

JONATHAN M. BOSNICH

jbosnich@luc.edu ~ jmbosnich.github.io ~ 720-684-9059

EDUCATION

Northwestern University

Evanston, IL

M.S. in Mechanical Engineering, *control and robotics emphasis*

2021 - 2024

Thesis: *Increasing Robustness in Koopman-Based Feedback Stabilization*

Advisor: Todd Murphey

University of Colorado, Boulder

Boulder, CO

B.S. in Mechanical Engineering, *Summa Cum Laude*

2016 - 2020

B.A. in Mathematics, *With Distinction*

2016 - 2020

Coursework

Topology, Real Analysis, Abstract Algebra, Applied Dynamical Systems, Data-Driven Dynamical Systems, Non-linear Optimization, Distributed Optimization, Linear Systems, Stochastic Processes, Active Robot Learning

Programming

Python, MATLAB, Julia, ROS

RESEARCH EXPERIENCE

Interactive & Emergent Autonomy Lab (Northwestern University)

Evanston, IL

Graduate Research Assistant

2021 - 2024

Advisor: Todd Murphey

- Applied Koopman operator theory to compute data-driven stabilizing control that accounts for model error
- Extended the Koopman-based modeling algorithm ResDMD to nonlinear systems with affine control input
- Derived error bounds on each eigenvalue of the model w.r.t. the true system using this algorithm
- Formulated and algorithmically solved finding min-norm stabilizing control gains for discrete linear systems
- Combined last 3 items to derive controller that pushes model eigenvalues into unit disk w/ error margin

Bio-Inspired Perception and Robotics Lab (University of Colorado)

Boulder, CO

Undergraduate Research Assistant

2018 - 2020

Advisor: J. Sean Humbert

- Extracted state information from a system of distributed sensors by projecting data onto basis functions
- Developed a data-driven method for choosing optimal basis functions by solving integral operator equations
- Used a Galerkin approximation of the singular value expansion to solve integral operator equations
- Investigated analytic and data-driven methods for modeling and controlling an array of soft actuators

Mathematics Department (University of Colorado)

Boulder, CO

Independent Research in Lie Theory

Spring 2020

Advisor: Keith Kearnes

- Worked on the unsolved classification of 10-dimensional simple Lie algebras over the two-element field
- Used the adjoint representation and spectral graph theory to study the only known Lie algebra of this type
- Formulated and programmed criteria for admissible Lie algebras, reducing 2048 possibilities to at most 85

Collective Dynamics and Control Lab (University of Maryland)

College Park, MD

Research Intern, Bio-Inspired Robotics REU

Summer 2019

Advisor: Derek Paley

- Created a soft-robotic gripper that adapts the force it applies to an object via sensory feedback control
- Implemented PID control law in MATLAB, fabricated the soft gripper, and integrated the system
- Delivered final presentation to the REU cohort, lab members, and PIs, and was awarded best presentation

Mathematics Department (University of Colorado)

Research Intern, Mathematics REU

Advisor: Professor Nathaniel Thiem

Boulder, CO

Summer 2018

- Sought an algebraic relationship relating the partitions of an integer n and of a set with n elements
- Employed techniques from algebraic combinatorics and graph theory to search for this relationship

TEACHING EXPERIENCE

Loyola University

Chicago, IL

Math Instructor

Fall 2024 - Present

- Teaching two sections of Precalculus II (MATH 118): created syllabus, wrote exams, graded, etc.
- Working on applying Koopman operator theory to set-valued dynamics with Rafal Goebel (informally)

Mechanical Engineering 314 - Machine Dynamics, Northwestern University

Evanston, IL

Teaching Assistant

Spring 2023 & 2024

- Taught total of 26 lectures, and received high praise from the students and instructor (Todd Murphey)
- Topics I covered: Euler-Lagrange equations, constraints, external forces, Noether's theorem, impacts

Math Academic Resource Center, University of Colorado

Boulder, CO

Tutor

2018 - 2020

Applied Mathematics Department, University of Colorado

Boulder, CO

Learning Assistant for Calculus I & II

2017 - 2018

TEAMS Elementary School Engineering Program

Longmont, CO

Group Leader

2015 - 2017

ENGINEERING EXPERIENCE

Spectra Logic Corporation

Boulder, CO

Systems Engineer Intern

2020 - 2021

- Wrote a Python program that queried and analyzed CAN communication metrics stored in a SQL database
- Identified performance degradation by visualizing data from different sources in a single multi-plot chart
- Conducted tests, collected data, and performed statistical analysis to investigate robot positioning issues

Mechanical Engineering Capstone Project

Boulder, CO

Systems Engineer

2019 - 2020

Client: National Oceanic and Atmospheric Administration (NOAA)

- Designed hardware and software for aircraft-mounted atmospheric LiDAR scanner to track wildfires
- Implemented feedback controller in LabVIEW that ensured a steady scan in the presence of aircraft motion

HONORS

Northwestern University

- NSF GRFP Honorable Mention 2021
- Ted Belytschko Fellowship (one of two recipients) 2021
- Walter P. Murphy Fellowship 2021

University of Colorado, Boulder

- Outstanding Undergraduate of the College of Engineering 2020
- Outstanding Undergraduate of the Mechanical Engineering Department 2020
- College of Engineering Dean's list (every semester) 2016 - 2020
- Engineering Honors Program 2016 - 2020
- Esteemed Scholars Program 2016 - 2020
- Phi Beta Kappa (academic fraternity) 2018 - 2020
- Pi Mu Epsilon (math honor society) 2018 - 2020