	G.G. Brown Building, Office 3480 2350 Hayward St, Ann Arbor, MI 48109	bruderd@umich.edu www.freelaboratory.org
Education	<b>University of Michigan</b> Ph.D., Mechanical Engineering, 2020 M.S., Mechanical Engineering, 2020 Fields: Robotics and Control	
	<b>Harvard University</b> B.S., Engineering Sciences, 2013 Honors: Magna Cum Laude	
Research	Mechanical Engineering Dept, University of Michigan-Ann Arbor Assistant Professor, 2023-present	
	School of Engineering and Applied Sciences, Harvard University Postdoctoral Fellow, 2020-2023	
	Mechanical Engineering Dept, University of Michigan-Ann Arbor Graduate Student Researcher, 2015-2020 Dissertation: Towards a Universal Modeling and Control Framework for Soft Robots	
	<b>School of Engineering and Applied Sciences, Harvard University</b> Undergraduate Student Researcher, 2011 Project: Design of mitral valve repair surgical device	
Teaching	<b>Mechanical Engineering Dept, University of Michigan</b> Professor, Robot Kinematics and Dynamics, 2024 Professor, Modeling, Analysis, & Control of Dynamic Systems, 2023 Graduate Student Instructor, Robot Kinematics and Dynamics, 2017 Graduate Student Instructor, Designs in Nature and Engineering, 2016	
	Jalen Rose Leadership Academy, Promise Schools Detroit Full-time Mathematics Teacher, Algebra and Geometry, 2013-2015	
	<b>Harvard University</b> Design Specialist, Capstone Design Course, 2012-2013 Teaching Assistant, Lab Electronics: Analog and Digital Circuit Design, 2011 Course Assistant, Calculus, Series, and Differential Equations, 2009-2010 Course Assistant, Functions and Calculus, 2009	
Awards and Fellowships	<b>NSF Graduate Research Fellowship</b> National Science Foundation, 2017-2020	
	Richard and Eleanor Towner Prize for Outstanding Ph.D. Research University of Michigan, 2019	
	<b>NextProf Nexus Travel Grant</b> Georgia Institute of Technology, 2019	
	Best Systems Paper Finalist, Best Student Paper Finalist Robotics: Science and Systems Conference, 2019	
	<b>RSS Pioneers Travel Grant</b> Robotics: Science and Systems Conference, 2019	
	Honorable Mention, Ford Foundation Fellowship National Academies of Sciences, Engineering, and Medicine, 2017	

### Publications Journal Papers

- [J1] **D. Bruder**, D. Bombara, and R. J. Wood. A koopman-based residual modeling approach for the control of a soft robot arm. *The International Journal of Robotics Research*, 2024. Accepted
- [J2] T. Dai, N. Velimirović, P. Zalles, D. Bruder, K. Buffinton, R. B. Gillespie, and C. D. Remy. Modeling and experimental validation of high-flow fluid-driven membrane valves for hyperactuated soft robots. Advanced Intelligent Systems, 2024. doi: https://doi.org/10. 1002/aisy.202300864
- [J3] C. D. Remy, Z. Brei, D. Bruder, J. Remy, K. Buffinton, and R. B. Gillespie. The "fluid jacobian": Modeling force-motion relationships in fluid-driven soft robots. *The International Journal* of Robotics Research, page 02783649231210592, 2023
- [J4] D. Bruder, M. A. Graule, C. B. Teeple, and R. J. Wood. Increasing the payload capacity of soft robot arms by localized stiffening. *Science Robotics*, 8(81):eadf9001, 2023
- [J5] **D. Bruder** and R. Wood. The chain-link actuator: Exploiting the bending stiffness of mckibben artificial muscles to achieve larger contraction ratios. *IEEE Robotics and Automation Letters*, 2021
- [J6] D. Bruder, X. Fu, R. B. Gillespie, C. D. Remy, and R. Vasudevan. Koopman-based control of a soft continuum manipulator under variable loading conditions. *IEEE Robotics and Automation Letters*, 6(4):6852–6859, 2021
- [J7] D. Bruder, X. Fu, and R. Vasudevan. Advantages of bilinear koopman realizations for the modeling and control of systems with unknown dynamics. *IEEE Robotics and Automation Letters*, 6(3):4369–4376, 2021. doi: 10.1109/LRA.2021.3068117
- [J8] D. Bruder, X. Fu, R. B. Gillespie, C. D. Remy, and R. Vasudevan. Data-driven control of soft robots using koopman operator theory. *IEEE Transactions on Robotics*, pages 1–14, 2020. doi: 10.1109/TRO.2020.3038693
- [J9] D. Bruder, A. Sedal, R. Vasudevan, and C. D. Remy. Force generation by parallel combinations of fiber-reinforced fluid-driven actuators. *IEEE Robotics and Automation Letters*, 3 (4):3999–4006, Oct 2018. ISSN 2377-3766. doi: 10.1109/LRA.2018.2859441
- [J10] A. Sedal, D. Bruder, J. Bishop-Moser, R. Vasudevan, and S. Kota. A continuum model for fiber-reinforced soft robot actuators. *Journal of Mechanisms and Robotics*, 10(2):024501, 2018

