

Blake Buchanan

ROBOTICS RESEARCHER

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Summary

My research experience has roots in the fields of robotics, applied mathematics, and mechanics. I currently research and implement novel geometric methods for accomplishing control and coordination for biologically inspired multi-robot systems as part of the research staff in the Biorobotics Lab at Carnegie Mellon University.

Work Experience

Biorobotics Lab, The Robotics Institute at Carnegie Mellon University

Pittsburgh, PA

RESEARCH STAFF

August 2020 - Present

- Introduced a novel perspective in finding optimal controls for nonholonomic multi-robot systems in dynamic environments using geometric optimal control techniques.
- Investigated the role of symmetries in a robot's shape space for identifying and deploying families of gaits for affecting locomotion and environment manipulation.
- Developed software in Python, Julia, and MATLAB programming languages to test and validate dynamical systems and control strategies.

Biorobotics Lab, The Robotics Institute at Carnegie Mellon University

Pittsburgh, PA

GRADUATE RESEARCH ASSISTANT

August 2018 - August 2020

- Proved stability of an underactuated elastically driven robot in a dynamic environment.
- Made progress in proving the stability of a *multi-agent* nonholonomic locomoting system in a dynamic environment.
- Developed a simulation and implemented a PID controller for a novel impulsively actuated two-dimensional aquatic vehicle in an inviscid fluid.

Biorobotics Lab, The Robotics Institute at Carnegie Mellon University

Pittsburgh, PA

ROBOTICS INTERN

May 2017 - August 2017

- Designed and developed a robot that contributed to published research concerning the effects of elastic elements on the locomotion of biologically inspired snake robots.

Faculty Lab, University of North Carolina at Charlotte

Charlotte, NC

UNDERGRADUATE RESEARCH ASSISTANT

May 2016 - May 2018

- Designed experiments and developed motion control electronics for biologically inspired terrestrial and aquatic robots.
- Developed an affordable RTK-based differential positioning Raspberry Pi package to track the position of biologically inspired terrestrial and aquatic robots.

Department of Mechanical Engineering, University of North Carolina at Charlotte

Charlotte, NC

UNDERGRADUATE TEACHING ASSISTANT

January 2016 - May 2018

- Delivered supplemental lectures for undergraduate dynamics courses.
- Assisted students in learning the PTC Creo CAD package.

Education

Carnegie Mellon University, Robotics Institute

Pittsburgh, PA

M.S. IN ROBOTICS

August 2020

Cumulative GPA: 3.76 / 4.00

University of North Carolina at Charlotte

Charlotte, NC

B.S. IN MECHANICAL ENGINEERING

May 2018

Cumulative GPA: 3.487 / 4.000

Publications

Mechanics and Control of Coupled Interactions in Ambient Media (PDF)

CARNEGIE MELLON UNIVERSITY

Authors: **Blake Buchanan**

Pittsburgh, PA

2020

Locomotion of a multi-link nonholonomic snake robot with passive joints (PDF)

INTERNATIONAL JOURNAL OF ROBOTICS RESEARCH

Authors: **Blake Buchanan**, Rodrigo Abaján-Guerrero, Scott D. Kelly, Matthew Travers, and Howie Choset

2020

Stability and Control of Chaplygin Beaniebots Coupled to a Platform through Nonholonomic Constraints (PDF)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, DYNAMIC SYSTEMS AND CONTROL CONFERENCE

Authors: **Blake Buchanan**, Matthew Travers, Howie Choset, and Scott D. Kelly

2020

Presentation

Modeling and Dynamics of Planar Swimmers Coupled through Wake Vorticity

SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS, 2019 DYNAMIC SYSTEMS CONFERENCE

Blake Buchanan, Matthew Travers, Howie Choset, and Scott D. Kelly

Snowbird, Utah

May, 2019

Stability and Control of Chaplygin Beaniebots Coupled to a Platform through Nonholonomic Constraints

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 2020 DYNAMIC SYSTEMS AND CONTROL CONFERENCE

Blake Buchanan, Matthew Travers, Howie Choset, and Scott D. Kelly

Virtual

May, 2019

Academic Projects

NASA Student Launch Initiative 201-2017

SAFETY OFFICER

- Identified and addressed critical failure modes in both mechanical and electronic designs for launch vehicle and payload subsystems.
- Developed and documented protocols for ensuring proper separation of launch vehicle sections, parachute deployment, and altimeter function.
- Participated in preliminary design, critical design, flight readiness, and launch readiness reviews and developed associated documentation.

Charlotte, NC

August 2016 - May 2017

Design Optimization of a Swimming Robot, Senior Design

RESEARCHER / PROJECT LEAD

- Optimized the distribution of elastic elements in an underactuated articulated swimming robot model using reinforcement learning.

Charlotte, NC

August 2017 - May 2018

Pick-and-place Robot Development, Junior Design

ENGINEER / PROJECT LEAD

- Developed software for executing pre-specified trajectories and picking up stainless steel spheres using magnetic manipulation.
- Ensured project plan was up-to-date and that project tasks were completed on time.

Charlotte, NC

August 2017 - May 2018

Rigid Bodies and Point Vortices

RESEARCHER

- Characterized the basin of attraction for a circular cylinder in point vortex flows.
- Researched stabilization methods for perturbations about equilibrium manifolds.

Charlotte, NC

August 2017 - May 2018

Coursework

Underactuated Robots · Machine Learning · Kinematics, Dynamics, and Control · Math Fundamentals for Robotics
Convex Optimization · Computer Vision · Optimal Control · Advanced Topics in Dynamics · Nonlinear Control

Programming Languages

 Python  Julia  MATLAB  Wolfram Mathematica