

# Andrew P. Sabelhaus

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## EDUCATION

### PH.D. MECHANICAL ENGINEERING

Dissertation title: *Quadruped Robots with Tensegrity Spines*

Dissertation Committee: Alice M. Agogino (Chair), Andrew Packard, Claire Tomlin, Murat Arcak

University of California, Berkeley

August 2019

### M.S. MECHANICAL ENGINEERING

Thesis: *Mechanism and Sensor Design for SUPERball, a Cable-Driven Tensegrity Robot*

University of California, Berkeley

Dec. 2014

### B.S. MECHANICAL ENGINEERING

Minor in Computer Science

University of Maryland, College Park

May 2012

## PROFESSIONAL EXPERIENCE

### Carnegie Mellon University

Dept. of Mechanical Engineering

Soft Machines Lab (PI: Carmel Majidi)

Postdoctoral Research Associate

2019 - Present

Pittsburgh, PA

### NASA Ames Research Center

Intelligent Systems Division

Intelligent Robotics Group and Robust Software Engineering

Visiting Technologist

2015 - 2019

Moffet Field, CA

### University of California, Berkeley

Dept. of Mechanical Engineering

Berkeley Emergent Space Tensegrities Lab (PI: Alice Agogino)

Graduate Student Researcher

2012-2019

Berkeley, CA

## GRANTS + FUNDING

4. **NASA Space Technology Research Fellowship.** 4 years. Title: *Trajectory Tracking in Nonlinear, High-Order, Underactuated Robotic Systems.* 2015-2019.
3. **CITRIS Tech for Social Good Development Grant.** Block grant. Title: *Laika, The Robot Transport for Disaster Relief.* University of California Center for Information Technology Research in the Interest of Society (CITRIS), 2018.
2. **Markowski-Leach Scholarship Award.** 4 years (re-awarded after two.) Awarded to LGBTQ individuals at San Francisco Bay Area institutions who "are likely to make a substantial contribution to society." 2013-2014, 2016-2018. Currently the only repeated awardee on record. Featured on ABC News: <https://abc7news.com/5460516/>
1. **NSF Graduate Research Fellowship.** National Science Foundation. 2012-2015

*\*In addition to these independent awards and grants, Drew has assisted in writing three large multiple-PI proposals (NSF), one large single-PI proposal (NASA), and two small single-PI proposals.*

## PEER-REVIEWED PUBLICATIONS

11. **Model-Predictive Control with Inverse Statics Optimization for Tensegrity Spine Robots.** Sabelhaus, A.P.; Zhao, H.; Zhu, E.; Agogino, A.K.; Agogino, A.M.; *IEEE Transactions on Control System Technology*, To Appear, 2020. Preprint available, arXiv:1806.08868
10. **Modular Elastic Lattice Platform for Rapid Prototyping of Tensegrity Robots.** Chen, L-H.; Daly, M.C.; Sabelhaus, A.P.; Janse van Vuuren, L.A.; Garnier, H.J.; Verdugo, M.I.; Tang, E.; Spangenberg, C.U.; Ghahani, F.; Agogino, A.K.; Agogino, A.M.; *ASME International Design Engineering Technical Conferences (IDETC) / 41st Mechanisms and Robotics Conference*, Aug 2017.

