

SAMUEL A. BURDEN

Curriculum Vitae

Electrical & Computer Engineering
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EDUCATIONAL HISTORY

University of California, Berkeley, CA
PhD, Electrical Engineering and Computer Sciences
December 2014
A Hybrid Dynamical Systems Theory for Legged Locomotion
University of Washington, Seattle, WA
BS, Cum Laude, with Honors, Electrical Engineering
June 2008

EMPLOYMENT HISTORY

University of Washington
Seattle, WA, USA
Assistant Professor, September 2015--present

University of California
Berkeley, CA, USA
Postdoctoral Scholar, October 2014--September 2015

University of California
Berkeley, CA, USA
Graduate Student Researcher, August 2008--October 2014

University of Washington
Seattle, WA, USA
Undergraduate Student Researcher, August 2004--August 2008

AWARDS AND HONORS

- College of Engineering Junior Faculty Award, 2021, University of Washington, Seattle
- CAREER Award, 2021, National Science Foundation
- Young Investigator Program, 2016, Army Research Office
- CISE Research Initiation Initiative, 2016, National Science Foundation
- Early Faculty Fellow, 2015--2020, Washington Research Foundation
- Outstanding Graduate Student Instructor Award, Fa 2011, University of California, Berkeley
- Graduate Research Fellowship, 2010, National Science Foundation
- Mathematical Contest in Modeling Outstanding Winner and MAA Prize, 2007, Consortium for Mathematics and Its Applications

AFFILIATIONS AND OTHER APPOINTMENTS

None to report.

PUBLICATIONS

Superscript key: “grad” indicates my PhD and/or MS student researchers; “undergrad” indicates my undergraduate researchers; “postdoc” indicates my postdoctoral researchers; “tech” indicates my research engineers and/or scientists

Refereed archival publications (journals and highly-selective conferences)

1. Yamagami^{grad}, M, Imsdahl, S, Lindgren, K, Bellatin^{undergrad}, Nhan O N, Burden S A, Pradhan, S, and Kelly, V E. “Effects of virtual reality environments on overground walking in people with parkinson disease and freezing of gait.” *Disability and Rehabilitation: Assistive Technology* pp. 1--8, Nov. 2020.
2. Rosenberg, M C, Banjanin^{grad}, B S, Burden, S A, and Steele, K M. “Predicting walking response to ankle exoskeletons using data-driven models.” *Journal of the Royal Society: Interface* 17(171):20200487, Oct. 2020.
3. Zhang, J, Pace^{grad}, A M, Burden, S A, and Aravkin, A. “Offline State Estimation for Hybrid Systems via Nonsmooth Variable Projection.” *Automatica* 115 (May): 108871, 2020. (Google Scholar: 2 cites)
4. Yamagami^{grad}, Steele, K M, and Burden, S A. “Decoding intent with control theory: Comparing muscle versus manual interface performance.” *ACM Conference on Human Factors in Computing Systems (CHI)* pp. 1--12, Apr. 2020. (Google Scholar: 2 cites)
5. Banjanin^{grad}, B S and Burden, S A. “Nonsmooth Optimal Value and Policy Functions in Mechanical Systems Subject to Unilateral Constraints.” *IEEE Control Systems Letters (L-CSS)* 4 (2): 506--11, 2019.
6. Chasnov^{grad}, B, Ratliff, L J, Mazumdar, E, and Burden, S A. “Convergence analysis for gradient-based learning in continuous games”. *Conference on Uncertainty in Artificial Intelligence (UAI)*, May 2019. (Google Scholar: 5 cites)

7. De, A, Burden, S A, and Koditschek, D E. “A hybrid dynamical extension of averaging and its application to the analysis of legged gait stability”. *The International Journal of Robotics Research* (IJRR) 37 (2-3): 266–286, 2018. (Google Scholar: 9 cites)
8. Pace^{grad}, A M, Burden, S A. “Piecewise-differentiable trajectory outcomes in mechanical systems subject to unilateral constraints”. *ACM Conference on Hybrid Systems: Computation and Control (HSCC)*, pp. 243--252, Apr. 2017. (Google Scholar: 22 cites)
9. Burden, S A, Sastry, S S, Koditschek, D E, and Revzen, S. “Event-Selected Vector Field Discontinuities Yield Piecewise-Differentiable Flows”. *SIAM Journal on Applied Dynamical Systems* (SIADS) 15 (2): 1227–67, 2016. (Google Scholar: 31 cites)
10. Johnson, A M, Burden, S A, and Koditschek, D E. “A Hybrid Systems Model for Simple Manipulation and Self-Manipulation Systems”. *The International Journal of Robotics Research* (IJRR) 35 (11): 1354–92, 2016. (Google Scholar: 67 cites)
11. Yang, I, Burden, S A, Rajagopal, R, Sastry, S S, and Tomlin, C J. “Approximation Algorithms for Optimization of Combinatorial Dynamical Systems”. *IEEE Transactions on Automatic Control* (TAC) 61 (9): 2644–49, 2016. (Google Scholar: 11 cites)
12. Ratliff, L J, Burden, S A, and Sastry, S S “On the Characterization of Local Nash Equilibria in Continuous Games”. *IEEE Transactions on Automatic Control* (TAC) 61 (8): 2301–7, 2016. (Google Scholar: 73 cites)
13. Burden, S A, Revzen, S and Sastry, S S. “Model reduction near periodic orbits of hybrid dynamical systems”. *IEEE Transactions on Automatic Control* (TAC) 60:2626—2639, 2015. (Google Scholar: 46 cites)
14. Burden, S A, Gonzalez, H, Vasudevan, R, Bajcsy, R and Sastry, S S. “Metritzation and simulation of controlled hybrid systems”. *IEEE Transactions on Automatic Control* (TAC) 60:2307—2320, 2015. (Google Scholar: 32 cites)
15. Revzen, S, Burden, S A, Moore, T Y, Mongeau, J M, and Full, R J. “Instantaneous Kinematic Phase Reflects Neuromechanical Response to Lateral Perturbations of Running Cockroaches”. *Biological Cybernetics* (BiCy) 107 (2): 179–200, 2013. (Google Scholar: 32 cites)
16. Napp, N, Burden, S A, and Klavins, E. “Setpoint Regulation for Stochastically Interacting Robots”. *Autonomous Robots* (ARO) 30: 57–71, 2011. (Google Scholar: 44 cites)

