Chengyang Huang

Machine Learning Engineer and Roboticist

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SUMMARY

Experienced in machine learning, controls, robotics, and automotive engineering. Graduate concentration in *Signal & Image Processing and Machine Learning* and *Mechatronics and Controls*. Primary strengths include deep learning, GANs, active learning, Bayesian analysis, mechatronics and controls.

EDUCATION

M.S. **Electrical and Computer Engineering** **University of Michigan** *Dec. 2020*
Research Area: Deep Learning, Active Learning, Bayesian Analysis *GPA: 3.93/4.00*

M.S.Eng. **Mechanical Engineering** **University of Michigan** *Dec. 2020*
Research Area: Mechatronics and Controls, Robotics, Self-Driving Car *GPA: 3.93/4.00*

B.S.Eng. **Mechanical Engineering** **University of Michigan** *May 2018*
Research Area: Controls, Design; Minor in Electrical Engineering *GPA: 3.63/4.00*

RESEARCH EXPERIENCE

Prof. Clayton Scott's Research Group and **theVioliGroup, University of Michigan**
***Project:** Domain Generalization via Ensemble Method for Microbes* *Jan. 2021 – Present*
Research Assistant *Advisor: Prof. Clayton Scott*
This project aims to develop an ensemble method for the domain generalization problem and apply it to predict interactions between nanoparticles and microbes.

- Surveying domain generalization methods and biological interaction prediction methods.
- Developing a generic structure for domain generalization via ensemble method.

Uncertainty Quantification Research Group (by Prof. Xun Huan), University of Michigan
***Project 1:** Generative Adversarial Networks (GANs) for Parameter Estimation* *May 2020 – Present*
Research Assistant *Advisor: Prof. Xun Huan*
This is a proof-of-concept project of developing a generative model using GANs to estimate the parameter distribution from experimental measurements, which can be further applied to various engineering problems (e.g. mechanical, aerospace, biomedical). Current results show that this method is about 10 times faster than MCMC with similar performance in a test problem.

- Surveyed more than 20 types of GANs for stably training GANs, training GANs with limited data, and uncertainty quantification with GANs.
- Investigated and proved for theoretical guarantees on the convergence of GANs in parameter estimation problems.
- Developing a GANs model for parameter estimation with low training cost and fast inference speed.

***Project 2:** Rapid Components Analysis of Thrombus by Deep Learning* *Jan. 2020 – May 2020*
Research Assistant *Advisor: Prof. Xun Huan & Dr. Yang Liu*
This project aimed to develop a rapid diagnosis approach that can analyze the thrombus components by bioelectrical impedance measurement, which provides tentative diagnosis to doctors in emergency. It significantly reduced the diagnosis time comparing to conventional diagnosis methods such as MRI and CT.

- Surveyed conventional diagnosis methods for thrombus components analysis.

- Developed a deep neural network model in PyTorch to directly predict hematocrit of thrombus components using bio-impedance measurement and achieved 93% accuracy.
- Developed a Sequential Monte Carlo algorithm in Python to predict hematocrit of thrombus components with a deep neural network model and achieved 98% accuracy.

General Motors - Multidisciplinary Design Program, University of Michigan

Project: *Durability Schedule for Drive Unit of Self-Driving Electric Cars* *Jan. 2019 – Dec. 2019*

Graduate Student Researcher *Mentor: Mr. Dan Kline & Mr. Tom Harding*

This project developed a durability test schedule for self-driving electric vehicles, which reflects the vehicle usages in emerging self-driving applications and assures the drive unit design meet all durability and reliability requirements.

- Identified self-driving car failure modes and their root causes by investigating driving conditions and routines in emerging applications in the latest literature and warranty data using Excel and MATLAB.
- Quantified the accumulated damage by fatigue analysis on self-driving cars in MATLAB.
- Implemented durability test development methods from state-of-the-art literature in MATLAB.
- Led 3 undergraduate students from multidiscipline. Assessed project risk and managed the project timeline.

