# JONATHAN M. BOSNICH

Chicago, IL ∼ jbosnich@u.northwestern.edu ∼ 720-684-9059

## EDUCATION

**Northwestern University**                                    Evanston, IL
M.S. in Mechanical Engineering, *control and robotics emphasis*                    2021 - 2024
Thesis: On Stabilization of Nonlinear Systems Using Koopman Operators
Advisor: Professor Todd Murphey
GPA: 3.63/4.00

**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**
(*Theoretical Math*) Point-Set Topology, Real Analysis, Abstract Algebra, Lie Theory (Independent Study)
(*Engineering Math*) Nonlinear Optimization*, Data-Driven Dynamical Systems*, Applied Dynamical Systems*,
Optimal Control for Learning*, Linear Systems*, Engineering (Lagrangian) Mechanics*, Numerical Analysis
(*graduate course)

**Programming**
Python, MATLAB, Julia, LabVIEW, ROS

## PAPERS IN PREPARATION

J. M. Bosnich, G. Mamakoukas, T. D. Murphey, "Data-Driven Minimal-Norm Stabilization of Nonlinear Systems
Using the Koopman Operator"

## RESEARCH EXPERIENCE

**Interactive & Emergent Autonomy Lab, Northwestern University**                  Evanston, IL
Graduate Research Assistant                                              2021 - Present
Advisor: Professor Todd Murphey
- Developing a data-driven minimal-control-effort stabilizing feedback controller for nonlinear systems
- Used the Koopman operator framework to learn an approximately linear representation
- Derived explicit error bounds on learned eigenvalues by extending ResDMD to include control systems
- Applied feedback to the (LTI) Koopman dynamics that guarantees minimal-norm feedback gains via matrix nearness optimization

**Bio-Inspired Perception and Robotics Lab, University of Colorado**               Boulder, CO
Undergraduate Research Assistant                                          2018 - 2020
Advisor: Professor 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

**Mathematics Department, University of Colorado**                            Boulder, CO
Independent Research in Lie Theory                                        Spring 2020
Advisor: Professor 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 new 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: Professor 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**  Boulder, CO
Research Intern, Mathematics REU  Summer 2018
Advisor: Professor Nathaniel Thiem
- 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

## 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

## TEACHING EXPERIENCE

**Mechanical Engineering 314 - Machine Dynamics, Northwestern University**  Evanston, IL
Graduate Teaching Assistant  Spring 2023
Grader  Fall 2023
- Taught 11 lectures in the Spring and 4 lectures in the Fall, and did very well at this
- Raving course evaluations, with an emphasis on my approachability and helpfulness during OH

**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

## HONORS

| | |
|---|---|
| Ted Belytschko Fellowship (one of two recipients; Northwestern Mechanical Engineering) | 2021 |
| Walter P. Murphy Fellowship (Northwestern Mechanical Engineering) | 2021 |
| NSF GRFP Honorable Mention | 2021 |
| Outstanding Undergraduate of the College of Engineering (CU, Boulder) | 2020 |
| Outstanding Undergraduate of the Mechanical Engineering Department (CU, Boulder) | 2020 |
| College of Engineering Dean's list (CU, Boulder) | 2016 - 2020 |
| Engineering Honors Program (CU, Boulder) | 2016 - 2020 |
| Phi Beta Kappa (academic fraternity; CU, Boulder) | 2018 - 2020 |
| Pi Mu Epsilon (math honor society; CU, Boulder) | 2018 - 2020 |
| Valedictorian (Berthoud High School) | 2016 |