

Chuyi Hou

Unimodal Research Inc. | University of Toronto

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Summary

Versatile and accomplished engineer specializing in full-stack research and prototyping across hardware, firmware, and software domains. A proven expert in programming software and firmware, with a strong focus on human-computer interaction. Leveraging a comprehensive understanding of technology's many layers, I create innovative UI/UX solutions that bridge the gap between user experience and system functionality, bringing ideas from conception to realization.

Education

University of Toronto

Toronto 2017-2022

- **BASc in Engineering Science**

Honour List in 2017, 2019, and 2020

- **Major in Robotics**

- **Minor in Artificial Intelligence Engineering and Engineering Business**

Undergraduate thesis supervisor: Margaret P. Chapman

Supervisor Position as of 2022: Assistant Professor

Thesis title: "Towards a Scalable Approach for Risk-Averse Safety Analysis"

Thesis Abstract: Risk-averse optimal control is an emerging area of research, where the existing risk-averse control algorithms suffer from the curse of dimensionality limiting their practical utility. We propose an approximate yet tractable method, the Monte Carlo Tree Search, to improve the computational efficiency of a current risk-averse exact method with theoretical guarantees. The computational benefits of our proposed algorithm and the cost improvement property it carries are thoroughly explained. We take steps towards showing that the cost improvement property of stochastic rollout still holds in risk-averse settings and obtain a promising result. We discuss the limitations of our algorithm and the potential directions for future implementations.

University of Toronto

Toronto 2022-Present

- **Master of Engineering in Mechanical and Industrial Engineering**

MEng Project - Supervisor: Prof. Eldan Cohen

Improving Patient Safety Event Report Classification with Parameter Efficient Fine-tuned Language Model

Courses Taken:

APS1050 - Blockchain Technologies and Cryptocurrencies

APS1051 - Portfolio Management Praxis Under Real Market Constraint

APS1052 - Artificial Intelligence in Finance: From Neural Networks to Deep Learning

APS1053 - Case Studies in A.I. in Finance

MIE1624 - Introduction to Data Science and Analytics

ECE1786 - Creative Applications of Natural Language Processing

MIE1512 - Data Analytics

Working Experience

Unmodal Research Inc.

Toronto 2022 - Present

R&D Full-time Signal Processing Engineer

Research Funded by the Company

- **Firmware Development & Hardware Assembly:** Enabled microcontrollers for multichannel audio output, demonstrating expertise in robust firmware creation and intricate hardware assembly, resulting in optimized system performance.
- **Signal Processing & Machine Learning Applications:** Leveraged advanced techniques in signal analysis and machine learning to bridge the gap between theoretical understanding and practical implementation, contributing to innovative technological solutions.
- **Multidisciplinary Skillset:** Proficient in Python programming, human-computer interaction, machine learning, and UI/UX design and development, showcasing a versatile and comprehensive skill set that has been applied to cutting-edge projects and initiatives.

UASK Education

Remote 2018 - 2022

Academic Part-time Online Tutor

- Performed online one-to-one and one-to-many tutoring.
- Tutored students who are from high schools and first year of universities. Developed great communication skills by undertaking over 300 hours of online tutoring experience.

Research Experience

Research Associate

2021 - 2022

Dynamic Graphics Project Lab of the University of Toronto Canada

Supervisor: **Prof. Daniel Wigdor** PI: **Dr. Varun Perumal C**

- Tested and validated various machine learning models to determine which ones are suitable for the task at hand and document the trade-offs.
- Interacted with hardware prototypes and developed pipelines to efficiently transfer data to the computing units.
- Quantified the performance of the system and built demos to showcase.

Title: pressAR : Vision-based freehand touch and force sensing

Research Abstract: Hand and finger tracking are instrumental for fluid interaction with objects and virtual content in mixed reality. However, the inability of head mounted displays (HMDs) to detect whether a user's finger is simply resting on a surface versus pressing down on a surface prevents HMDs from supporting interaction that is truly controller-free. Even if advanced depth sensors are integrated into HMDs, they cannot determine the minute changes that occur when the fingers rest or press on a surface. Thus, when building applications, researchers and developers are limited to a small set of imprecise, gross movement-based gestures such as hovering or holding. The methods that have been proposed to overcome detection issues all rely on the use of hand-held controllers, instrumenting the human body with wrist worn sensors, or instrumenting the interactable surfaces in one's environment. Within this work, we present pressAR, a novel technique that uses the depth and infrared sensors within HMDs to analyse the subtle anatomical and kinematic changes that occur in a user's fingers when they press on a surface. A mixed analytical and machine learning-based method identifies the subtle variations that occur in a user's hands and fingers when such presses are made. The method then uses these subtle variations to identify presses, as well as the precise moment of contact that a finger touches the user's own body or a surface in the environment. This method achieves an accuracy of 82% under a variety of hand pose conditions.

NSERC Summer Research Assistant

2019

Intelligent Transportation System Lab of the University of Toronto Canada

Supervisor: **Prof. Baher Abdulhai** PI: **Dr. Hasan Bayanouni**

- Performed literature review on topics such as "How Ontology is used in Smart City Projects and OpenTripPlanner", and "How to conduct inferencing based on Transportation Ontology Mappings", and successfully identified opportunities.
- Integrated loop detector Ontology map with the OpenTripPlanner using AlleogroGraph.
- Developed a gtfs auto-updater. Worked with JSON, and urllib.request in Python.

No research title nor publication

Projects

Steam Game Review Analysis

2024

Role: **Lead Data Analyst** Supervisor: **Prof. Mariano P. Consens** University of Toronto

Conducted a comprehensive analysis of over 3 million Steam game reviews to identify key factors influencing review helpfulness and engagement.

Performed extensive data cleaning and preprocessing to ensure the accuracy and relevance of the dataset.

