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EDUCATION

Ph.D. 2001 Electrical Engineering and Computer Science, University of Michigan, Ann Arbor
Advisor: Daniel E. Koditschek
Dissertation: Vision-Based Control via Navigation Functions
M.S. 1997 Electrical Engineering and Computer Science University of Michigan, Ann Arbor
B.S. 1995 Electrical Engineering, Ohio State University, Columbus

POSITIONS HELD

Primary Appointments

- ◇ Johns Hopkins University, Baltimore
 - 2017–present Professor, Department of Mechanical Engineering
 - 2010–2017 Associate Professor, Department of Mechanical Engineering
 - 2003–2010 Assistant Professor, Department of Mechanical Engineering
- ◇ The University of California, Berkeley
 - 2001–2003 Postdoctoral Fellow, Department of Integrative Biology
Advisor: Robert J. Full

Other, Secondary, and Visiting Appointments

- ◇ Johns Hopkins University, Baltimore
 - 2013–2018 Deputy Directory, Laboratory for Computational Sensing and Robotics (LCSR)
 - 2010–present Secondary Appointment, Department of Electrical and Computer Engineering
 - 2004–present Secondary Appointment, Department of Computer Science
 - 2003–present Director, Locomotion in Mechanical and Biological Systems (LIMBS) Laboratory
- ◇ The University of Washington, Seattle
 - 2010-2011 Visiting Scholar, Department of Biology

AWARDS AND HONORS

- 2024 **IEEE Fellow** “for contributions to sensing, navigation, and control in animals and machines”
- 2024 **Discovery Award**, Johns Hopkins University.
- 2016 **Discovery Award**, Johns Hopkins University.
- 2015 Inducted into the **Delaware Hayes High School Hall of Fame**, Delaware, OH.
- 2015 **Discovery Award**, Johns Hopkins University.
- 2014 **The Dunn Family Award**, conferred for having . . . *an extraordinarily positive impact upon the lives of one or more undergraduate students . . .* Johns Hopkins University
- 2012 **Scholar Award in Complex Systems Science**, James S. McDonnell Foundation.
- 2012 **Journal of Experimental Biology, Most Outstanding Paper Award**, Finalist.

- 2010 **Presidential Early Career Award in Science and Engineering (PECASE)**, National Office of Science and Technology Policy, “for innovative research in biologically inspired robotic systems with application to disaster recovery and space exploration and for motivating students to explore careers in science and engineering.”
- 2009 **CAREER Award**, National Science Foundation
- 2006 **Finalist, Best Paper**, IEEE/RSJ Intelligent Robots and Systems Conference
- 2005 **William H. Huggins Excellence in Teaching Award**, Johns Hopkins University.
- 2000 **Rackham Doctoral Fellowship**, University of Michigan.
- 2000 **Finalist, Best Student Paper**, IEEE Conference on Decisions and Controls, Sydney, Australia

SIGNIFICANT TRAINEE AWARDS

- ◇ **2023 Regeneron STS Scholar**, i.e. one of “America’s Top 300 Teen Scientists” from the Society for Science, High School Mentee (minority, female) from the Baltimore Ingenuity Project.
- ◇ **Dick Volz Best U.S. Ph.D. Thesis in Robotics and Automation**, Awarded to Doctoral Student Robert J. Webster, III (co-advised with Dr. Allison Okamura), 2011.
- ◇ **NSF Fellows:** Eatai Roth (2010), Erin Sutton (2012), Michael Wilkinson (Honorable Mention, 2020).
- ◇ **Kavli Foundation Predoctoral Fellows:**
 - 2022–present: Michael Wilkinson (PhD student; co-supervised with Cindy Moss)
 - 2022–present: Bharath Krishnan (PhD student; primary supervisor: James Knierim)
- ◇ **Kavli Foundation Postdoctoral Fellows:**
 - 2017–2019: Manu Madhav (Postdoc, co-supervised with James Knierim)
 - 2022–present: Will Olson (Postdoc; primary supervisor: Daniel O’Connor).
- ◇ **ARCS Foundation Fellows:** Eatai Roth (2009) and Erin Sutton (2015).
- ◇ **Siebel Scholar:** Mert Ankarli (2015).
- ◇ **LINK Foundation Fellows:** Robert Nickl (2017) and Chris Yang (2019; Primary supervisor: Adrian Haith)

PUBLICATIONS

Dr. Cowan’s **postdocs and students** in green. * = contributed equally. † = supervised equally.

