

CAPPRIN BASS

Robotician, Boston, MA

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EDUCATION

Oregon State University - Corvallis, Oregon M.S. Robotics Thesis: Geometric Optimization Methods for Mobile Systems	Sept. 2020 - July 2022 3.78 GPA
Colorado School of Mines - Golden, Colorado B.S. Computational and Applied Mathematics Biomechanical Engineering Minor	Aug. 2016 - May 2020 3.54 GPA
Peak to Peak Charter School - Lafayette, Colorado Magna Cum Laude National Honors Society	Aug. 2012 - May 2016 3.8 GPA

WORK EXPERIENCE

Boston Dynamics AI Institute <i>Robotician</i>	October 2023 - Present
<ul style="list-style-type: none">• Research and development on generational robotics problems• Modeling and control (stability, model-based, and adaptive) for a custom bimanual manipulator• Geometric mechanics of in-hand manipulation and the nature of nonholonomic constraint	
MITRE Labs <i>Robotics And Autonomous Systems Engineer</i>	December 2022 - September 2023
<ul style="list-style-type: none">• Research and on-hardware implementation of control barrier functions for safety-critical autonomy• Designed optimal control with respect to constraints on safety, actuators, dynamics, and mission• Support for the DoD TRMC Testing & Evaluation program in Autonomy and Artificial Intelligence	
RightHand Robotics <i>Graduate Intern</i>	July 2022 - September 2022
<ul style="list-style-type: none">• Performed research and development in robot planning approaches, directly addressing customer needs• Practiced agile development on top of a modern robot system to maintain a physical product• Leveraged statistics on available data to inform relevant design decisions in robot planning	
Laboratory for Robotics and Applied Mechanics (LRAM) <i>Graduate Research Assistant</i>	October 2020 - July 2022
<ul style="list-style-type: none">• Applied geometric mechanics as a generalized framework for modeling of robot locomotion• Used differential geometry to map dynamics between robot shape, position, and other spaces of interest• Abstract-algebraic formulation makes methods invariant to coordinate choice or parametrization	
United States Geological Survey <i>Computer Scientist, Full Stack Developer</i>	May 2019 - October 2020
<ul style="list-style-type: none">• Worked with a small team responsible for maintenance of nationwide earthquake data pipeline (PDL)• Constructed Amazon Web Services infrastructure-as-code for cloud hosted earthquake applications• Created, updated, and maintained production code for web services, server-based and cloud hosted	

Comillas Universidad Pontificia

June 2018 - July 2018

Undergraduate Robotics Researcher

- Use and integration of current robotics technologies, including: ABB arm robots, programmable logic controllers, image recognition cameras, and auxiliary systems (conveyor belts, pneumatics, etc)
- Developed teaching software and documentation for use in graduate robotics classes

iD Tech Camps

June 2017 - July 2017

Lead Programming Instructor

- Taught week-long high school courses on C++, Java, and Python, with special topics like Cryptography
- Created lesson plans, teaching material, assignments, and projects to improve on existing resources
- Mentored new instructors, providing resources and guidance for improvement where necessary

iD Tech Camps

June 2016 - July 2016

Programming Instructor

- Taught week-long courses for all ages on topics such as C++, Java, Python, and Scratch
- Leveraged and expanded on provided teaching material to improve the learning experience of students
- Collaborated with other instructors to provide rich exposure to several subjects

TECHNICAL PROJECTS

Manipulator Path Planning Under Uncertainty

June 2022

Oregon State University

- Cast actuator covariance as a cost metric in the joint space
- Used Newton-Rhapson inverse kinematics to map path coordinates into joint coordinates
- Computed weighted distances using covariance matrix to act as a heuristic for path planning

Lagrangian Dynamics of a Series Elastic Manipulator

March 2022

Oregon State University

- Used geometric mechanics to define manipulator kinematics and derive Lagrangian equation of motion
- Modeled actuators with series springs for compliance and vibratory characteristics
- Simulation in MATLAB revealed that basic P/D control modified the spring constant and damping

