec. 2022*
  ○ Integrated a physics-based simulation of sloshing liquid in a shaking bottle with the Magnetic Levitation Haptic Device (MLHD).
  ○ Designed and conducted a user study to evaluate the haptic rendering.

International Robomasters Competition
Leader of Electrical Group of NTU Team   *Jan. 2017 – Jun. 2018*
  ○ Led a multidisciplinary team of 15 members to design a formation of eight Unmanned Ground Vehicles.
  ○ Developed STM32 microcontroller for vehicle shooting, climbing, and box-grabbing.
  ○ Awarded the third prize among international teams.

Singapore Amazing Flying Machine Competition
Team Member   *Dec. 2016 – Mar. 2017*
  ○ Assembled a drone with a Printed Circuit Board (PCB), peripheral electronic sensors, and 3D printed parts.
  ○ Accomplished tasks of mirror maze, black room, and human model detection.

HONORS & REWARDS

National Science Scholarship (5-yr funding for Ph.D. study)	*2020*
KUKA Innovation Award (Finalist) with Team CHRIS at A*STAR	*2021*
PREMIA (Pattern Recognition and Machine Intelligence Association) Best Student Presentation Award	*2021*
Lee Kuan Yew Gold Medal (top 1 among the undergraduate cohort)	*2020*
NTU Science and Engineering Scholarhsip	*2016-2020*
Dean's List (undergraduate)	*2016, 2017*

SERVICE

Reviewer for IROS 2021, 2022

MENTORSHIP

Undergraduate Students: Tian Tian(NTU), Kaela Marsheck (CMU, Summer AI mentoring program)

SKILLS

Programming: Python, C/C++, MATLAB
Softwares and Libraries: PyTorch, OpenCV, ROS
Harwares and Design tools: Solidworks, Arduino, Carla simulator, LT-Spice, 3D Printing, Laser Cutting

SOCIAL / CO-CURRICULUM ACTIVITIES

TechNight Session on Generative Models
Jan. 2022 – Apr. 2022
  ○ Designed the online tutorial Intro to Neural Networks and Generative Models.
  ○ Reached out to middle school students to expand the diversity of interest in computing among them.

Vice President, Da Vinci 3D Printing and Robotics Society
Aug. 2017 – May. 2019
  ○ Coordinated two 3D Printing and Robotics Workshops; 30 students attended and built their first self-designed 3D-printed car in groups of two.
  ○ Organized 3 outreach exhibitions at local high schools; instructed over 200 students to operate robots.