Refereed archival journal publications (under review)

1. Burden, S A and Coogan, S C. “On infinitesimal contraction analysis for hybrid systems”. *IEEE Transactions on Automatic Control* (TAC). (submitted Nov 2018; 1st revision Aug 2019; 2nd revision Jul 2020; conditionally accepted Jan 2021).
2. Yamagami^{grad}, M, Peterson^{undergrad}, L N, Howell^{tech}, D, Roth, D, and Burden, S A. “Effect of handedness on learned controllers and sensorimotor noise during trajectory-tracking”. *IEEE Transactions on Cybernetics* (TCYB). (submitted Jul 2020; 1st revision Jan 2021; 2nd revision Jun 2021)
3. Council, G, Revzen, S, and Burden, S A. “Representing and Computing the B-Derivative of an Event-Selected C^r vector field’s Piecewise-Differentiable flow”. *ASME Journal on Computational Nonlinear Dynamics*. (submitted Feb 2021)

Refereed conference proceedings

1. Madduri^{grad}, M M, Burden, S A, and Orsborn, A L. A Game-Theoretic model for Co-Adaptive Brain-Machine interfaces. IEEE EMBS Conference on Neural Engineering, 2021 (accepted; to appear).
2. Mallik, R, Pace^{grad}, A M, Burden, S A, and Johnson, B. Accurate small-signal discrete-time model of dual active bridge using saltation matrices. IEEE Energy Conversion Congress and Exposition (ECCE), pp. 6312--6317, 2020.
3. Chasnov^{grad}, B J, Calderone, D, Açıkmeşe, B, Burden, S A, and Ratliff, L J. 2020. Stability of Gradient Learning Dynamics in Continuous Games: Scalar Action Spaces. IEEE Conference on Decision and Control (CDC), 3543--48, 2020.
4. Chasnov^{grad}, B, Ratliff, L J, Calderone, D, Mazumdar, E, and Burden, S A. Finite-time convergence of gradient-based learning in continuous games. AAAI-19 Workshop on Reinforcement Learning in Games, Jan. 2019.
5. Chasnov^{grad}, B, Yamagami^{grad}, M, Parsa, B, Ratliff, L J, and Burden, S A. Experiments with sensorimotor games in dynamic human/machine interaction. SPIE Micro- and Nanotechnology Sensors, Systems, and Applications XI, vol. 10982, p. 109822A, 2019.
6. Yamagami^{grad}, M, Howell^{tech}, D, Roth, E, and Burden, S A. Contributions of Feedforward and Feedback Control in a Manual Trajectory-Tracking Task. IFAC Conference on Cyber-Physical-Human Systems 51 (34): 61--66, 2019.
7. Roth, E, Howell^{tech}, D, Beckwith^{undergrad}, C, and Burden, S A. Toward Experimental Validation of a Model for Human Sensorimotor Learning and Control in Teleoperation. SPIE Defense + Security, pg. 101941X, 2017.
8. Pace^{grad}, A M, and Burden, S A. Decoupled Limbs Yield Differentiable Trajectory Outcomes through Intermittent Contact in Locomotion and Manipulation. IEEE International Conference on Robotics and Automation (ICRA), pg. 2261--2266, 2017.
9. Nothwang, W D, McCourt, M J, Robinson^{postdoc}, R M, Burden, S A, and Curtis, J W. The Human Should Be Part of the Control Loop? IEEE Resilience Week (RWS), 214--20, 2016.
10. Robinson^{postdoc}, R M, Scobee, D R R, Burden, S A and Sastry, S S. Dynamic Inverse Models in Human-Cyber-Physical Systems. SPIE Defense + Security, no. 9836-68, 2016.
11. Bestick, A M, Burden, S A, Willits, G, Naikal, N, Sastry, S S and Bajcsy, R. Personalized kinematics for human-robot collaborative manipulation. IEEE International Conference on Intelligent Robots and Systems (IROS), pg. 1037-1044, 2015.
12. Elhamifar, E, Burden, S A and Sastry, S S. Adaptive piecewise--affine inverse modeling of hybrid dynamical systems. IFAC World Congress, pg. 10844-10849, 2014.
13. Ratliff, L J, Burden, S A and Sastry, S S. Genericity and structural stability of non--degenerate differential Nash equilibria. American Control Conference (ACC), pg. 3990-3995, 2014.
14. Yang, I, Burden, S A, Sastry, S S and Tomlin, C J. Infinitesimal interconnection variation in nonlinear networked systems. IEEE Conference on Decision and Control (CDC), pg. 1417-1422, 2013.
15. Ratliff, L J, Burden, S A and Sastry, S S. Characterization and computation of local Nash equilibria in continuous games. Allerton Conference on Communication, Control, and Computing, pg. 917-924, 2013.
16. Burden, S and Sastry, S S. Reduction and identification for hybrid dynamical models of terrestrial locomotion. SPIE Conference on Micro-Nanotechnology Sensors, Systems, and Applications, 87251B, 2013.