[NCBI Bibliography](#)

[Google Scholar](#)

Review Articles

- [R1] **M. S. Madhav** and **N. J. Cowan**. The synergy between neuroscience and control theory: the nervous system as inspiration for hard control challenges. *Annu Rev Control Robot Auton Syst* 3:243–267, 2020, <https://doi.org/10.1146/annurev-control-060117-104856>.
- [R2] **N. J. Cowan**, **M. M. Ankarali**, J. P. Dyhr, **M. S. Madhav**, **E. Roth**, **S. Sefati**, S. Sponberg, **S. A. Stamper**, E. S. Fortune, and T. L. Daniel. Feedback control as a framework for understanding tradeoffs in biology. *Integr Comp Biol* 54(2):223–237, 2014, <http://dx.doi.org/10.1093/icb/icu050>.
- [R3] **E. Roth**, S. Sponberg, and **N. J. Cowan**. A comparative approach to closed-loop computation. *Curr Opin Neurobiol* 25:54–62, 2014, <http://dx.doi.org/10.1016/j.conb.2013.11.005>.

Preprints

- [S1] **S. Deng**, J. Liu, B. Datta, A. Pantula, D. H. Gracias, T. D. Nguyen, B. A. Bittner, and **N. J. Cowan**. A data-driven approach to geometric modeling of systems with low-bandwidth actuator dynamics. *Proc IEEE Int Conf Robot Autom*, 2024. submitted.
- [S2] **S. Deng**, **N. J. Cowan**, and B. A. Bittner. Adaptive gait modeling and optimization for principally kinematic systems. *Proc IEEE Int Conf Robot Autom*, 2024. submitted.

- [S3] Y. Yang, D. G. Yared, and N. J. Cowan. Can a fish learn to ride a bicycle? Sensorimotor adaptation to destabilizing dynamics in weakly electric fish. *bioRxiv*, 2023, <https://www.biorxiv.org/content/early/2023/01/30/2023.01.27.525956>.
- [S4] D. Cao, N. J. Cowan, and J. S. Freudenberg. Optimal estimation with sensor delay. *arXiv*, 2022, <https://arxiv.org/abs/2210.12123>.
- [S5] E. D. Sontag, D. Biswas, and N. J. Cowan. An observability result related to active sensing. *arXiv*, 2022, <https://arxiv.org/abs/2210.03848>.
- [S6] M. S. Madhav, R. P. Jayakumar, B. Li, F. Savelli, J. J. Knierim, and N. J. Cowan. Closed-loop control and recalibration of place cells by optic flow. *bioRxiv*, 2022.

Journal Articles (published)