3D Rotational Coordinate Optimization

January 2022

Oregon State University

- Derived and programmed finite-element optimization of rotational frame for kinematic, drag-dominated, and inertia-dominated mobile robot systems using robot dynamics as an objective function
- Chosen frame minimizes perturbation of orientation under changes in robot configuration

Visualization of Highly-Dimensional Robot Shape Spaces

December 2021

Oregon State University

- Explored methods of visualizing shape/config spaces in up to three dimensions
- Further developed projections of functions on higher-dimensional spaces down to a subset of the space
- Some effort to make optimal choices of lower-dimensional spaces for useful visualizations of dynamics

Computer Vision Game Development

November 2021

Personal Project

- Uses OpenCV to draw bounding boxes on objects in 2D drawings and save them as separate assets
- Written as a more natural level design workflow, allowing artists to draw levels as a design tool

- Exploration of the plain, fast, and discrete-time Fourier transforms with respect to audio
- Transformed waves from the amplitude space to the frequency space for different kinds of compression
- Used Mel scaling in frequency domain to prioritize frequencies based on the human ear

PUBLICATIONS

Yanhao Yang, **Capprin Bass**, and Ross L Hatton. “Towards geometric motion planning for high-dimensional systems: gait-based coordinate optimization and local metrics”. In: *2024 IEEE International Conference on Robotics and Automation (ICRA)*. IEEE. 2024, pp. 18494–18500.

Bill Fan, Farhan Rozaidi, **Capprin Bass**, Gina Olson, Melinda Malley, and Ross L Hatton. “Linear kinematics for general constant curvature and torsion manipulators”. In: *2023 IEEE International Conference on Soft Robotics (RoboSoft)*. IEEE. 2023, pp. 1–7.

Capprin Bass. “Geometric Optimization Methods for Mobile Systems”. MS Thesis. Oregon State University, 2022.

Capprin Bass, Suresh Ramasamy, and Ross L. Hatton. “Characterizing Error in Noncommutative Geometric Gait Analysis”. In: *2022 International Conference on Robotics and Automation (ICRA)*. 2022, pp. 9845–9851. DOI: 10.1109/ICRA46639.2022.9812130.

Jinwoo Choi, **Capprin Bass**, and Ross L. Hatton. “Optimal Gait Families using Lagrange Multiplier Method”. In: *2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2022, pp. 8873–8878. DOI: 10.1109/IROS47612.2022.9981871.

TEACHING

LRAM Reading Group

Spring 2021 - Spring 2022

*Administrator**Oregon State University*

- Started reading group to study and discuss geometric mechanics text and publications across universities
- Chose publications or book chapters, led discussion at meetings, and taught others about content

Introduction to Robotics II

Winter 2022

*Teaching Assistant**Oregon State University*

- One-on-one instruction and assistance with theory, programming, and hardware for embedded robots
- Course administration, lesson and lab planning, and update of syllabus and manual where necessary

iD Tech Camps

2016 - 2017

Instructor, Lead Instructor

- Two summers spent teaching programming courses for teens based off of my own teaching material
- Applied, week-long learning environment, with first days spent on topics and last days on projects

PRESENTATIONS

Defense: Geometric Optimization Methods for Mobile Systems

June 2022

Oregon State University

- Defense of masters thesis work, including context/background, contributions, applications, and Q&A

Characterizing Error in Noncommutative Geometric Gait Analysis

May 2022

International Conference for Robotics and Automation (ICRA)

- Presented accepted conference paper at ICRA 2022, including additional visualizations

TECHNICAL SKILLS

Languages	MATLAB, Python, C++, R, Java, SQL, PhP, JavaScript, Node, Bash
Mathematics	Abstract Algebra, Differential Geometry, Finite Element Analysis, Optimization, Multivariate Analysis, Stochastic Models, Statistical Analysis
Mechanics	Lagrangian and Newtonian Mechanics, Optimal Control, Kinematics, Dynamics
Technologies	ROS, OpenCV, PyTorch, TensorFlow, Docker, Kubernetes, boto3, Neo4j

REFERENCES

Available on request.