17. Burden, S A, Ohlsson, H and Sastry, S S. Parameter identification near periodic orbits of hybrid dynamical systems. IFAC Symposium on System Identification (IFAC SysID), pg. 1197-1202, 2012.
18. Burden, S, Gonzalez, H, Vasudevan, R, Bajcsy, R and Sastry, S S. Numerical integration of hybrid dynamical systems via domain relaxation. IEEE Conference on Decision and Control (CDC), pg. 3958-3965, 2011.
19. Burden, S A, Revzen, S and Sastry, S S. Dimension reduction near periodic orbits of hybrid systems. IEEE Conference on Decision and Control (CDC), pg. 6116-6121, 2011.
20. Hoover, A, Burden, S A, Fu, X, Sastry, S S and Fearing, R. Bio—inspired design and dynamic maneuverability of a minimally actuated six—legged robot. IEEE Conference on Biomedical Robotics and Biomechatronics (BIROB), pg. 869-876, 2010.
21. Napp, N, Burden, S A and Klavins, E. Setpoint regulation for stochastically interacting robots. Robotics: Science and Systems (RSS), p17, 2009.
22. Burden, S A, Clark, J, Weingarten, J, Komsuoglu, H and Koditschek, D E. Heterogeneous leg stiffness and roll in dynamic running. IEEE International Conference on Robotics and Automation (ICRA), pg. 4645-4652, 2007.
23. Burden, S A, Dilley, A and Svec, L. Applying Voronoi diagrams to the redistricting problem. Undergraduate Mathematics and Its Applications, 28(3):313-329, 2007.
24. Klavins, E, Burden, S A and Napp, N. The statistical dynamics of programmed robotic self—assembly. IEEE International Conference on Robotics and Automation (ICRA), pg. 1469-1476, 2006.
25. Klavins, E, Burden, S A and Napp, N. Optimal rules for programmed stochastic self—assembly. Robotics: Science and Systems (RSS), p02, 2006.
26. Bishop, J, Burden, S A, Klavins, E, Kreisberg, R, Malone, W, Napp, N and Nguyen, T. Programmable parts: A demonstration of the grammatical approach to self—organization. IEEE International Conference on Intelligent Robots and Systems (IROS), pg. 3684-3691, 2005.

Complete books written None to report.

Parts of books (chapters in edited books) None to report.

Books edited None to report.

Journal issues edited None to report.

Patents submitted and/or awarded None to report.

Abstracts

1. Chasnov, B, Ratliff, L J, Burden, S A. *Stability of human/machine learning dynamics*. Dynamic Walking, 2020.
2. Madduri, M M, Orsborn, A L, Burden, S A. *Simulating Neural Dynamics in a Closed-Loop Adaptive Decoder Brain-Machine Interface*. Dynamic Walking, 2020.
3. Pace, A M, Murphey, T D, Burden, S A. *Tracking in legged locomotion without discontinuities*. Dynamic Walking, 2020.

4. Sullivan, J G, Duddala, R, Burden, S A. *Acrobatic Vertical Climbing with a Monopod Robot*. Dynamic Walking, 2020.
5. Yamagami, M, Steele, K M, Burden, S A. *Comparing Muscle Versus Manual Interface Performance With Control Theory*. Dynamic Walking, 2020.
6. Banjanin, B S, Rosenberg, M, Steele, K M, Burden, S A. *Subject-specific models for predicting human locomotor response to ankle foot orthoses*. Dynamic Walking, 2019.
7. Chasnov, B, Ratliff, L J, Burden, S A. *Sensorimotor game dynamics in coupled human-machine tasks*. Dynamic Walking, 2019.
8. Libby, T, Sullivan, J G, Burden, S A. *Design of Legged Robots Using Haptic Mixed Reality*. Dynamic Walking, 2019.
9. Yamagami, M, Steele, K M, Burden, S A. *Assessing Sensorimotor Learning of Cyber-Physical-Human Systems In Individuals With and Without Motor Impairment*. Dynamic Walking, 2019.
10. Libby, T, Coogan, S D and Burden, S A. *When do feedforward inputs yield stable behaviors?* Dynamic Walking, 2018.
11. Banjanin, B and Burden, S A. *Challenges for optimal control of contact-rich dynamics*. Dynamic Walking, 2018.
12. Pace, A M and Burden, S A. *Are rigid robots mechanical systems subject to unilateral constraints?* American Physical Society, 2018.
13. Pace, A M and Burden, S A. *Assessing stability and controllability of multi-legged gaits*. Dynamic Walking, 2017.
14. Pace, A M and Burden, S A. *How (de)coupled are Minitaur limbs?* Dynamic Walking, 2016.
15. Banjanin, B, Burden, S A, Moore, T Y, Revzen, S and Full, R J. *Estimating predictive dynamical models of legged locomotion from data*. Society for Integrative and Comparative Biology, 2016.
16. Burden, S A, Sastry, S S, Koditschek, D E and Revzen, S. *Near-Simultaneous Footfalls Lend Stability to Multi-Legged Gaits*. Dynamic Walking, 2015.
17. Revzen, S, Kenneally, G D, Burden, S A and Koditschek, D E. *Uncertain multiple contacts: A new class of bio-inspired controllers*. Dynamic Walking, 2015.
18. Burden, S A, Sastry, S S and Full, R J. *Optimization for models of legged locomotion: Parameter estimation, gait synthesis, and experiment design*. Society for Integrative and Comparative Biology, 2014.
19. Revzen, S, Burden, S A and Kvalheim, M D. *Why the trot?* Society for Integrative and Comparative Biology, 2014.
20. Burden, S A, Revzen, S and Sastry, S S. *From anchors to templates: Exact and approximate reduction in models of legged locomotion*. Dynamic Walking, 2013.
21. Revzen, S, Burden, S A, Koditschek, D E and Sastry, S S. *Pinned equilibria provide robustly stable multilegged locomotion*. Dynamic Walking, 2013.
22. Burden, S A, Revzen, S, Moore, T Y, Sastry, S S and Full, R J. *Using reduced-order models to study dynamic legged locomotion: Parameter identification and model validation*. Society for Integrative and Comparative Biology, 2013.
23. Moore, T Y, Revzen, S, Burden, S A and Full, R J. *Adding inertia and mass to test stability predictions in rapid running insects*. Society for Integrative and Comparative Biology, 2010.