- [J1] D. Biswas, A. Lamperski, Y. Yang, K. Hoffman, J. Guckenheimer, E. S. Fortune, and N. J. Cowan. Mode switching in organisms for solving explore-versus-exploit problems. *Nat Mach Intell*, 2023, <https://www.biorxiv.org/content/early/2023/01/11/2023.01.11.523566>.
- [J2] S. C. Whitehead, S. Leone, T. Lindsay, M. R. Meiselman, N. J. Cowan, M. H. Dickinson, N. Yapici, D. L. Stern, T. Shirangi, and I. Cohen. Neuromuscular embodiment of feedback control elements in drosophila flight. *Sci Adv* 8(50):eabo7461, 2022, <https://www.science.org/doi/abs/10.1126/sciadv.abo7461>.
- [J3] A. Pantula, B. Datta, Y. Shi, M. Wang, J. Liu, S. Deng, N. J. Cowan, T. D. Nguyen, and D. H. Gracias. Untethered unidirectionally crawling gels driven by an asymmetry in contact forces. *Sci Robot* 7(73):eadd2903, 2022.
- [J4] C. S. Yang, N. J. Cowan, and A. M. Haith. Control becomes habitual early on when learning a novel motor skill. *J Neurophysiol* 128(5):1278–1291, 2022, <https://doi.org/10.1152/jn.00273.2022>.
- [J5] T. Raab, M. S. Madhav*, R. P. Jayakumar*, J. Henninger, N. J. Cowan, and J. Benda. Advances in non-invasive tracking of wave-type electric fish in natural and laboratory settings. *Front Integr Neurosci* 16:965211, 2022, <https://doi.org/10.3389/fnint.2022.965211>.
- [J6] B. P. Vagvolgyi, R. P. Jayakumar*, M. S. Madhav*, J. J. Knierim, and N. J. Cowan. Wide-angle, monocular head tracking using passive markers. *J Neurosci Methods* 368:109453, 2022, <https://doi.org/10.1016/j.jneumeth.2021.109453>.
- [J7] M. S. Madhav*, R. P. Jayakumar*, S. G. Lashkari, F. Savelli, H. T. Blair, J. J. Knierim, and N. J. Cowan. The dome: a virtual reality apparatus for freely locomoting rodents. *J Neurosci Methods* 368:109336, 2022, <https://doi.org/10.1016/j.jneumeth.2021.109336>.
- [J8] C. S. Yang, N. J. Cowan, and A. M. Haith. De novo learning versus adaptation of continuous control in a manual tracking task. *eLife* 10:e62578, 2021, <https://elifesciences.org/articles/62578>.
- [J9] E. S. Fortune, N. Andanar, M. S. Madhav*, R. P. Jayakumar*, N. J. Cowan, M. E. Bichuette, and D. Soares. Spooky interaction at a distance in cave and surface dwelling electric fishes. *Front Integr Neurosci* 14, 2020, <https://doi.org/10.3389/fnint.2020.561524>.
- [J10] E. E. Sutton, B. Fuerst, R. Ghotbi, N. J. Cowan, and N. Navab. Biologically inspired catheter for endovascular sensing and navigation. *Sci Rep* 10(1):5643, 2020, <https://doi.org/10.1038/s41598-020-62360-w>.
- [J11] A. M. Zimmet, D. Cao, A. J. Bastian, and N. J. Cowan. Cerebellar patients have intact feedback control that can be leveraged to improve reaching. *eLife* 9:e53246, 2020, <https://doi.org/10.7554/eLife.53246>.
- [J12] I. Uyanik, S. Sefati, S. A. Stamper, K.-A. Cho, M. M. Ankarali, E. S. Fortune, and N. J. Cowan. Variability in locomotor dynamics reveals the critical role of feedback in task control. *eLife* 9:e51219, 2020, <http://dx.doi.org/10.7554/eLife.51219>.