9. **Model-Predictive Control of a Flexible Spine Robot.** Sabelhaus, A.P.; Akella, A.K.; Ahmad, Z.A.; SunSpiral, V.; *American Control Conference (ACC), IEEE, May 2017.*
8. **DNA-Structured Linear Actuators.** Zampaglione, K.; Sabelhaus, A.P.; Chen, L.; Agogino, A.M.; Agogino, A.K.; *ASME International Design Engineering Technical Conferences (IDETC) / 40th Mechanisms and Robotics Conference, Aug 2016.*
7. **Mechanism Design and Simulation of the ULTRA Spine, a Tensegrity Robot.** Sabelhaus, A.P.; Ji, H.; Hylton, P.; Madaan, Y.; Yang, C.; Friesen, J.; SunSpiral, V.; Agogino, A.M.; *ASME International Design Engineering Technical Conferences (IDETC) / 39th Mechanisms and Robotics Conference, Aug 2015.*
6. **System Design and Locomotion of SUPERball, an Untethered Tensegrity Robot.** Sabelhaus, A.P.; Bruce, J.; Caluwaerts, K.; Manovi, P.; Fallah Firoozi, R.; Dobi, S.; Agogino, A.M.; SunSpiral, V.; *IEEE International Conference on Robotics and Automation (ICRA), May 2015.*
5. **Design and Control of Compliant Tensegrity Robots through Simulation and Hardware Validation.** Caluwaerts, K.; Despraz, J.; Iscen, A.; Sabelhaus, A.P.; Bruce, J.; Schrauwen, B.; SunSpiral, V.; *Journal of the Royal Society Interface, Sept. 2014.*
4. **Hardware Design and Testing of SUPERball, a Modular Tensegrity Robot.** Sabelhaus, A.P.; Bruce, J.; Caluwaerts, K.; Chen, Y.; Lu, D.; Liu, Y.; Agogino, A.K.; SunSpiral, V.; Agogino, A.M.; *The 6th World Conference on Structural Control and Monitoring (6WCSCM), July 2014*
3. **SUPERball: Exploring Tensegrities for Planetary Probes.** Bruce, J.; Sabelhaus, A.P.; Chen, Y.; Lu, D.; Morse, K.; Milam, S.; Caluwaerts, K.; Agogino, A.M.; SunSpiral, V.; *12th International Symposium on Artificial Intelligence, Robotics, and Automation in Space (i-SAIRAS), June 2014*
2. **Design and Evolution of a Modular Tensegrity Robot Platform.** Bruce, J.; Caluwaerts, K.; Iscen, A.; Sabelhaus, A.P.; SunSpiral, V.; *IEEE International Conference on Robotics and Automation (ICRA), May 2014*
1. **TinyTeRP: A Tiny Terrestrial Robotic Platform with Modular Sensing.** Sabelhaus, A.P.; Mirsky, D.; Hill, L.M.; Bergbreiter, S.; *IEEE International Conference on Robotics and Automation (ICRA), May 2013*

## PRE-PRINTS + PUBLICATIONS UNDER REVIEW

2. **Inverse Statics Optimization for Compound Tensegrity Robots.** Sabelhaus, A.P.; Li, A.H.; Sover, K.A.; Madden, J.; Barkan, A.; Agogino, A.K.; Agogino, A.M.; *Under Review (Journal.)* Preprint available, arXiv:1808.08252
1. **Design, Simulation, and Testing of a Flexible Actuated Spine for Quadruped Robots.** Sabelhaus, A.P.; Janse van Vuuren, L.A.; Joshi, A.; Zhu, E.; Garnier, H.J.; Sover, K.A.; Navarro, J.; Agogino, A.K.; SunSpiral, V.; Agogino, A.M.; *Preprint Only.* Available, arXiv:1804.06527

## IN-PREPARATION PUBLICATIONS

1. **Twisted Helix Linear Actuators.** Sabelhaus, A.P.; Tang, E.; Zampaglione, K.; Chen, L-H.; Agogino, A.M.

## PATENTS

2. **DNA Structured Linear Actuator.** Agogino, A.; Zampaglione, K.; Chen, L-H.; Sabelhaus, A.; US Patent Application Number: PCT/US2016/032899. Under Review.
1. **Elastic Lattices for Design of Tensegrity Structures and Robots.** Chen, L-H.; Agogino, A.; Daly, M.; Sabelhaus, A.P.; Agogino, A.K.; US Patent Application Number forthcoming, WIPO Publication Number: WO 2018/161089. Under Review.

## PRESENTATIONS + POSTERS

\*Asterisk indicates an invited talk or invited presentation.

9. \* **Laika and Belka: Walking Robots with Flexible Spines.** Workshop on Autonomy for Future NASA Science Missions, Oct. 2018. Presentation and poster, by invitation.
8. \* **Laika, The Four-Legged Robot with a Flexible Spine.** NASA Space Tehnology Day-On-The-Hill, Nov. 2017. Poster, by invitation, presented to the United States Congress / U.S. House of Representatives.