Other significant research dissemination (web sites, software, Wikis, etc.) None to report.

OTHER SCHOLARLY ACTIVITY

Invited lectures and seminars

1. People and Robots Seminar, University of California, Berkeley, CA, USA, *Toward telelocomotion: contact-rich robot dynamics and human sensorimotor control*, Oct 2020. *Hosts:* David McPherson, Andrea Bajcsy, Shankar Sastry (EECS)
2. Industrial and Systems Engineering Seminar, University of Washington, Seattle, WA, USA, *sensorimotor games: human/machine collaborative learning and control*, Feb 2021. *Hosts:* Ji-Eun Kim (ISE), Archis Ghate (ISE).
3. Laboratory for Computational Sensing and Robotics Seminar, Johns Hopkins University, Baltimore, MD, USA, *Toward telelocomotion: contact-rich robot dynamics and human sensorimotor control*, Sep 2020. *Host:* Noah Cowan (ME).
4. ARO Workshop on human/machine interactive control, Johns Hopkins University, Baltimore, MD, USA, *human/machine collaborative learning and control*, Feb 2020. *Hosts:* Sri Sarma (JHU BME); Muther Dahleh (MIT EECS).
5. Robotics Institute Seminar, Carnegie Mellon University, Pittsburgh, PA, USA, *Toward Telelocomotion: human sensorimotor control of contact-rich robot dynamics*, Jan 2020. *Hosts:* Aaron Johnson (ME); Chris Atkeson (CS).
6. Controls Seminar, University of Michigan, Ann Arbor, MI, USA, *Toward Telelocomotion: human sensorimotor control of contact-rich robot dynamics*, Oct 2019. *Hosts:* Ram Vasudevan (ME); Jessy Grizzle (EECS).
7. NVIDIA Robotics, Seattle, WA, USA, *Toward Telelocomotion: human sensorimotor control of contact-rich robot dynamics*, April 2019. *Host:* Dieter Fox.
8. Robotics Group Seminar, California Institute of Technology, Pasadena, CA, USA, *Toward Telelocomotion: human sensorimotor control of contact-rich robot dynamics*, March 2019. *Hosts:* Aaron Ames (ME), John Doyle (CDS).
9. Neuroscience and Robotics Seminar, Northwestern University, Evanston, IL, USA, *Toward Telelocomotion: human sensorimotor control of contact-rich robot dynamics*, March 2019. *Host:* Todd Murphey (ME).
10. MathDay, University of Washington, Seattle, WA, USA, *Humans & Robots*, March 2018. *Host:* Jim Morrow (Math).
11. NSF Cyber-Physical Systems PI Meeting, Arlington, VA, USA, *Provably-safe interventions for Human-Cyber-Physical Systems (HCPS)*, Nov 2017. *Host:* David Corman (NSF).
12. UWIN Seminar, University of Washington, Seattle, WA, USA, *Predictive dynamical models for human sensorimotor control of teleoperated robots*, May 2017. *Host:* Tom Daniel (Bio).
13. GRASP Lab Seminar, University of Pennsylvania, Philadelphia, PA, USA, *Smoothing contact-rich dynamics with morphological computation*, April 2017. *Host:* Dan Koditschek (ESE).
14. Nonlinear Dynamics and Control Seminar, University of California, San Diego, CA, USA, *Smoothing contact-rich dynamics with morphological computation*, April 2017. *Host:* Nick Gravish (ME).
15. MathDay, University of Washington, Seattle, WA, USA, *Humans & Robots*, March 2017. *Host:* Jim Morrow (Math).