### **Conference Papers**

- [C1] S. Dahdah, J. R. Forbes, R. Vasudevan, and D. Bruder. Identification and control of soft robots using the koopman operator. 40th Anniversary of the IEEE Conference on Robotics and Automation (ICRA@40), 2024. Accepted
- [C2] R. Zuo, M. Mehta, D. H. Han, and D. Bruder. Embedded valves for distributed control of soft pneumatic actuators. 2024 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2024. Accepted
- [C3] Y. J. Martin, D. Bruder, and R. J. Wood. A proprioceptive method for soft robots using inertial measurement units. In 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pages 9379–9384. IEEE, 2022

- [C4] S. M. Danforth, M. Kohler, D. Bruder, A. R. D. Rabosky, S. Kota, R. Vasudevan, and T. Y. Moore. Emulating duration and curvature of coral snake anti-predator thrashing behaviors using a soft-robotic platform. In 2020 IEEE International Conference on Robotics and Automation (ICRA), pages 5068–5074. IEEE, 2020
- [C5] D. Bruder, B. Gillespie, C. D. Remy, and R. Vasudevan. Modeling and control of soft robots using the koopman operator and model predictive control. In *Proceedings of Robotics: Science and Systems*, FreiburgimBreisgau, Germany, June 2019a. doi: 10.15607/RSS. 2019.XV.060
- [C6] D. Bruder, C. D. Remy, and R. Vasudevan. Nonlinear system identification of soft robot dynamics using koopman operator theory. In *Robotics and Automation (ICRA), 2019 IEEE International Conference on.* IEEE, 2019b
- [C7] D. Bruder, A. Sedal, J. Bishop-Moser, S. Kota, and R. Vasudevan. Model based control of fiber reinforced elastofluidic enclosures. In *Robotics and Automation (ICRA), 2017 IEEE International Conference on*, pages 5539–5544. IEEE, 2017
- [C8] A. Sedal, D. Bruder, J. Bishop-Moser, R. Vasudevan, and S. Kota. A constitutive model for torsional loads on fluid-driven soft robots. In ASME 2017 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, pages V05AT08A016-V05AT08A016. American Society of Mechanical Engineers, 2017

### **Invited Presentations**

- [P1] D. Bruder. Leveraging Data and the Koopman Operator to Make Soft Robots More Capable. Controls Seminar, University of Michigan. 2024. https://www.youtube.com/ watch?v=mXWjCTS8tDA
- [P2] D. Bruder. Leveraging Data and the Koopman Operator to Control Soft Robots. Society of Engineering Science (SES) Technical Meeting, University of Minnesota. 2023
- [P3] D. Bruder. Making Soft Robotics Less Hard: Towards a Unified Modeling, Design, and Control Framework. Center for Information and Systems Engineering (CISE) Seminar, Boston University. 2023
- [P4] D. Bruder. Making Soft Robotics Less Hard: Towards a Unified Modeling, Design, and Control Framework. AI in Robotics Seminar, University of Toronto. 2022. https://www. youtube.com/watch?v=N-xpv3Iyf6k&t=1194s
- [P5] D. Bruder. Making Soft Robotics Less Hard: Towards a Unified Modeling, Design, and Control Framework. *Cornell Robotics Seminar, Cornell University*. 2022
- [P6] D. Bruder. Making Soft Robotics Less Hard: Towards a Unified Modeling, Design, and Control Framework. Prof. Shankar Sastry's Semiautonomous Seminar, University of California, Berkeley. 2022
- [P7] D. Bruder. Towards a Universal Modeling and Control Framework for Soft Robots. Illinois Robotics Seminar, University of Illinois at Urbana-Champaign. 2021
- [P8] D. Bruder. Leveraging Data and the Koopman Operator to Build Control-oriented Models of Soft Robots. Modeling Soft Robots: A Discussion on Capabilites and Limitations of Numerous Techniques. 2020

# Service & **Reviewer**

Outreach T-RO, RA-L, T-MECH, ICRA, IROS, RoboSoft, Soft Robotics, Mechatronics, Automatica, IJRR

### **REACT Workshop for K-12 Educators** Robotics Track Lead, 2020

Robotics Activity Coordinator, 2019

# **RSS Pioneers**

Program Committee Member, 2020

### FIRST Robotics Competition Mentor, 2015-2018

Press Solutions Science (podcast) Soft Robots for Safe Human Interactions, Sept. 28, 2023

#### **Tech Xplore**

Targeted stiffening yields more efficient soft robot arms, Sept. 5, 2023

### Medium

The robotic snakes that could teach us about animal behavior, Jan. 9, 2021

# How To Do Grad School (podcast)

Daniel Bruder - Teaching, Collaborations, & Getting Started in Research, Sept. 24, 2020

### The Michigan Engineer News Center

Grad student's ventilator design sparks conversations with doctors and engineers, Apr. 17, 2020