

JOSEPH NORBY

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EDUCATION

Carnegie Mellon University

Doctor of Philosophy in Mechanical Engineering
GPA: 3.97/4.0

Pittsburgh, PA

Aug 2022

Selected Coursework: Linear Systems, Nonlinear Control, Planning and Decision-Making in Robotics, Robot Design and Experimentation, Underactuated Robotics

University of Notre Dame

Bachelor of Science - Mechanical Engineering
GPA: 3.93/4.0, summa cum laude

Notre Dame, IN

May 2016

SKILLS

Programming Languages: C/C++, Python

Software: ROS, Linux, Git, CI/CD, Gazebo, IPOPT, MATLAB, Simulink, Solidworks, Optitrack, Doxygen, Latex

Hardware: 3D Printing, Laser Cutting, Soldering, Mill, Lathe

THESIS

Carnegie Mellon University

Enabling Autonomous Legged Robot Agility

Pittsburgh, PA

Aug 2016 – Aug 2022

- Led the development of Quad-SDK, an open-source ROS-based framework for legged robot planning, control, estimation, and simulation; won Best Paper at ICRA Workshop for Legged Robots as chosen by peers
- Developed a novel motion planning algorithm for legged robots in C++ that solves 10x faster than other methods while permitting highly dynamic behaviors (e.g., running, leaping)
- Harnessed connections between formal model reduction techniques and model predictive control, enabling adaptive control method which reduced solve times and increased peak acceleration threefold
- Designed, simulated, and tested a novel aerodynamic drag-based tail that improves robot stability while reducing weight 2.5x compared to standard methods

PROFESSIONAL EXPERIENCE

Aptronik Inc.

Software Engineer

Austin, TX (remote)

Jul 2022 – Present

- Deploying state-of-the-art navigation and autonomy algorithms to highly dynamic humanoid robots
- Leading software team towards completion of strategy-critical demos
- Coordinating development with the software team in Agile framework

Leonardo's Basement

STEM Course Instructor

Minneapolis, MN

Summer 2015 & 2016

- Designed and instructed STEM courses for K-12 students (e.g. LEGO Robotics, Circuits)
- Managed student teams during builds of 20-ft long Viking ship and Millennium Falcon

ADDITIONAL RESEARCH EXPERIENCE

Robomechanics Lab

Graduate Research Assistant

Pittsburgh, PA

Aug 2016 – Present

- Collaborated with industry partners to generate novel design methodology for autonomous soil sampling robots
- Implemented trajectory optimization framework in MATLAB for solving constrained hybrid dynamical systems and optimizing robot behaviors (e.g., improved robot acceleration by 35% via optimized tail control)
- Mentored three masters and eight undergraduate students
- Led lab discussions on ethical deployment of mobile robots and promoting diversity, equity, and inclusion

Locomotion and Biomechanics Lab

Undergraduate Research Assistant

Notre Dame, IN

Feb 2015 – May 2016

- Optimized virtual constraints to improve biped disturbance rejection by up to 20% in MATLAB simulation
- Calculated basin of attraction of controller via data-driven approach to guide optimization objective

PUBLICATIONS

Joseph Norby, et al. "Enabling Dynamic Behaviors with Aerodynamic Drag in Lightweight Tails." IEEE Transactions on Robotics (2021).

Joseph Norby and Aaron M. Johnson. "Fast Global Motion Planning for Dynamic Legged Robots." 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE, 2020.

SELECTED CONFERENCES

Joseph Norby, et al. "Quad-SDK: Full stack software framework for agile quadrupedal locomotion," in ICRA Workshop on Legged Robots, **Best Workshop Paper**

Joseph Norby, et al. "Leveraging aerodynamic drag for tails in legged robot locomotion." American Physical Society (APS) March Meeting, Virtual, March 2021. Workshop Presentation.

Joseph Norby and Aaron M. Johnson. "Tail actuation improves quadrupedal robot acceleration," in Dynamic Walking, Canmore, Canada, May 2019. Conference Presentation.

Joseph Norby and James Schmiedeler, "Modifying Virtual Constraints to Improve Simulated Biped Robot Stability," in Dynamic Walking, Holly, MI, June 2016. Poster Presentation.

PROJECTS

Aggressive Quadrotor Planning and Control

Aug – Dec 2018

Advanced Control System Integration Course, Carnegie Mellon University

- Developed 200Hz iLQR-MPC controller for quadrotor to fly through thrown hoops with 60% success rate
- Wrote MATLAB ROS interface between remote computer and quadrotor

Bio-inspired Leg Design

Jan – May 2018

Robot Design and Experimentation Course, Carnegie Mellon University

- Collaborated with a team of five to design a bio-inspired robot leg capable of leaping to a height of one leg length
- Developed a MATLAB trajectory optimization algorithm to select leg geometry and series-elastic spring stiffness for maximum jumping height, improved by 10% in simulation

ADDITIONAL EXPERIENCE

Carnegie Mellon University

Pittsburgh, PA

Teaching Assistant - Robot Dynamics and Analysis (graduate), Dynamics (undergraduate)

Aug 2017 - Dec 2018

- Developed solutions manual and optimization tools for assignments on robot kinematics, dynamics, and analysis
- Assisted professor in the generation of homework and exam problems
- Taught guest lectures, held office hours and recitations (4.7/5.0 student approval rating)

AWARDS and HONORS

Best Workshop Paper, ICRA Workshop on Legged Robotics

May 2022

Jeremiah Mpagazehe Student Service Award, Carnegie Mellon University

May 2022

Graduate Research Fellowship, National Science Foundation

May 2016

Eagle Scout, Boy Scouts of America

May 2012

LEADERSHIP and VOLUNTEER WORK

Reviewer, IEEE Transactions on Robotics, Robotics and Automation Letters (journals)

May 2019 – Present

Mentor, Robomechanics Lab outreach events

Aug 2016 – Jun 2022

Co-Chair & Dept. Liaison, CMU MechE DEI Task Force Representation Subcommittee

Jan 2021 – Jan 2022

Presenter, CMU Gelfand Center Road2Research: Meet the Researcher program

Sept 2020 – Apr 2021

Assistant Coach, CMU Men's Ultimate Frisbee Team

Aug 2018 – May 2019