- [J13] R. W. Nickl, M. M. Ankarali, and N. J. Cowan. Complementary spatial and timing control in rhythmic arm movements. *J Neurophysiol* 121(4):1543–1560, 2019, <http://dx.doi.org/10.1152/jn.00194.2018>.
- [J14] I. Uyanik, S. A. Stamper, N. J. Cowan, and E. S. Fortune. Sensory cues modulate smooth pursuit and active sensing movements. *Front Behav Neurosci* 13(59), 2019.
- [J15] R. P. Jayakumar*, M. S. Madhav*, F. Savelli, H. T. Blair, N. J. Cowan[†], and J. J. Knierim[†]. Recalibration of path integration in hippocampal place cells. *Nature* 566(745):533—537, 2019, <https://doi.org/10.1038/s41586-019-0939-3>.
- [J16] D. Biswas, L. A. Arend, S. A. Stamper, B. P. Vágvölgyi, E. S. Fortune, and N. J. Cowan. Closed-loop control of active sensing movements regulates sensory slip. *Curr Biol* 28(4), 2018.
- [J17] I. Uyanik, U. Saranlı, M. M. Ankarali, N. J. Cowan, and O. Morgul. Frequency-domain subspace identification of linear time periodic (LTP) systems. *IEEE Trans Autom Control* 64(6):2529–2536, 2018.
- [J18] A. M. Zimmet, N. J. Cowan, and A. J. Bastian. Patients with cerebellar ataxia do not benefit from limb weights. *Cerebellum* 18(1), 2018.
- [J19] E. D. Tytell, J. A. Carr, N. Danos, C. Wagenbach, C. M. Sullivan, T. Kiemel, N. J. Cowan, and M. M. Ankarali. Body stiffness and damping depend sensitively on the timing of muscle activation in lampreys. *Integr Comp Biol*, 2018, <https://doi.org/10.1093/icb/icy042>.
- [J20] M. S. Madhav*, R. P. Jayakumar*, A. Demir, S. A. Stamper, E. S. Fortune, and N. J. Cowan. High-resolution behavioral mapping of electric fishes in amazonian habitats. *Sci Rep* 8(1):5830, 2018, <http://www.nature.com/articles/s41598-018-24035-5>.
- [J21] E. E. Sutton, A. Demir, S. A. Stamper, E. S. Fortune, and N. J. Cowan. Dynamic modulation of visual and electrosensory gains for locomotor control. *J R Soc Interface* 13(118):20160057, May 2016, <https://dx.doi.org/10.1098/rsif.2016.0057>. PMC4892261.
- [J22] I. Uyanik, M. M. Ankarali, N. J. Cowan, U. Saranlı, and O. Morgul. Identification of a vertical hopping robot model via harmonic transfer functions. *Trans Inst Measurement Control* 38(5):501–511, 2016, <http://dx.doi.org/10.1177/0142331215583327>.
- [J23] A. Lamperski and N. J. Cowan. Optimal control with noisy time. *IEEE Trans Autom Control* 61(2):319–333, Feb. 2016, <http://dx.doi.org/10.1109/TAC.2015.2444234>.
- [J24] M. M. Ankarali, S. Sefati, M. S. Madhav, A. Long, A. Bastian, and N. J. Cowan. Walking dynamics are symmetric (enough). *J R Soc Interface* 12(108):20150209, 2015, <http://dx.doi.org/10.1098/rsif.2015.0209>.
- [J25] J. P. Swensen, M. Lin, A. M. Okamura, and N. J. Cowan. Torsional dynamics of steerable needles: modeling and fluoroscopic guidance. *IEEE Trans Biomed Eng* 66(11):2707–2717, Nov. 2014, <http://dx.doi.org/10.1109/TBME.2014.2326161>.
- [J26] J.-M. Mongeau, A. Demir, C. J. Dallmann, K. Jayaram, N. J. Cowan, and R. J. Full. Mechanical processing via passive dynamic properties of the cockroach antenna can facilitate control during rapid running. *J Exp Biol* 217(18):3333–3345, 2014, <http://dx.doi.org/10.1242/jeb.101501>.
- [J27] M. M. Ankarali, H. T. Sen, A. De, A. M. Okamura, and N. J. Cowan. Haptic feedback enhances rhythmic motor control by reducing variability, not improving convergence rate. *J Neurophysiol* 111(6):1286–1299, 2014, <http://dx.doi.org/10.1152/jn.00140.2013>.
- [J28] J.-M. Mongeau, A. Demir, J. Lee, N. J. Cowan, and R. J. Full. Locomotion- and mechanics-mediated tactile sensing: antenna reconfiguration simplifies control during high-speed navigation in cockroaches. *J Exp Biol* 216(24):4530–4541, 2013, <http://dx.doi.org/10.1242/jeb.083477>.

