

# JONATHAN M. BOSNICH

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## EDUCATION

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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  
GPA: 3.69/4.00

**University of Colorado, Boulder** Boulder, CO  
B.S. in Mechanical Engineering, *Summa Cum Laude* 2016 - 2020  
B.A. in Mathematics, *With Distinction* 2016 - 2020  
GPA: 3.91/4.00

### Coursework

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

### Programming

Python, MATLAB, Julia, ROS

## RESEARCH EXPERIENCE

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**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 model eigenvalue's distance to a true eigenvalue of the system using this algorithm
- Formulated and algorithmically solved finding min-norm stabilizing control gains for discrete linear systems

**Bio-Inspired Perception and Robotics Lab (University of Colorado)** Boulder, CO  
Undergraduate Research Assistant 2019 - 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

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### Loyola University Chicago

Chicago, IL

Mathematics Instructor

Fall 2024 - Present

- Teaching two sections of Precalculus II, covering exponential, logarithmic, and trigonometric functions
- Applying Koopman operator theory to model and control set-valued discrete dynamics with Rafal Goebel

### 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 for Precalculus through Calculus III

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

2016 - 2017

## PROFESSIONAL EXPERIENCE

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### Spectra Logic Corporation

Boulder, CO

Systems Engineer Intern

2020 - 2021

- Wrote Python program that queried and analyzed CAN communication metrics stored in an 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

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### 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