16. Physics of Living Systems Seminar, Georgia Institute of Technology, Atlanta, GA, USA, *Smoothing contact-rich dynamics with morphological computation*, February 2017. *Hosts*: Simon Sponberg (Physics); Dan Goldman (Physics).
17. Microsoft Research, Redmond, WA, USA, *Toward Telelocomotion*, September 2016. *Host*: Debadeepta Dey.
18. Summer Institute for Mathematics, University of Washington, Seattle, WA, USA, *A First Course in Robotics*, July 2016. *Host*: Jim Morrow (Math).
19. Washington Aerospace Scholars, University of Washington, Seattle, WA, USA, *Humans & Robots*, June 2016. *Host*: Eve Riskin (ECE).
20. Mary Gates Endowment Scholars Dinner, University of Washington, Seattle, WA, USA, *Some Thoughts, Delivered on a Significant Occasion, about Living*, April 2016. *Host*: Janice DeCosmo (ESS).
21. MathDay, University of Washington, Seattle, WA, USA, *Humans & Robots*, March 2016. *Host*: Jim Morrow (Math).
22. UWIN Neural Computation and Engineering Connection, University of Washington, Seattle, WA, USA, *Predictive dynamical models for sensorimotor control*, January 2016. *Host*: Tom Daniel (Bio).
23. NSF RCN Winter Workshop on Neuromechanics and Dynamics of Locomotion, New Orleans, LA, USA, *Predictive dynamical models for legged locomotion*, January 2016. *Hosts*: Simon Sponberg (GATech Physics); Lisa Fauci (Tulane Math); Avis Cohen (UMD Bio).
24. EE Colloquium, University of Washington, Seattle, WA, USA, *Predictive dynamical models for sensorimotor control*, November 2015. *Host*: Matt Reynolds (ECE).
25. ONR Science of Autonomy Workshop, Arlington, VA, USA, *Dynamic Inverse Models in Human-Cyber-Physical Systems*, August 2015. *Host*: Marc Steinberg.
26. ICRA Workshop on Robotics-Inspired Biology (and Bio-Inspired Robotics), Seattle, WA, USA, *Parsimonious predictive models for legged locomotion*, May 2015. *Host*: Nick Gravish (UCSD ME).
27. Kavli Futures Workshop on Neuroscience-Inspired Computing, Berkeley, CA, USA, *Dynamic Inverse Models in Cyber-Human Systems*, July 2015. *Host*: Shankar Sastry (EECS).
28. CSE Robotics Colloquium, University of Washington, Seattle, WA, USA, *Hybrid Models for Dynamic and Dexterous Robots*, October 2014. *Host*: Maya Cakmak (CSE).
29. NSF CPS-FORCES Review Meeting, Berkeley, CA, USA, *Metrization, Simulation, and First-Order Approximation for Networked CPS*, September 2014. *Hosts*: Claire Tomlin (EECS); Ruzena Bajcsy (EECS); Shankar Sastry (EECS).
30. ECE Dept, Northeastern University, Boston, MA, USA, *Reduction and identification for models of locomotion: an emerging systems theory for neuromechanics*, March 2014. *Host*: Deniz Erdogmus (ECE).
31. EE Dept, Harvard University, Cambridge, MA, USA, *Reduction and identification for models of locomotion: an emerging systems theory for neuromechanics*, March 2014. *Host*: Evelyn Hu (EE).
32. Institute for Systems Research, University of Maryland, College Park, MD, USA, *Reduction and identification for models of locomotion: an emerging systems theory for neuromechanics*, March 2014. *Host*: Reza Ghodssi (ECE).

33. ECEE Dept, University of Colorado, Boulder, CO, USA, *Reduction and identification for models of locomotion: an emerging systems theory for neuromechanics*, February 2014. *Host*: John Hauser (ECEE).
34. ME Dept, University of Maryland, College Park, MD, USA, *Reduction and identification for models of locomotion: an emerging systems theory for neuromechanics*, February 2014. *Host*: Sarah Bergbreiter (ME; now CMU ME).
35. EE Dept, University of Washington, Seattle, WA, USA, *Reduction and identification for models of locomotion: an emerging systems theory for neuromechanics*, February 2014. *Host*: Howard Chizeck (ECE).
36. ME Dept, University of Maryland, College Park, MD, USA, *Bio-inspired reduction and robustness of dynamic robot gaits*, October 2013. *Host*: Sarah Bergbreiter (CMU ME).
37. Army Research Lab, Adelphi, MD, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, April 2013. *Host*: Will Nothwang (ARL).
38. University of Michigan, Ann Arbor, MI, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2013. *Host*: Shai Revzen (EECS).
39. SRI International, Menlo Park, CA, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2013.
40. University of Washington, Seattle, WA, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2012. *Host*: Eric Klavins (ECE).
41. Harvard University, Cambridge, MA, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2012. *Host*: Rob Wood (EE).
42. Massachusetts Institute of Technology, Cambridge, MA, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2012. *Host*: Russ Tedrake (EECS).
43. University of Maryland, College Park, MD, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2012. *Host*: Sarah Bergbreiter (CMU ME).
44. University of Pennsylvania, Philadelphia, PA, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2011. *Host*: Dan Koditschek (ESE).
45. University of Delaware, Newark, DE, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2011. *Host*: Herbert Tanner (ME).
46. Johns Hopkins University, Baltimore, MD, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, 2011. *Host*: Noah Cowan (ME).
47. Summer Institute for Mathematics, University of Washington, Seattle, WA, USA, *A First Course in Robotics*, 2009, 2010, 2011, 2012. *Host*: Sandor Kovacs (Math).
48. MathDay, University of Washington, Seattle, WA, USA, *Robots that run, climb, flap, and swim* 2009, 2010, 2011, 2012. *Hosts*: Jim Morrow (Math).
49. Summer Institute for Mathematics, University of Washington, Seattle, WA, USA, *Mathematical Contest in Modeling*, 2007, 2008. *Host*: Sandor Kovacs (Math).
50. WA NASA Space Grant Reception, University of Washington, Seattle, WA, USA, *Pull Yourself Together: Creating Robots that Self-Assemble*, 2007. *Host*: Janice DeCosmo (ESS).

