



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

10. [G. Chen](#), H. Muriki, C. Pradalier, Y. Chen, and F. Dellaert, “[A Hybrid Cable-Driven Robot for Non-Destructive Leafy Plant Monitoring and Mass Estimation using Structure from Motion](#)”, *IEEE International Conference on Robotics and Automation (ICRA)*. (2023 - in review). **Pending Review**
9. Y. Zhang, F. Jiang, [G. Chen](#), V. Agrawal, A. Rutkowski, and F. Dellaert, “[Constraint Manifolds for Robotic Inference and Planning](#)”, *IEEE International Conference on Robotics and Automation (ICRA)*. (2023 - in review). **Pending Review**
8. [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)*. p (2022).
7. Y. Zhang, [G. Chen](#), A. Rutkowski, F. Dellaert, “[Efficient Range-Constrained Manifold Optimization with Application to Cooperative Navigation](#)”, *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. p (2022).
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
<i>Honorable Mention</i>	
The NSF GRFP recognizes and supports outstanding graduate students in supported STEM disciplines.	
Guinness World Records	06/2019
<i>Most Efficient Prototype Electric Vehicle</i>	
President of the Duke Electric Vehicles team that broke the record with 77.98Wh/100km.	
Duke University Electrical and Computer Engineering Department	05/2019
<i>Graduation with Departmental Distinction</i>	
Presented for my distinguished research and academic record.	
Guinness World Records	07/2018
<i>Most Fuel-Efficient Vehicle</i>	
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
<i>Georgia Institute of Technology - Dr. Frank Dellaert</i>	
<ul style="list-style-type: none"> • 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 multilevel 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 aspects 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, L^AT_EX