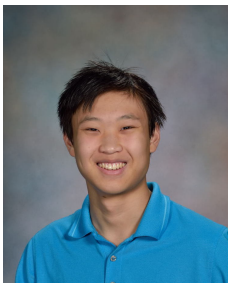

Gerry Chen

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OVERVIEW

Combined estimation and optimal control for robotic systems using factor graphs.
Georgia Tech Robotics PhD cohort of 2019.
Keywords: robot art, human-robot collaboration, optimal control, computer vision, robotics
Primary Languages: C++, Python, MATLAB

EDUCATION

Georgia Institute of Technology **08/2019 to Present**
College of Computing
PhD Robotics under Professors Frank Dellaert and Seth Hutchinson studying robot art
4.00/4.00 cumulative GPA

Duke University **08/2015 to 05/2019**
Pratt School of Engineering
BSE Electrical & Computer Engineering, BSE Mechanical Engineering, CS (minor), Math (minor)
3.87/4.00 cumulative GPA, Magna Cum Laude

PUBLICATIONS

7. G. Chen, S. Hutchinson, F. Dellaert, "Locally Optimal Estimation and Control of Cable Driven Parallel Robots using Time Varying Linear Quadratic Gaussian (LQG) Control", *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. (2022 - in review). **Pending Review**

6. G. Chen, S. Baek, J. Florez, W. Qian, S. Leigh, S. Hutchinson, and F. Dellaert, "GTGraffiti: Spray Painting Graffiti Art from Human Painting Motions with a Cable Driven Parallel Robot", *IEEE International Conference on Robotics and Automation (ICRA)*. p 3-19 (2022 - in press).

5. A. Cohen, G. Chen, E. Berger, S. Warrier, G. Lan, E. Grubert, F. Dellaert, Y. Chen, "Dynamically Controlled Environment Agriculture: Integrating Machine Learning and Mechanistic and Physiological Models for Sustainable Food Cultivation", *ACS ES&T Engineering*. p 3-19 (2022).

4. S. Yang, G. Chen, Y. Zhang, F. Dellaert, H. Choset, "Equality Constrained Linear Optimal Control With Factor Graphs", *2021 International Conference on Robotics and Automation (ICRA)*. p 9717-9723 (2021).

3. Z. Li, A. Yang, G. Chen, Z. Zeng, A. Peterchev, S. Goetz, "A High-Frequency Pulsating DC-Link for Electric Vehicle Drives with Reduced Losses", *47th Annual Conference of the IEEE Industrial Electronics Society (IECON)*. p 1-6 (2021).

2. P. Grady, G. Chen, S. Verma, A. Marellapudi, N. Hotz, "A Study of Energy Losses in the World's Most Fuel Efficient Vehicle", *IEEE Vehicle Power and Propulsion Conference (VPPC)*. p 1-6 (2019).

1. F. Wang*, G. Chen*, and K. Hauser, "Robot Button Pressing in Human Environments", *2018 IEEE International Conference on Robotics and Automation (ICRA)*. p 7173-7180 (2018).

HONORS AND AWARDS

Sigma Xi Honor Society **08/2020 to Present**

Tau Beta Pi Honor Society – *NC Gamma Chapter* **05/2019 to Present**

IEEE Eta Kappa Nu Honor Society – *Delta Lambda Chapter* **01/2018 to Present**

Pi Tau Sigma Honor Society – *Pi Iota Chapter* **01/2017 to Present**

National Science Foundation Graduate Research Fellows Program **03/2020**
Honorable Mention
The NSF GRFP recognizes and supports outstanding graduate students in supported STEM disciplines.

Guinness World Records **06/2019**
Most Efficient Prototype Electric Vehicle
President of the Duke Electric Vehicles team that broke the record with 77.98Wh/100km.

Duke University Electrical and Computer Engineering Department **05/2019**
Graduation with Departmental Distinction
Presented for my distinguished research and academic record.

Guinness World Records **07/2018**
Most Fuel-Efficient Vehicle
Head of hydrogen fuel cell development for the record breaking fuel cell vehicle achieving 14,573MPGe.

RESEARCH EXPERIENCE

Robotics Estimation and Control **08/2019 to Present**
Georgia Institute of Technology - Dr. Frank Dellaert

- Combined estimation and optimal control using factor graphs
- Cable driven parallel robot (CDPR) design and control

Power Electronics **08/2018 to 05/2019**
Duke University - Dr. Stefan Goetz and Dr. Angel Peterchev

- Implemented novel FOC motor controller using modular multilever series-parallel converter to self-balance battery cells, reduce noise, increase voltage ratings, and minimize losses
- Thermal analysis of battery/converter modules for use in automotive setting
- Electrical losses analysis for MOSFET selection in converter modules
- Installation of novel motor controller in electric vehicle to test practical cell-balancing performance

Fuel Cell Hybrid Vehicle **08/2017 to 05/2018**

Duke University - Dr. Josiah Knight and Dr. Nico Hotz

- Optimization of fuel cell operating parameters for use in hybrid vehicle to achieve 58.9% in-system efficiency (increase from baseline efficiency of 40%)
- Design and optimization of voltage converter for active supercapacitor load power leveling system resulting in 22% higher vehicle efficiency
- See Publication 2 – fuel cell vehicle system level design

