Boyang Zhang

CONTACT INFORMATION

121 Hudson Hall, Durham
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Duke Scholar Profile

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Personal Website

RESEARCH INTERESTS

Dynamics and control; Multi-agent robotics; Autonomous vehicle; Optimization theory.

EDUCATION

Ph.D., Civil and Environmental Engineering Sept 2023 (expected)

Duke University, *Durham, United States*

- Dissertation: An instantaneous nonlinear optimal control paradigm via constraints.
- **Committee**:
  Henri Gavin (Chair), Jerome Lynch, Earl Dowell, Michael Zavlanos, Dennis Bernstein.
- **Highlights**:
  - Graduate/Professional Academic Exemplar of the Year
  - Preparing Future Faculty Fellow (22 fellows out of all Duke Ph.D. students/postdocs)
  - Bass Instructional TA Fellow (four fellows out of all Duke Ph.D. candidates)
  - Summer Research Fellow (two fellows out of all third year and beyond Duke Ph.D. students in seven Physical Sciences and Engineering departments)
  - Certificate in College Teaching
  - Certificate in Teaching Writing

M.S., Electrical and Computer Engineering Sept 2023 (expected)

Duke University, *Durham, United States*

- Research project: A nonlinear feedback control paradigm via constraints.
- **Committee**:
  Vahid Tarokh (Chair), Tyler Bletsch, Ebsan Abadi.

M.Eng., Ocean and Naval Architectural Engineering Oct 2017

Memorial University (MUN), *St. John's, Canada*

- Thesis: Improving time-domain prediction of vortex-induced vibration for marine risers.
- **Committee**:
  Wei Qiu (Chair), David Molyneux, James Yang.
- **Highlights**:
  - GPA: 4.0/4.0
  - Fellow of the School of Graduate Studies (awarded to less than 10% of a degree program's final-year students.)

B.Eng., Ocean and Naval Engineering July 2013

Tianjin University (TJU), *Tianjin, China*

RESEARCH EXPERIENCE

Research Assistant June 2018 – Present

Duke University, Durham, United States

- Developed centralized and decentralized frameworks for the navigation and control of hundreds of double integrators based on extensions of Gauss's principle of least constraint (GPLC).
- Resolved the deadlocks naturally among double integrators by a constraint reformulation.

- Originated computationally simple, centralized and decentralized control methods for single/multiple nonlinear quadrotors based on generalizations of GPLC.
- Formulated computationally simple, centralized and decentralized control methods for single/multiple nonholonomic wheeled mobile robots based on extensions of GPLC.
- Derived the input-output stability of nonlinear dynamical systems based on conic sectors.

Research Assistant June 2014 – June 2017

Memorial University, St. John's, Canada

- Derived and compared time-domain models to predict vortex-induced vibration (VIV).
- Re-developed an in-house finite-element program in Fortran for mooring line analysis.
- Designed a model test of two cylinders under VIV interaction at high Reynolds numbers.

Undergraduate Research Student Mar 2012 – June 2013

Tianjin University, Tianjin, China

- Analyzed extreme loading scenarios for an offshore jack-up platform in ANSYS.
- Assisted in coupling the hull heave-moonpool fluid motion for a SPAR platform.
- Conducted ship resistance/propulsion tests at Tianjin University Towing Tank.

Refereed Journal Publications

1. **Zhang, B.** and Gavin, H.P. Gauss's Principle with Inequality Constraints for Multi-agent Navigation and Control. *IEEE Transactions on Automatic Control*, vol. 67, no. 2, pp. 810-823, 2022, doi: 10.1109/TAC.2021.3059677.
   (2021 impact factor: 6.549; Google Scholar Metrics ranking in **Automation & Control Theory: 1/20**)

2. **Zhang, B.** and Gavin, H.P. Decentralized Control of Multiagent Navigation Systems. *IEEE/CAA Journal of Automatica Sinica (JAS)*, vol. 9, no. 5, pp. 922-925, 2022, doi: 10.1109/JAS.2022.105569.
   (2021 impact factor: 7.847; Scopus ranking in **Control and Optimization: 1/118**)

3. **Zhang, B.** and Qiu, W. Improving Time-Domain Prediction of Vortex-Induced Vibration for Marine Risers. *Marine Systems & Ocean Technology*, vol. 13, no. 1, pp. 13-25, 2018, doi: 10.1007/s40868-017-0041-3.