Presentations given at conferences

1. Dynamic Walking, Pensacola, FL, USA, *When do feedforward inputs yield stable behaviors?*, June 2018
2. SPIE Conference on Defense, Security, and Sensing, Anaheim, CA, USA, *Toward experimental validation of a model for human sensorimotor learning and control in teleoperation*, March 2017

3. SIMPAR, San Francisco, CA, USA, *Predictive dynamical models for intermittent contact*, December 2016
4. Dynamic Walking, Ann Arbor, MI, USA, *Assessing stability and controllability of multi-legged gaits*, June 2016
5. CPS Workshop, Berkeley, CA, USA, *Towards provably-safe interventions for human-cyber-physical systems*, May 2016
6. Dynamic Walking, Columbus, OH, USA, *Near-simultaneous footfalls lend stability to multi-legged gaits*, June 2015
7. IFAC World Congress, Cape Town, South Africa, *Adaptive piecewise-affine inverse modeling of hybrid dynamical systems*, August 2014
8. SICB Yearly Meeting, Austin, TX, USA, *Optimization for models of legged locomotion: parameter estimation, gait synthesis, and experiment design*, January 2014
9. SPIE Conference on Defense, Security, and Sensing, Baltimore, MD, USA, *Reduction and Identification for Hybrid Dynamical Models of Terrestrial Locomotion*, April 2013
10. Dynamic Walking, Pittsburgh, PA, USA, *From Templates to Anchors: Exact and Approximate Reduction in Models of Legged Locomotion*, June 2013
11. SICB Yearly Meeting, San Francisco, CA, USA, *Using reduced-order models to study dynamic legged locomotion: Parameter identification and model validation*, January 2013
12. IEEE Conference on Decision and Control, Maui, HI, USA, *Reduction and robustness via intermittent contact*, December 2012
13. IFAC Symposium on System Identification, Brussels, Belgium, *Parameter Identification Near Periodic Orbits of Hybrid Dynamical Systems*, October 2012
14. IEEE Conference on Decision and Control / European Control Conference, Orlando, FL, USA, *Dimension Reduction Near Periodic Orbits of Hybrid Systems*, December 2011
15. Hybrid Systems: Computation and Control, Stockholm, Sweden, *On State Estimation for Hybrid Abstractions of Legged Locomotion*, October 2010
16. IEEE International Conference on Robotics and Automation, Rome, Italy, *Heterogeneous Leg Stiffness and Roll in Dynamic Running*, May 2007

Professional society memberships

- IEEE, August 2008--present
- Society for Integrative and Comparative Biology, August 2012--present
- American Physical Society, March 2018--present

Other (reviewer for journal papers)

- ASME Journal of Mechanisms and Robotics (JMR) -- 2 papers
- Biological Cybernetics (BiCy) -- 1 paper
- Nonlinear Analysis: Hybrid Systems (NA:HS) -- 6 papers
- IEEE Trans. Automatic Control (TAC) -- 6 papers
- IEEE Trans. Automation Systems and Engineering (TASE) -- 1 paper
- IEEE Trans. Robotics (TRO) -- 3 papers
- International Journal of Robotics Research (IJRR) -- 7 papers
- Mechanism and Machine Theory (MECHMT) -- 1 paper
- Publicacions Matemàtiques -- 1 paper
- Robotica -- 6 papers
- Robotics and Automation Letters (RAL) -- 1 paper

- Robotics and Automation Magazine (RAM) -- 1 article
- Robotics and Autonomous Systems (RAS) -- 1 paper
- Science -- 2 papers

Other (reviewer for funding agencies)

- National Science Foundation (NSF) -- 4 panels
- Army Research Office (ARO) -- 3 proposals

GRADUATE STUDENTS

Chaired Doctoral Degrees

1. Bora Banjanin, Chair, graduated Summer 2019
thesis title: Data-driven modeling for hybrid systems
now: Senior Applied Scientist, Amazon, Seattle, WA, USA
2. Andrew Pace, Chair, graduated Fall 2020
thesis title: Stepping Towards Control of Systems Undergoing Impact for Legged Locomotion

Current Doctoral Students

1. Momona Yamagami, co-Chair (with Kat Steele, ME), passed general exam 2019
thesis topic: human/machine sensorimotor learning and control
2. Benjamin Chasnov, co-Chair (with Lillian Ratliff, ECE), passed qualifying exam 2019
thesis topic: reinforcement learning in human/machine systems
3. Joseph Sullivan, Chair, passed qualifying exam 2020
thesis topic: design and control of robot terradynamics using mixed-reality
4. Maneeshika Madduri, co-Chair (with Amy Orsborn, ECE), passed qualifying exam 2020
thesis topic: co-adaptation in brain/machine interfaces
5. Amber Chou, Chair
thesis topic: sensorimotor fusion in human/machine systems

Chaired Masters Degrees

1. Yana Sosnovskaya, Chair, Thesis, *External Measurement System for Robot Dynamics*, June 2017
now: PhD student with Blake Hannaford, Electrical & Computer Engineering, University of Washington, Seattle, WA, USA
2. Jacob Baldassini, Chair, Thesis, *An Examination of the Effects of Deformable Foam Contact Surfaces on Robotic Locomotion*, June 2017
now: US Coast Guard
3. SeungHoon Han, Chair, Thesis, *Automating Perturbation Experiments for a Hopping Robot using a Cable-Driven Impedance Haptic Device*, June 2018
now: Robotics Engineer, Amyris, Emeryville, CA, USA
4. Tianqi Li, Chair, Thesis, *Experimental Realization of Deadbeat Control on a Hybrid Model of Legged Locomotion*, June 2018
now: PhD student, Mechanical Engineering, Texas A&M, College Station, TX, USA

Current Masters Students None to report.