Robotics Motion Planning **01/2017 to 05/2018**

Intelligent Motion Laboratory - Dr. Kris Hauser

- Applied convolution-based image similarity metrics for database assisted vehicle path planning
- Fabricated silicon and polyurethane cornea models with <50um repeatability for use in surgical robot testing
- See Publication 1 – work funded by NSF Research Experiences for Undergraduates (REU) to implement a Precision Positioning Unit (PPU) on the Tele-Robotic Intelligent Nursing Assistant (TRINA)
- Redundancy resolution for minimum manipulability / maximum continuous range joint configurations
- Fabricated polyurethane "finger" tip with integrated tactile sensor and 95.7% actuation success rate

WORK HISTORY

Instructor **05/2022 to 08/2022**

Georgia Institute of Technology

- **CS3630:** Intro to Perception & Robotics

Software Engineer Intern: Autonomous Vehicle Perception **05/2021 to 08/2021**

Zoox - Dr. Subhasis Das

- Developed smoothing-based tracker for improved object tracking using sensor fusion
- My code achieved improvements in all tracking metrics for use in offline labeling, with 2 patents pending

Integrated Control and Estimation Intern **06/2020 to 08/2020**

Air Force Research Laboratory (Eglin AFB) - Dr. Adam Rutkowski

- Refine collaborative vehicle control with imperfect multi-vehicle trajectory estimations
- Compute optimal sensor measurement timing and inter-vehicle communication
- Compute optimal collaborative trajectories to minimize navigation uncertainty using factor graphs

Controls Engineer Intern **05/2018 to 08/2018**

Deka R&D - Dirk Van Der Merwe

- Developed novel 2-wheel balancing control scheme with constrained wheel displacement (patent pending)
- Created multi-system integration over CAN, EtherCAT, RS232 to create hybrid wheeled/legged robot
- Developed stability control of robot w/ powered casters + differential steering to test high speed dynamics

Robotics Motion Planning Intern **01/2017 to 05/2018**

Intelligent Motion Laboratory - Dr. Kris Hauser

- Work on PPU for TRINA (see entry in Research Experience)
- Coded (Python, C++) and tested max. continuous range / min. manipulatability arm configurations

Teaching Assistant **08/2019 to 12/2019**
Georgia Institute of Technology

- **CS3630:** Intro Perception & Robotics Fall 2019

Teaching Assistant **08/2016 to 05/2018**
Duke University

- **EGR201:** Mechanics of Statics Fall 2017
- **ECE230:** Microelectronics Fall 2017
- **ECE230:** Microelectronics Summer 2017
- **EGR103:** Computational Methods in engineering Fall 2016
- **CS201:** Data structures and Algorithms Fall 2016

Tutor **05/2014 to 05/2019**
Multiple Employers

- Duke Academic Resource Center - group instruction:
  - Multivariable Calculus 08/2016 to 05/2019
  - Linear Algebra 01/2017 to 01/2018
  - Differential Equations 01/2017 to 01/2018
- Duke Academic Resource Center - individual instruction:
  - Multivariable Calculus 08/2016 to 05/2017
  - Linear Algebra 08/2016 to 05/2017
  - Differential Equations 08/2016 to 05/2017
- America Reads America Counts at Duke 08/2015 to 06/2016
  - Durham Public Schools
  - Math + Reading
- Kumon Math and Reading Center of Fox Chapel 05/2014 to 08/2016
  - personalized curriculum generation for 40+ students
  - student performance evaluations

EXTRACURRICULAR ACTIVITIES

Co-President **08/2015 to 08/2019**
Duke Electric Vehicles Team

- World Record (2019): World's most efficient electric vehicle - team president
- World Record (2018): World's most fuel efficient vehicle - head of hydrogen system
- Lead creation of a fully autonomous vehicle to allow the vehicle to follow a "total system energy" optimized path subject to physical control constraints
- Co-lead hydrogen fuel cell hybrid vehicle for 2018 to achieve 14,573 MPGe
- Design + Manufacture + Test the high power super-capacitor control board to increase vehicle efficiency by 22%
- Create an automated testing system resulting in fuel cell efficiency increase from 40% to 63%
- Design + Manufacture + Install the carbon fiber inserts to decrease weight and increase modularity
- 2018: 1st place H2, 1st place battery-electric (12,398 MPGe), Technical Innovation Award at the Shell Eco-Marathon Americas

CTO **08/2018 to 05/2019**

Delta Band Inc. - *deltatrainer.fit*

- Designed all electrical systems of the strength training workout tracker watch based on machine learning
- Currently on 7th generation electrical boards (Dec 2018)
- Initiating small-scale (100 devices) manufacturing for beta-testing devices to be shipped Jan 2019

Project Lead **01/2016 to 01/2018**

Solar Benches

- Lead technical, financial, and administrative aspcts of augmenting existing campus benches with solar powered night-time task lighting and laptop/phone chargers to raise enthusiasm for clean energy
- Installed 2 test benches on campus after passing safety inspection on an off-site prototype bench

RELEVANT COURSEWORK

Georgia Institute of Technology

- CS7643 - Deep Learning
- CS8803 - Probabilistic Graphical Models in Machine Learning
- CS7476 - Advanced Computer Vision
- CS8803 - Mobile Manipulation
- CS6601 - Artificial Intelligence
- ECE6553 - Optimal Control

Duke University

- CS520/MATH565 - Numerical Analysis
- MATH577 - Mathematical Modeling
- MATH216 - Linear Algebra and Diff. Equations
- MATH353 - Ordinary and Partial Diff. Equations
- ECE382/ME344 - Control Systems

SKILLS

- Strong command of C++, Matlab, and Python
- Estimation, Sensor fusion, SLAM
- Path Planning + Classical Controls
- Embedded Software Development
- Eagle, SPICE, Solidworks, Autodesk Fusion
- Proficiency in ROS, Java, MATHEMATICA, LaTeX