7. **Laika, The Quadruped Robot with a Tensegrity Spine.** Bay Area Robotics Symposium (BARS), Oct. 2017. Presentation and Poster.
6. **UC Berkeley Robotics for Disaster Relief.** Field Innovation Team Bootcamp 5.0, March 2017. Presentation.
5. **DNA-Structured Linear Actuators.** SKTA Innopartners IP Redux Event, Apr 2016. Presentation.
4. **ULTRA Spine Project.** Bay Area Robotics Symposium (BARS), Oct 2015. Presentation and Poster.
3. **\* Robotics, Mechatronics, and Intelligent Systems.** Osher Lifelong Learning Institute, Feb 2014. Invited Talk.
2. **Mechatronic Design of Tensegrity Robotic Systems for Dynamic Locomotion.** NASA Ames Research Center Autonomous Systems Lab Poster Symposium, Aug 2013. Poster.
1. **TinyTeRP: A Tiny Terrestrial Robotic Platform.** International Symposium on Distributed Autonomous Robotic Systems (DARS), Nov 2012. Poster.

## REVIEWER FOR JOURNALS AND CONFERENCES

Drew has served as a reviewer for the following journals and conferences:

- IEEE Transactions on Control System Technology (T-CST), 2018
- Journal of Open-Source Software (JOSS), 2018-2019
- IEEE Robotics and Automation Magazine (RA-M), 2018
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2018
- IEEE Robotics and Automation Letters (RA-L), 2017-2019
- IEEE International Conference on Robotics and Automation (ICRA), 2017, 2019
- American Control Conference (ACC), 2017-2018.
- ASME International Design Engineering Technical Conference (IDETC), 2016-2017.
- International Journal of Space Structures, 2017.
- IEEE Conference on Control Technology and Applications (CCTA), 2017.

## TEACHING

2. **Outstanding Graduate Student Instructor (GSI) Award.** University of California, Berkeley, 2019
1. **Graduate Student Instructor (GSI).** University of California, Berkeley
  - Jan. - May, 2018 | Mech. Eng. 135/235, Design of Microprocessor-Based Mechanical Systems
    - Created course content for lab and discussion sections, delivered stand-in lectures, assisted students with projects.
    - Overall Course Evaluations: *Total Effectiveness of Instructor: 4.7/5.0 (Undergrad.), 4.88/5.0 (Grad.)*
    - Teaching evaluations were above department averages in every metric.

## DIVERSITY + OUTREACH + SERVICE

- **ASME Diversity and Inclusion Strategic Committee (DISC), Advisor.** American Society of Mechanical Engineers (ASME). Revised ASME policy P-15.11, PS16-02, and Statement on Diversity and Inclusion to include protections for transgender ASME members. June 2016 - 2018.
- **ASEE LGBTQ Virtual Community of Practice, Member.** American Society for Engineering Education. Organizing for LGBTQ safe space workshops in engineering. March 2018 - Ongoing.
- **Graduate Student Search Committee, Member.** UC Berkeley Mechanical Engineering Faculty Searches. Led committee in interviewing and recommending faculty candidates. Spring 2017 - Spring 2018.
- **Graduate Peer Advisor.** UC Berkeley Mechanical Engineering - Equity, Diversity, and Inclusion Initiative. Created and assessed various programs serving under-represented students. Aug 2014 - May 2015.
- **Coordinator, Chapter Leadership Programs.** Out in Science, Technology, Engineering, and Mathematics (oSTEM) Incorporated. Led team in developing resources for LGBTQ student leaders. July 2012 - April 2013.

*\*In addition to these formal programs, Drew has organized many lab tours and smaller outreach events, and has volunteered with programs that recruit under-represented students to UC Berkeley.*

## PROFESSIONAL DEVELOPMENT

- **Summer Institute for Preparing Future Faculty.** A professional development program to prepare students for academic careers. University of California, Berkeley. Completed / certified in June 2018.
- **Question, Persuade, Refer: Gatekeeper.** Trained for response to mental health crises in students. University of California Berkeley Health Center, March 2018.
- **Teaching of Mechanical Engineering at the University Level.** UC Berkeley Mechanical Engineering Department. Course on teaching pedagogy in engineering. Spring 2018.
- **Workshops on Teaching and Learning.** UC Berkeley GSI Teaching and Resource Center / Academic Innovation Studio. Attended workshops on teaching pedagogy, including 'How Students Learn' and 'Teaming With Diversity.' Fall 2017 - Spring 2018.
- **Teaching Conference for Graduate Student Instructors.** UC Berkeley GSI Teaching and Resource Center. Introductory pedagogy for first-time Graduate Student Instructors. Attended in Jan. 2018.