Other significant student supervision (undergraduate research)

Student Name	Funding	Where are they now?	Completed (Year)
Akhil Mandala		UW ECE BS	<i>ongoing</i>
Lauren Peterson (F)	UWIN Undergrad Fellowship	UW ECE BS	<i>ongoing</i>
Trixie Ip (F)	WISE	UW ECE BS	<i>ongoing</i>
Alyssa Giedd (F)	WISE; UWIN Undergrad Fellowship	UW Physics BS	<i>ongoing</i>
Jimmy Coleman	CNT REU	UMD Baltimore County CS BS	2019
Ashley Grey (F)	Mary Gates Research Fellowship	UW ECE BS	2019
Clara Orndorff (F)	UWIN Undergrad Fellowship; Mary Gates Research Fellowship	UC Berkeley ME MS	2018
Olivia Bellatin	CNT REU	Marquette University BME BS	2018
Joshua Quichocho (URM)	NSF REU	Microsoft	2017
Cydney Beckwith (F)	NSF REU	EWU ME	2017
Gabriel Solia	Brazillian Scientific Mobility Program	Manufacturing Costs Analyst, PepsiCo Brazil	2016

RESEARCH ACTIVITIES

Funded Research

Funding Agency	Title	Your role with other PI's and co-PI's	Total Amount, Your Amount, (Subcontracts if any, University Matching if any)	Dates (start-finish)
NSF (M3X)	CAREER: Human/Machine	PI	total \$737k, mine \$737k	8/21-8/26
NSF NRI	Multi-behavioral Robots	UW PI (co-PI: Johnson, CMU)	total \$750k, mine \$500k	9/19-9/22
NSF CPS	Certifiable learning	UW PI (co-PIs: Ratliff, UW; Coogan, GATech)	total \$644k, mine \$330k	9/18-9/21
NSF S-STEM	STARS	co-PI (PI: Riskin, UW)	total \$980k, mine \$30k	9/16-8/21
UW CoE	SRI	PI (co-PIs: Kelly, Moritz, Rombokas, Steele, UW)	total \$108k, mine \$108k (UW match \$8k)	8/16-6/20
ARO	YIP	PI	total \$359k, mine \$359k	5/16-5/19
NSF CPS	CRII	PI	total \$182k, mine \$182k	4/16-3/18

Unfunded Proposals

Funding Agency	Title	Your role with other PI's and co-PI's	Total Amount, Your Amount, (Subcontracts if any, University Matching if any)	Dates (start-finish)
ONR	Octopus MURI	co-PI (PI Geyer, UW; co-PIs: B Brunton, S Brunton, J Smith, UW; Scheel, UA)	total \$7.5m, mine \$750k	9/19-9/24
ARO PECASE	Morphological Computation	PI	total \$1m, mine \$1m	9/18-9/23
AFOSR	RAVENS	PI (co-PIs: Acikmese, UW; Ames, Murray, Caltech; Love, Milam, NGAS)	total \$1.5m, mine \$250k	9/18-9/20

NSF EFRI	ROAMS	co-PI (PI Lin, UW; co-PIs: Fuller, UW; Wong, PSU)	total \$2m, mine \$400k	9/18-9/22
NSF CPS	NEXUS ERC	co-PI (PI: Tomlin, UCB)	total \$3.1m, mine \$310k	7/17-6/22

DOCUMENTATION OF TEACHING EFFECTIVENESS

Courses Taught & Student Evaluations

Course	Title	Quarter	Credit Hrs	Enrollment	Evaluations? Response	Item 1	Item 3	Item 4	Average, Items 1-4
EE 548	MIMO Systems	Spr, 2021	3	27	Yes, 22/27	4.3	4.6	4.2	4.4
EE 547	Linear Systems	Wtr, 2021	4	19	Yes, 17/19	4.5	4.8	4.4	4.6
EE 447	Control Systems	Fall, 2020	4	21	Yes, 20/21	4.4	4.6	4.5	4.5
EE 548	MIMO Systems	Spr, 2020	3	31	Yes, 14/31	3.7	4.6	4.1	4.1
EE 546	Optimization & Learning	Wtr, 2020	3	14	Yes, 8/14	4.4	4.5	4.4	4.4
EE 447	Control Systems	Fall, 2019	4	51	Yes, 44/51	4.1	4.8	4.3	4.4
EE 594	Robust Control	Spr, 2019	3	23	Yes, 19/23	4.1	4.5	4.5	4.3
EE 548	MIMO Systems	Wtr, 2019	3	42	Yes, 39/42	4.1	4.0	4.1	4.1
EE 447	Control Systems	Fall, 2018	4	81	Yes, 73/81	3.2	3.3	3.1	3.2
EE 546	Optimization & Learning	Spr, 2018	3	17	Yes, 13/17	4.0	4.2	4.3	4.2
EE 546	Hybrid Systems	Spr, 2017	3	10	Yes, 10/10	4.6	4.9	4.9	4.8
EE 548	MIMO Systems	Wtr, 2017	3	38	Yes, 31/35	3.9	4.2	3.7	3.9
EE 547	Linear Systems	Fall, 2016	4	61	Yes, 56/61	3.5	3.9	3.3	3.6
EE 548	MIMO Systems	Wtr, 2016	3	46	Yes, 32/46	4.0	4.4	4.1	4.2
EE 547	Linear Systems	Fall, 2015	4	55	Yes, 32/55	3.8	4.2	3.6	3.9

Supervision of independent study (design projects and research). None to report.