- [J29] A. Rosenberg, **N. J. Cowan**, and D. E. Angelaki. The visual representation of 3D object orientation in parietal cortex. *J Neurosci* 33(49):19352–19361, 2013, <http://dx.doi.org/10.1523/JNEUROSCI.3174-13.2013>. PMC3850047.
- [J30] **S. Sefati**, I. D. Neveln, **E. Roth**, T. Mitchell, J. B. Snyder, M. A. MacIver, E. S. Fortune, and **N. J. Cowan**. Mutually opposing forces during locomotion can eliminate the tradeoff between maneuverability and stability. *Proc Nat Acad Sci* 110(47):18798–18803, 2013, <http://dx.doi.org/10.1073/pnas.1309300110>. PMC3839770.
- [J31] **M. S. Madhav**, **S. A. Stamper**, E. S. Fortune, and **N. J. Cowan**. Closed-loop stabilization of the jamming avoidance response reveals its locally unstable and globally nonlinear dynamics. *J Exp Biol* 216(22):4272–4284, 2013, <http://dx.doi.org/10.1242/jeb.088922>.
- [J32] J. P. Dyhr, T. L. Daniel, K. A. Morgansen, and **N. J. Cowan**. Flexible strategies for flight control: an active role for the abdomen. *J Exp Biol* 216(9):1523–1536, 2013, <http://dx.doi.org/10.1242/jeb.077644>.
- [J33] **N. J. Cowan**, E. J. Chastain, D. A. Vilhena, J. S. Freudenberg, and C. T. Bergstrom. Nodal dynamics, not degree distributions, determine the structural controllability of complex networks. *PLoS ONE* 7(6):e38398, 2012, <http://dx.doi.org/10.1371/journal.pone.0038398>. PMC3382243.
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- [J35] **S. A. Stamper**, **E. Roth**, **N. J. Cowan**, and E. S. Fortune. Active sensing via movement shapes spatiotemporal patterns of sensory feedback. *J Exp Biol* 215(9):1567–1574, 2012, <http://dx.doi.org/10.1242/jeb.068007>.
- [J36] **K. B. Reed**, A. Majewicz, **V. Kallem**, R. Alterovitz, K. Goldberg, **N. J. Cowan**, and A. M. Okamura. Robot-assisted needle steering. *IEEE Robot Autom Mag* 18(4):35–46, 2011, <https://ieeexplore.ieee.org/document/6096030/>. PMC3460644.
- [J37] **E. Roth**, **K. Zhuang**, **S. A. Stamper**, E. S. Fortune, and **N. J. Cowan**. Stimulus predictability mediates a switch in locomotor smooth pursuit performance for *Eigenmannia virescens*. *J Exp Biol* 214(7):1170–1180, 2011, <http://dx.doi.org/10.1242/jeb.048124>.
- [J38] **V. Kallem**, D. E. Chang, and **N. J. Cowan**. Task-induced symmetry and reduction with application to needle steering. *IEEE Trans Autom Control* 55(3):664–673, Mar. 2010, <http://dx.doi.org/10.1109/TAC.2009.2039241>. PMC2871331.
- [J39] D. C. Rucker, **R. J. Webster III**, G. S. Chirikjian, and **N. J. Cowan**. Equilibrium conformations of concentric-tube continuum robots. *Int J Robot Res* 29:1263–1280, 2010, <http://dx.doi.org/10.1177/0278364910367543>.
- [J40] **S. G. Carver**, **N. J. Cowan**, and J. M. Guckenheimer. Lateral stability of the spring-mass hopper suggests a two step control strategy for running. *Chaos* 19(2), 2009, <http://dx.doi.org/10.1063/1.3127577>.
- [J41] **S. G. Carver**, T. Kiemel, **N. J. Cowan**, and J. J. Jeka. Optimal motor control may mask sensory dynamics. *Biol Cybern* 101(1):35–42, 2009, <http://dx.doi.org/10.1007/s00422-009-0313-x>. PMC2778031.
- [J42] **V. Kallem** and **N. J. Cowan**. Image guidance of flexible tip-steerable needles. *IEEE Trans Robot* 25(1):191–196, 2009, <http://dx.doi.org/10.1109/TR0.2008.2010357>. PMC2860577.
- [J43] **K. B. Reed**, A. M. Okamura, and **N. J. Cowan**. Modeling and control of needles with torsional friction. *IEEE Trans Biomed Eng* 56(12):2905–2916, Dec. 2009, <http://dx.doi.org/10.1109/TBME.2009.2029240>. PMC2859043.

- [J44] R. J. Webster III, J. M. Romano, and N. J. Cowan. Mechanics of precurved-tube continuum robots. *IEEE Trans Robot* 25(1):67–78, 2009, <http://dx.doi.org/10.1109/TR0.2008.2006868>.
- [J45] S. G. Carver, E. Roth, N. J. Cowan, and E. S. Fortune. Synaptic plasticity can produce and enhance direction selectivity. *PLoS Comp Biol* 4(2), 2008, <http://dx.doi.org/10.1371/journal.pcbi.0040032>. PMC2242823.
- [J46] J. Lee, S. N. Sponberg, O. Y. Loh, A. G. Lamperski, R. J. Full, and N. J. Cowan. Templates and anchors for antenna-based wall following in cockroaches and robots. *IEEE Trans Robot* 24(1):130–143, 2008, <http://dx.doi.org/10.1109/TR0.2007.913981>.
- [J47] N. J. Cowan. Navigation functions on cross product spaces. *IEEE Trans Autom Control* 52(7):1297–1302, 2007, <http://dx.doi.org/10.1109/TAC.2007.900834>.
- [J48] N. J. Cowan and E. S. Fortune. The critical role of locomotion mechanics in decoding sensory systems. *J Neurosci* 27(5):1123–1128, 2007, <http://dx.doi.org/10.1523/JNEUROSCI.4198-06.2007>.
- [J49] N. J. Cowan, J. Lee, and R. J. Full. Task-level control of rapid wall following in the American cockroach. *J Exp Biol* 209(9):1617–1629, 2006, <http://dx.doi.org/10.1242/jeb.02166>.
- [J50] R. J. Webster III, J. S. Kim, N. J. Cowan, G. S. Chirikjian, and A. M. Okamura. Nonholonomic modeling of needle steering. *Int J Robot Res* 25(5/6):509–526, May 2006, <http://dx.doi.org/10.1177/0278364906065388>.
- [J51] N. J. Cowan and D. E. Chang. Geometric visual servoing. *IEEE Trans Robot* 21(6):1128–1138, Dec. 2005, <http://dx.doi.org/10.1109/TR0.2005.853491>.
- [J52] N. J. Cowan, J. D. Weingarten, and D. E. Koditschek. Visual servoing via navigation functions. *IEEE Trans Robot Automat* 18(4):521–533, 2002, <http://dx.doi.org/10.1109/TRA.2002.802202>.