Peer-Reviewed Conference Publications

1. **Zhang, B.** and Gavin, H.P. Computationally Efficient Tracking Control of Differential Drive Wheeled Mobile Robots. *Proceedings of the 2023 American Control Conference (ACC)*, accepted.

2. **Zhang, B.** and Gavin, H.P. Decentralized Unified Position-Attitude Control of Nonlinear UAVs. *Proceedings of the 61st IEEE Conference on Decision and Control (CDC)*, pp. 5214-5219, 2022, doi: 10.1109/CDC51059.2022.9992624.

3. **Zhang, B.** and Gavin, H.P. Unified Position-Attitude Control of A Nonlinear Quadrotor Swarm. *Proceedings of the 2022 American Control Conference (ACC)*, pp. 4030-4035, 2022, doi: 10.23919/ACC53348.2022.9867205.

4. **Zhang, B.** and Gavin, H.P. Natural Deadlock Resolution for Multi-agent Multi-swarm Navigation. *Proceedings of the 60th IEEE Conference on Decision and Control (CDC)*, pp. 5958-5963, 2021, doi: 10.1109/CDC45484.2021.9683102.

5. **Zhang, B.** and Gavin, H.P. Unified Position and Attitude Control of a Fully Nonlinear Quadrotor. *Proceedings of the 2021 American Control Conference (ACC)*, pp. 1064-1069, 2021, doi: 10.23919/ACC50511.2021.9483358.

Academic Presentations

- 2023 Southeast Control Conference, Gainesville, FL. — Feb 2023
  Best Presentation Award
- 61st IEEE Conference on Decision and Control, Cancún, Mexico. — Dec 2022
- 2022 American Control Conference, Atlanta, GA. — June 2022
- IEEE/CAA JAS Symposium Series 1 (virtual). — Feb 2022
- 60th IEEE Conference on Decision and Control, Austin, TX. — Dec 2021
- 2021 Southeast Control Conference, Blacksburg, VA. — Oct 2021
- 2021 American Control Conference, New Orleans, LA. — May 2021

Teaching & Professional Experience

Co-instructor of Uncertainty, Design, and Optimization (CEE 201) — Spring 2023
Duke University, Durham, United States

- Gave four guest lectures and weekly 75-minute recitations to 20 undergraduate students.
- Assisted in preparing lecture materials and homework questions/solutions.
- Held weekly office hours.

Instructor of Robust Control (ME 592) — Spring 2018
Duke University, Durham, United States

- Developed lecture notes.
- Gave lectures to seven people, including five undergraduate/graduate students and two research professors.

Teaching Assistant — Aug 2021 – Present
Duke University, Durham, United States

- Gave three tutorial labs to 51 students.
- Gave two guest lectures to 15 students.
- Held weekly office hours.
- Graded the assignments and lab reports.

Mechanics of Solids (EGR 201) — Fall 2021
Undergraduate course, 54 students.

Risk and Resilience in Engineering (CEE 690.06) — Spring 2022
Graduate/Undergraduate hybrid course, 15 students.

Teaching Assistant — Jan 2014 – Dec 2015
Memorial University, St. John's, Canada

- Gave tutorial lectures and labs to 344 students.
- Generated the solutions to assignments and exams.
- Graded the assignments and lab reports.

Mechanical Vibrations (EN 6933) — Fall 2014/2015
Undergraduate course, 106/105 students.

Fluid Mechanics (EN 4961) — Spring 2015
Undergraduate course, 91 students.

Dynamics and Maneuvering of Ocean Vehicles (EN 7035) — Spring 2014
Undergraduate course, 20 students.

Marine Propulsion (EN 5020) — Winter 2014
Undergraduate course, 22 students.