Independent Study None to report.

List of other teaching contributions None to report.

Other supporting documents None to report.

Have you gone through an ET&L teaching review?
Have you gone through a peer teaching review? If so, list when and whom reviewed you.

Course	Title	Quarter	ET&L teaching review?	Peer teaching review?
EE 548	MIMO Systems	Sp 2021	no	yes, Li
EE 547	Linear Systems	Wi 2021	no	yes, Kirschen
EE 447	Control Systems	Fa 2020	no	yes, Hannaford
EE 548	MIMO Systems	Sp 2020	no	yes, Klavins
EE 546	Optimization & Learning	Wi 2020	no	no
EE 447	Control Systems	Fa 2019	yes	yes, Wilson
EE 594	Robust Control	Sp 2019	no	no
EE 548	MIMO Systems	Wi 2019	no	no
EE 447	Control Systems	Fa 2018	yes	yes, Seelig
EE 546	Optimization & Learning	Sp 2018	yes	no
EE 546	Hybrid Systems	Sp 2017	yes	yes, Hauck
EE 548	MIMO Systems	Wi 2017	yes	yes, Bushnell
EE 547	Linear Systems	Fa 2016	yes	yes, Hannaford
EE 548	MIMO Systems	Wi 2016	no	yes, Klavins
EE 547	Linear Systems	Fa 2015	yes	yes, Chizeck

Teaching Awards, Nominations for Teaching Awards None to report.

SERVICE

Departmental service

- Associate Director, AMP Lab (in Wallace Hall), Fa 2015--present
 - 3400 sq ft facility for motion analysis of humans and machines, shared between ECE, ME, and Rehab Med
 - conception, design, renovation 2015 – 2017
 - open since Jan 2018
 - PI on UW CoE Strategic Research Initiative award (\$100k)
- Yang dissertation award committee, 2017
- PhD fellowship committee, 2016, 2018, 2019
- Undergraduate Admissions, Sp 2018
- Faculty Search Committee, 2018--2019
- PhD Admissions, 2019--2020
- SCR Curriculum Group Chair, 2020
- DEI Coordinator, 2020--2021
 - drafted proposal for ECE strategy based on large- and small-group meetings with stakeholders from ECE, CoE, UW
- Associate Chair for DEI, 2021--present
 - working to implement proposed strategy

College service

- Engineering Discovery Days lab demonstrations in 2016, 2017, 2018, 2019
- EE research presentation to CoE STARS, Sp 2016, Wi 2021
- EE research presentation to SHPE, NSBE, SWE, Wi 2016
- EE research presentation to prospective undergraduates, Fa 2016, Fa 2017
- PI, AMP Center Strategic Research Initiative, Fa 2016--present
 - Organized Grand Opening in Jan 2018 and Open House in Jan 2019
 - Sponsored 15 AMP Fellows projects total over 3 years (2017, 2018, 2019)
- Co-PI and faculty mentor lead, STARS, Fa 2016--present
 - Recruited 72 faculty from all 10 CoE departments to mentor 102 STARS students
- Strategic Planning Committee for Diversity, Equity, and Inclusion, 2020--2021
- Engineering Department Diversity Committee, 2020--present

University service None to report.

Professional society and other service

- Co-organizer (with Sadigh, Stanford CS; Topcu, UT Austin AA; Oishi, UNM ECE) for workshop at NSF Cyber-Physical Systems PI Meeting, *Human-Cyber-Physical Systems*, Nov 2017
 - Created half-day technical program with 8 invited speakers
 - Facilitated working group discussion and report-out to sponsor
- Organizer (with Ruina, Cornell ME) for Dynamic Walking Meeting in Mariehamn, Finland, Jun 2017

- Created 4-day technical program from > 100 abstract submissions
 - Managed travel, venue, and accommodation logistics for > 150 participants
- Co-organizer (with Poovendra, Ratliff, Zhang, UW ECE) for workshop at University of Washington, *Smart Cities Visioning Workshop*, Jan 2016
 - Facilitated working group discussion and report-out to sponsor
- Co-organizer (with Dong, Ratliff, Ohlsson, UC Berkeley EECS) for workshop at IEEE Conference on Decision and Control, *Smart Cities: Service Models, Vulnerabilities, and Resilience*, Dec 2015
 - Created technical program with 10 invited speakers
 - Managed venue logistics for > 40 participants
- Co-organizer (with Gonzalez, Vasudevan, UC Berkeley EECS) for workshop at IEEE Conference on Decision and Control, *Control systems in the open world*, Dec 2013
 - Created technical program with 8 invited speakers
 - Managed venue logistics for > 30 participants

Community service None to report.

International, national or governmental service None to report.

All other service

- Plenary speaker at UW MathDay, 1200 middle- and high-school students, Mar 2017