Book Chapters/Articles in Collections

- [B1] S. A. Stamper, M. S. Madhav, N. J. Cowan, and E. S. Fortune. Using control theory to characterize active sensing in weakly electric fishes. *Electroreception: Fundamental Insights from Comparative Approaches*, vol. 70, pp. 227–249. Springer, Springer Handbook of Auditory Research, 2019.
- [B2] N. J. Cowan, K. Goldberg, G. S. Chirikjian, G. Fichtinger, R. Alterovitz, K. B. Reed, V. Kallem, W. Park, S. Misra, and A. M. Okamura. Robotic needle steering: Design, modeling, planning, and image guidance. *Surgical Robotics – Systems, Applications, and Visions*, pp. 557–582. Springer, 2011.
- [B3] E. S. Fortune and N. J. Cowan. Robot behavior. *Encyclopedia of Animal Behavior*, vol. 3, pp. 87–90. Academic Press, Oxford, 2010.
- [B4] J. P. Swensen, V. Kallem, and N. J. Cowan. Empirical characterization of convergence properties for kernel-based visual servoing. *Visual Servoing via Advanced Numerical Methods*, vol. 401, pp. 23–38. Springer, 2010.
- [B5] J. Lee, A. Lamperski, J. Schmitt, and N. J. Cowan. Task-level control of the lateral leg spring model of cockroach locomotion. *Fast Motions in Biomechanics and Robotics: Optimization and Feedback Control*, vol. 340, pp. 167–188. Heidelberg: Springer-Verlag, Lecture Notes in Control and Information Sciences, 2006.

Full-Length Refereed Conference Articles

- [C1] S. Deng, R. L. Hatton, and N. J. Cowan. Enhancing maneuverability via gait design. *Proc IEEE Int Conf Robot Autom*, pp. 5799–5805, 2022.
- [C2] S. Cutlip, J. Freudenberg, N. Cowan, and R. B. Gillespie. Haptic feedback and the internal model principle. *IEEE World Haptics Conf*, pp. 568–573, 2019.