Utilized exploratory data analysis techniques to uncover patterns and correlations between review content and metrics such as helpfulness and the number of comments.

Developed and trained a linear regression model to classify and predict the quality of reviews based on identified key metrics.

Provided actionable insights to enhance the understanding of what makes a game review successful on Steam.

Demonstrated strong proficiency in data analysis, machine learning, and text mining techniques within the context of gaming.

Animyth - A tool for assisting creation of 2D animation for game development

2023

Role: **Developer** Supervisor: **Prof. Jonathan Rose** University of Toronto

Originated and defined the project scope, leading the conceptualization and planning phases.

Collaborated with a partner, leveraging GPT-4, prompt engineering, Stable Diffusion, and Python OpenCV for keyframe processing. Generated and evaluated a custom dataset using a blend of qualitative insights and quantitative metrics.

Project is open sourced: <https://github.com/ece1786-2023/Animyth>

Social Media Sentiment Analysis

2023

Role: **Lead Data Analyst** Supervisor: **Prof. Oleksandr Romanko** University of Toronto

Conducted sentiment analysis on Twitter data related to an ongoing real-life event, extracting public opinions and reactions. Developed and trained classifiers including Random Forest, Logistic Regression, and Support Vector Machines (SVM). Created engaging visualizations like word clouds and data charts to represent sentiment trends. Presented findings to a classroom audience, highlighting key insights and data interpretation techniques.

Producing 360-Degree Panoramas Using the CPET Dataset

2020

Role: **Developer** Supervisor: **Prof. Jonathon Kelly** University of Toronto

Identified the project thesis, dataset, general approaches, and evaluation metrics in the project proposal. Implemented two panorama-stitching algorithms using Python and libraries such as OpenCV, SciPy, and NumPy. Utilized the dataset collected by the Clearpath Husky rover to produce high-quality panoramas with a reduced vignetting effect. Wrote a project report that summarizes the process and the outcome.

Project Report can be accessed via: <https://github.com/houchuyi/Producing-360-Degree-Panoramas-Using-the-CPET-Dataset>

YouTube Trending Video Database Analysis

2020

Role: **Developer** Supervisor: **Prof. Diane Horton** University of Toronto

Identified project domain, dataset, investigative questions, and schema. Implemented schema using SQL. Cleaned the dataset using Python. Wrote queries to find the results that solve the investigative questions.

Project Report can be accessed via: https://houchuyi.github.io/projects/4_project/assets/pdf/YouTube_Trending_Video_Database_Analysis.pdf

The Galbraith Memorial Mail Robot

2019

Role: **Developer** Supervisor: **Prof. G.M.T.D'Eleuterio** University of Toronto

Gained expertise in controlling TurtleBot3 Waffle Pi. Gained experience working with ROS and coding in Python. Implemented PID control for line-following purposes, and applied Kalman Filter and Bayesian Localization on the robot.

Public repository can be accessed via: <https://github.com/houchuyi/Robotic-Control-ROB301.git>

Deep Learning Food Recognition Model

2019

Role: **Developer** Supervisor: **Prof. Lisa Zhang** University of Toronto

Gained expertise in implementing and training deep learning neural networks, ranging from very basic models, fully connected layers, and convolutional networks, to Faster R-CNN, an object detection neural network. Trained, tuned, and tested a PyTorch standard Faster-RCNN. Created a Python graphic user interface (GUI), using the tkinter library, for presentation demonstration purposes. Collaborated smoothly with my teammates offline.

Public repository can be accessed via: <https://github.com/nbjameslee/Deep-Learning-Food-Detection-Model>

Fully Autonomous Ball Dispensing Mobile Machine

2019

Role: **Developer** Supervisor: **Prof. M.R.Emami** University of Toronto

Designed and tested a fully automatic ball dispensing mobile machine with PID control. Specialized in the design and construction of circuitry and sensor subsystems as well as integration with electromechanical and microcontroller. Developed communication between PIC board and Arduino through I^2C . Excellent teamwork throughout the project. "Almost professional", said by the supervisor. Won 2nd place out of over 20 teams for performance efficiency and overall features in a public demonstration showcase.

School Experience

Technical Design Team Lead – University of Toronto Scarborough Robotics Club	2021-2022
Designed robotics hackathon challenges and organized various workshops.	
Event Director – University of Toronto Association of Chinese Engineers (UTACE)	2018-2022
Led teams to organize and conduct various student cultural/academic events.	
Peer Mentor for Linear Control Theory (ECE557) – University of Toronto	2021
Strengthened students skills in deriving mathematical proofs.	
Circuit Team Member University of Toronto Robotics Association (UTRA)	2019-2020
Designed and soldered circuits.	
Engineering Ambassador UofT Faculty of Applied Science & Engineering	2019-2020
Student volunteers that partner with the Faculty recruitment and alumni events.	

Awards

Dean's Honour List	Fall 2020
Dean's Honour List	Winter 2020
NSERC Undergraduate Student Research Award	2019
Dean's Honour List	Fall 2019
Dean's Honour List	Fall 2017

Professional Skill

Proficient in	Python, SwiftUI, Hugging Face API, PyTorch, OpenCV
Experienced in	Unity Engine
Familiar with	C, SQL, MATLAB
Used	Java, ROS, Verilog, Assembly

Personal Information

Languages

Chinese/Mandarin (native), English (fluent)

Hobbies

Video game design, board game

Sport

Tennis, table tennis, ski

Canadian permanent resident

Publications

- [1] P. V. Chadalavada, C. Hou, H. Satgunarajah, N. Pol, Y. Liu, and D. Wigdor, “Pressar : Vision-based freehand touch and force sensing,” ACM Conference on Human Factors in Computing Systems (CHI), 2024 in submission.