Technology Intern — Jan 2015 – May 2015
American Bureau of Shipping, Houston, United States

- Researched the rules and regulations from seven classification societies: ABS, DNV-GL, LR, BV, NK, CCS, and KR.

- Upgraded the ABS notation comparison database with 371 modifications.

Grants, Awards, & Honors

International/National Level:

- Best Presentation Award — Feb 2023
  2023 Southeast Control Conference
- 2022 Society for Risk Analysis Annual Meeting Student Award ($75) — Nov 2022
  Society for Risk Analysis - Research Triangle Regional Organization
- 2022 CDC Student Travel Award and Workshop Support ($825) — Sept 2022
  61st IEEE Conference on Decision and Control (CDC)
- 2022 ACC Student Travel Grant ($445) — Apr 2022
  2022 American Control Conference (ACC)
- Selected oral presenter — Jan 2023/Oct 2021
  Southeast Control Conference
- 60th IEEE CDC Student Travel Support ($125) — Sept 2021
  60th IEEE Conference on Decision and Control (CDC)
- 2021 ACC Student Registration Grant ($100) — Apr 2021
- Short-Term Innovative Research Grant ($60,000) — Sept 2019
  U.S. Army Research Office
- Mitacs Accelerate Award ($10,000) — Jan 2015
  Mitacs Canada
- NSERC CREATE Offshore Technology Research Fellowship ($42,000) — Sept 2013/14
  Natural Sciences and Engineering Research Council of Canada (NSERC)
- Excellent Volunteer — Sept 2012
  World Economic Forum (Tianjin Summer Davos)

University Level:

- Senol Utku Award with High Distinction — May 2023
- Duke In the Spotlight Award — May 2023
- Duke Graduate/Professional Academic Exemplar of the Year — Mar 2023
- Duke Graduate School Conference Travel Award ($700) — Nov 2022
- Preparing Future Faculty Fellowship ($500) — July 2022
- Duke Graduate School Conference Travel Award ($525) — May 2022
- Summer Research Fellowship ($12,561) — Jan 2022
- Bass Instructional Teaching Assistant Fellowship ($29,770) — Dec 2021
- Selected Auburn Preparing Future Faculty Fellow (200 out of 800+) — Sept 2021
- Senol Utku Award with Highest Distinction ($350) — Apr 2021
- The only student participant & speaker at Duke Libraries fundraising event — Apr 2019
- Fellow of the MUN School of Graduate Studies — Nov 2017
- Duke Graduate School Fellowship ($85,479) — Aug 2017
- McGill Engineering Doctoral Award ($96,000) — Mar 2017
- MUN Outstanding Teaching Assistant Award Nominee — May 2016
- MUN School of Graduate Studies Scholarship ($2,000) — Sept 2013/14
- TJU Excellent Student Leadership Scholarship — Dec 2011
- TJU Advanced Student in Volunteer Service — Dec 2011

Certifications

- Science Communication — Mar 2023
  Duke University, Durham, United States
- Offshore Systems for Oil & Gas Production and Renewable Energy — Mar 2016
  University of Maine, Orono, United States
- Arctic/Subarctic Offshore Engineering — May 2015

American Society of Mechanical Engineers (ASME)

- Fundamentals of Riser & Flexible Pipe Engineering — May 2015
  American Society of Mechanical Engineers (ASME)
- The Fundamentals of Project Management — May 2015
  Memorial University, St. John's, Canada
- Design and Analysis of Floating Platforms — Oct 2014
  John Halkyard Associates, Houston, United States

Reviewership

IEEE/CAA Journal of Automatica Sinica
IEEE Control Systems Letters
IEEE Conference on Decision and Control
American Control Conference

Professional Societies

Student Member of IEEE
Student Member of IEEE Control Systems Society

Languages & Skills

Language:

- Proficient in English and Chinese (Simplified and Traditional).

Computer:

- LaTeX, MATLAB, Fortran, Linux, SolidWorks, Gnuplot, AutoCAD, ANSYS.