Smart and Sustainable Automation Research Lab, University of Michigan

Project: *Low-Level Control of 3D Printers from the Cloud* *May 2018 – July 2018*

Research Assistant *Advisor: Prof. Chinedum Okwudire*

This project developed an IoT based control system to solve the problem that the advanced control algorithms are not executable on a local controller due to expensive computation. It migrated the Filtered B-spline control algorithm to the Cloud and streamed low-level control commands to a 3D printer. It reduced the printing time by 54% without sacrificing the surface finishing using Cloud control.

- Implemented and operated Filtered B-spline control algorithm on Google Cloud Platform.
- Analyzed and optimized the performance issues of migrating Filtered B-spline Control algorithm from a local dSpace control desk to Google Cloud Platform.
- Diagnosed 3D printer mechanical issues, remodeled 3D printer electrical system to prevent electrical hazards, and created maintenance guidelines.

Undergraduate Capstone Design, University of Michigan

Project: *Autonomous Go-Kart Prototype Design* *Jan. 2018 – Apr. 2018*

Student Researcher *Mentor: Mrs. Amy Hortop*

This project was proposed as a proof-of-concept vehicle for competing in the Formula Student competition's driverless class. The goal was to develop and test subsystems that met the rules of the competition.

- Developed a PID controller for a DC motor in C++ on Arduino Mega for speed control.
- Implemented a stepper motor position controller in Python on Raspberry Pi 3 for steering control.
- Developed LiDAR-based mapping and path-planning algorithms in Python on Raspberry Pi 3.

International Summer Research Program, Technical University of Berlin

Project: *Optimizing Manual and Autonomous Warehouse Robot* *July 2017 – Aug. 2017*

Student Researcher *Advisor: Dr. Benjamin Fietzke*

This project was to design the prototype of the warehouse robot that can manually or autonomously retrieve and deliver warehouse cargo by following the indication lines on the ground using a Pololu m3pi Robot.

- Developed and implemented a PD controller using C++ for the robot to follow the desired trajectory based on the reflectance sensor reading.
- Implemented A-star searching algorithm using C++ for the robot to determine the optimal path.

- Implemented manual control mechanism through Bluetooth in Python.

PUBLICATIONS

Journal Publication

J1. Okwudire, C.E.; Huggi, S.; Supe, S.; **Huang, C.**; Zeng, B. Low-Level Control of 3D Printers from the Cloud: A Step toward 3D Printer Control as a Service. *Inventions* 2018, *3*, 56.

Posters

P1. Durability Schedule for Drive Unit of Autonomous Vehicle, *Fall 2020 Michigan Engineering Design Expo*, Ann Arbor, Michigan, Dec. 2019.

P2. Autonomous Go-Kart Prototype Design, *Winter 2018 Michigan Engineering Design Expo*, Ann Arbor, Michigan, April 2018.

PROFESSIONAL EXPERIENCE

Magna Powertrain (Changzhou) Co. Ltd, Changzhou, Jiangsu, China *July 2016 – Aug. 2016*
Tooling Engineer Intern *Supervisor: Mr. Kevin Lam*

- Created 3D CAD models and engineering drawings for spare parts in dies using SolidWorks and AutoCAD.
- Optimized tooling part design using tolerance stack-up analysis and GD&T.
- Analyzed and compared material property of tool steel in ASTM standard and GB/T standard to find the equivalent material in China for reducing cost in local production.
- Standardized preventive maintenance instructions and tool life tracking list for dies maintenance and increasing tooling longevity.

TEACHING EXPERIENCE

Mechanical Engineering Department, University of Michigan
MECHENG 305: Introduction to Finite Elements in Mechanical Engineering *Sept. 2018 – May 2020*
Graduate Student Instructor *Supervisor: Prof. Greg Hulbert & Prof. Xun Huan*

- Tutored students in weekly assignments and course projects and elaborated on areas of confusion in weekly office hours.
- Graded weekly assignments and provided concrete feedback for students.
- Assisted in leading lectures on learning finite elements analysis concepts, and led 10 lectures on hands-on exercises for CAD finite elements analysis.
- Counseled students in their capstone design project about finite elements analysis.