- [C3] D. Ehrens, F. Assaf, **N. J. Cowan**, S. V. Sarma, and Y. Schiller. Ultra broad band neural activity portends seizure onset in a rat model of epilepsy. *Conf Proc IEEE Eng Med Biol Soc.* IEEE, July 2018.
- [C4] **A. Kunapareddy** and **N. J. Cowan**. Recovering observability via active sensing. *Proc Amer Control Conf*, pp. 2821–2826, 2018.
- [C5] B. Fuerst, **E. E. Sutton**, R. Ghotbi, **N. J. Cowan**, and N. Navab. Bioelectric navigation: a new paradigm for intravascular device guidance. *Proc Med Image Computing and Computer-Assisted Intervention*, vol. 9902. Springer, LNCS, 2016.
- [C6] **I. Uyanik**, **M. M. Ankarali**, **N. J. Cowan**, O. Morgul, and U. Saranli. Toward data-driven models of legged locomotion using harmonic transfer functions. *Int Conf Advanced Robotics*, pp. 357–362, July 2015.
- [C7] **I. Uyanik**, **M. M. Ankarali**, **N. J. Cowan**, U. Saranli, O. Morgul, and H. Ozbay. Independent estimation of input and measurement delays for a hybrid vertical spring-mass-damper via harmonic transfer functions. *IFAC Workshop on Time Delay Systems*, June 2015.
- [C8] **S. Sefati**, **N. J. Cowan**, and R. Vidal. Linear systems with sparse inputs: observability and input recovery. *Proc Amer Control Conf*, pp. 5251–5257, 2015.
- [C9] **S. Sefati**, **N. J. Cowan**, and R. Vidal. Learning shared, discriminative dictionaries for surgical gesture segmentation and classification. *Proc Med Image Computing and Computer-Assisted Intervention*, October 2015.
- [C10] **M. M. Ankarali** and **N. J. Cowan**. System identification of rhythmic hybrid dynamical systems via discrete time harmonic transfer functions. *Proc IEEE Int Conf on Decision Control*, December 2014.
- [C11] **A. Lamperski** and **N. J. Cowan**. Time-changed linear quadratic regulators. *Proc Euro Control Conf*, July 2013.
- [C12] **S. G. Carver**, E. S. Fortune, and **N. J. Cowan**. State-estimation and cooperative control with uncertain time. *Proc Amer Control Conf*, pp. 2990–2995. IEEE, June 2013.
- [C13] **J. P. Swensen** and **N. J. Cowan**. Torsional dynamics compensation enhances robotic control of tip-steerable needles. *Proc IEEE Int Conf Robot Autom*, May 2012.
- [C14] **J. P. Swensen** and **N. J. Cowan**. An almost global estimator on $SO(3)$ with measurement on S^2 . *Proc Amer Control Conf*, June 2012.
- [C15] **S. Sefati**, I. Neveln, M. A. MacIver, E. S. Fortune, and **N. J. Cowan**. Counter-propagating waves enhance maneuverability and stability: a bio-inspired strategy for robotic ribbon-fin propulsion. *Proc IEEE Int Conf on Biomed Robot and Biomech*, 2012.
- [C16] **E. Roth**, M. B. Reiser, M. H. Dickinson, and **N. J. Cowan**. A task-level model for optomotor yaw regulation in *Drosophila melanogaster*: a frequency-domain system identification approach. *Proc IEEE Int Conf on Decision Control*, 2012.
- [C17] J. P. Dyhr, **N. J. Cowan**, D. J. Colmenares, K. A. Morgansen, and T. L. Daniel. Autostabilizing airframe articulation: Animal inspired air vehicle control. *Proc IEEE Int Conf on Decision Control*, 2012.
- [C18] **A. Demir**, **M. M. Ankarali**, J. P. Dyhr, K. A. Morgansen, T. L. Daniel, and **N. J. Cowan**. Inertial redirection of thrust forces for flight stabilization. *Proc Conf on Climbing and Walking Robots*, 2012.
- [C19] **V. Kallem**, D. E. Chang, and **N. J. Cowan**. Observer design for needle steering using task-induced symmetry and reduction. *World Cong Intl Fed Autom Control*, Aug. 2011.
- [C20] **A. De**, **J. Lee**, N. Keller, and **N. J. Cowan**. Toward SLAM on graphs. *Workshop on the Algorithmic Foundations of Robotics*, pp. 631–646. Springer-Verlag, Springer Tracts in Advanced Robotics, 2010.

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- [C31] R. J. Webster III, N. J. Cowan, G. S. Chirikjian, and A. M. Okamura. Nonholonomic models for needle steering. *Proc Int Symp Exp Robot*, vol. 21, pp. 35–44, Tracts in Advanced Robotics, June 2006.
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- [C40] **N. J. Cowan** and D. E. Chang. Toward geometric visual servoing. *Control Problems in Robotics*, vol. 4, pp. 233–248. Springer-Verlag, STAR, Springer Tracts in Advanced Robotics, 2002.
- [C41] **N. J. Cowan**. Binocular visual servoing with a limited field of view. *Mathematical Theory of Networks and Systems*, Aug. 2002.
- [C42] **N. J. Cowan**, J. D. Weingarten, and D. E. Koditschek. Empirical validation of a new visual servoing strategy. *Proc Conf Control Applications*, pp. 1117–1123, 2001.
- [C43] **N. J. Cowan**, G. A. D. Lopes, and D. E. Koditschek. Rigid body visual servoing using navigation functions. *Proc IEEE Int Conf on Decision Control*, pp. 3920–3926, 2000.
- [C44] **N. J. Cowan** and D. E. Koditschek. Planar image based visual servoing as a navigation problem. *Proc IEEE Int Conf Robot Autom*, vol. 1, pp. 611–617, 1999.
- [C45] **N. J. Cowan** and D. E. Koditschek. Toward global visual servos and estimators for rigid bodies. *Proc IEEE Int Conf Robot Autom*, vol. 3, pp. 2658–2663, 1998.