LEADERSHIP EXPERIENCE

Mentor, Mechanical Engineering Graduate Council, University of Michigan *Sept. 2018 – Dec. 2020*

OTHER EXPERIENCE

Automotive Mechanic, Jiangyin Huadong Auto Service, Jiangyin, Jiangsu, China *May 2014 – Aug. 2014*

COURSE PROJECTS

Machine Learning:

Commonsense Question Answering using BERT-based Models: *Sept. 2020 – Dec. 2020*

- Implemented and investigated the performance of multiple-choices classification models based on BERT, ALBERT, RoBERTa, and DistilBERT on CommonsenseQA dataset.

Learning Sample-Specific Models with Low-Rank Personalized Modeling: *Sept. 2020 – Dec. 2020*

- Implemented a personalized modeling algorithm and examined the adaptability and robustness of it by applying it on datasets in the field of business, healthcare, and academic performance.

Risk-Sensitive Distributional Reinforcement Learning with Forward-Looking Actor: *Sept. 2020 – Dec. 2020*

- Developed a risk-averse approach to make safe planning and control decisions and integrated it with deep Q-Learning.
- Integrated distributional reinforcement learning algorithms with a forward-looking actor to make predictions on future states and rewards.
- It outperformed D4PG, SAC, and TD3 in the bipedal walker environment.

Optical Flow estimation using PWC-Net: *Jan. 2020 – Apr. 2020*

- Implemented a CNN model for optical flow using pyramid, warping, and cost volume (PWC-Net).
- Proposed a novel improvement on the warping layer for training stability.

Robotics:

Dynamic Continuous Semantic Counting Sensor Model: *Jan. 2020 – Apr. 2020*

- Integrated continuous semantic mapping via Bayesian kernel inference (BKI-CSM) with dynamic semantic information to improve the mapping quality in the city street.

BotLab: *Nov. 2019 – Dec. 2019*

- Developed a simultaneous localization and mapping (SLAM) system and a path planning system using LiDAR in C++ for a robot to explore and navigate in a maze environment.

BalanceBot: *Oct. 2019 – Nov. 2019*

- Composed three PID controllers in C++ for balancing, moving, and turning a two-wheeled robot in an obstacle course.
- Developed an odometry system in C++ using quadrature encoders to follow the desired trajectory.

ArmLab: *Sept. 2019 – Oct. 2019*

- Designed a 6 degrees-of-freedom robot arm with a Kinect camera to detect and manipulate colored blocks.

Auto Tuning Weight Model Predictive Control of Automated Vehicle: *Jan. 2019 – Apr. 2019*

- Developed a model predictive controller for a linear time-variant system with an auto-tuning method for online selection of the cost function weight matrix.

SKILLS

Programming: Python (PyTorch, TensorFlow), C++, MATLAB and Simulink, Julia, JavaScript/HTML5.

Technical: LaTeX, SolidWorks (CSWP), Altair HyperWorks, LabVIEW, Arduino, 20SIM, AutoCAD, Wolfram Mathematica.

Languages: Mandarin (native), English (bilingual proficient), Cantonese (limited working proficient), German (elementary proficient).

Outdoor Skills: Aviation (student private pilot), Motorcycling.

AWARDS

- 2016 - 2018 University Honor.
- 2016 - 2018 University of Michigan Dean's List.

SELECTED COURSEWORK

Machine Learning: EECS 501: Probability and Random Processes,
EECS 504: Foundations of Computer Vision,
EECS 505: Computational Data Science and Machine Learning,
EECS 545: Machine Learning,
EECS 595: Natural Language Processing,
EECS 598: Reinforcement Learning Theory.

Robotics: ROB 501: Math for Robotics,
ROB 530: Mobile Robotics: Methods and Algorithms,
ROB 550: Robotic Systems Laboratory,
MECHENG 461: Automatic Control,
MECHENG 552: Mechatronic System Design,
MECHENG 560: Modeling Dynamic Systems,
MECHENG 561: Design of Digital Control System,
MECHENG 564: Linear Systems Theory,
MECHENG 567: Robot Kinematics and Dynamics,
MECHENG 599: Self-Driving Cars: Perception and Control,
EECS 351: Digital Signal Processing,
EECS 562: Nonlinear System and Control,
MECHENG 305: Finite Elements Analysis,
MECHENG 481: Manufacturing Processes.