Non-refereed Articles and Abstracts (Recent)

- [A1] **G. Secer**, **R. P. Jayakumar**, M. Madhav, J. J. Knierim, and **N. Cowan**. A rate code for position error in a ring attractor model of path integration. *Comp and Systems Neurosci*, Mar. 2023.
- [A2] **H. Yeh**, **Y. Yang**, and **N. J. Cowan**. Luminance modulates sensorimotor delay in refuge tracking of *Eigenmannia virescens*. *Soc Int Comp Biol*, Jan. 2023.
- [A3] **Y. Yang**, **D. G. Yared**, and **N. J. Cowan**. Sensorimotor adaptation to novel dynamics in weakly electric fish. *Soc Int Comp Biol*, Jan. 2023.
- [A4] S. Zerefa, **D. Biswas**, **Y. Yang**, and **N. J. Cowan**. Decoding active sensing via tracking behavior in weakly electric fish. *Soc Int Comp Biol*, Jan. 2023.
- [A5] A. Pantula, B. Datta, Y. Shi, M. Wang, **S. Deng**, **N. J. Cowan**, T. D. Nguyen, and D. H. Gracias. Pick a side: Untethered thermoresponsive gel crawlers that can break symmetry. *American Chemical Society Spring Meeting*, Mar. 2023.
- [A6] **S. Deng**, R. L. Hatton, and **N. J. Cowan**. Enhancing maneuverability via gait design. *American Physical Society March Meeting*, Mar. 2022.
- [A7] **S. G. Lashkari**, **B. M Woronowicz**, P. Ozel, B. Krishnan, J. J. Knierim, and **N. J. Cowan**. Hippocampal place cell encoding during gap-crossing behaviors. *The Society for Neuroscience*, Nov. 2022.
- [A8] **D. Cao**, **M. G. T. Wilkinson**, A. J. Bastian, and **N. J. Cowan**. The cerebellar contribution to human feed-forward and feedback visuomotor control. *The Society for Neuroscience*, Nov. 2022.
- [A9] **M. S. Madhav**, **R. P. Jayakumar**, B. Y. Li, K. Wright, F. Savelli, J. J. Knierim, and **N. J. Cowan**. Coherent path integration recalibration observed in simultaneously recorded place cell and head direction cell populations. *The Society for Neuroscience*, Nov. 2022.
- [A10] Y. Sueoka, **R. P. Jayakumar**, M. M. Madhav, F. Savelli, **N. J. Cowan**, and J. J. Knierim. Phase code of place cells is maintained under hippocampal gain manipulations. *The Society for Neuroscience*, Nov. 2022.
- [A11] **R. P. Jayakumar**, Y. Sueoka, M. Ferreyros, B. Y. Li, M. M. Madhav, **N. J. Cowan**, and J. J. Knierim. Coherent path integration recalibration observed in simultaneously recorded place cell and head direction cell populations. *The Society for Neuroscience*, Nov. 2022.

- [A12] B. Krishnan, G. Secer, F. Savelli, S. G. Lashkari, R. P. Jayakumar, K. Wright, N. J. Cowan, and J. J. Knierim. Population responses in medial entorhinal cortex during recalibration of path integration gain. *The Society for Neuroscience*, Nov. 2022.
- [A13] G. Secer, R. Jayakumar, M. S. Madhav, J. J. Knierim, and N. J. Cowan. Representation of path-integration error in a ring attractor model. *The Society for Neuroscience*, Nov. 2022.
- [A14] G. Secer, R. P. Jayakumar, M. S. Madhav, J. J. Knierim, and N. J. Cowan. Representation of path-integration error in a ring attractor model. *The Brain Initiative Meeting*, June 2022.
- [A15] B. Krishnan, G. Secer, F. Savelli, S. G. Lashkari, N. J. Cowan, and J. J. Knierim. Mechanisms governing modulation of path-integration gain in the medial entorhinal cortex. *The Brain Initiative Meeting*, June 2022.
- [A16] Y. Yang, D. G. Yared, L. N. Peterson, E. S. Fortune, and N. J. Cowan. Can a fish ride a bicycle? the impacts of destabilizing feedback on refuge tracking behavior in *Eigenmannia virescens*. *Soc Int Comp Biol*, Jan. 2022.
- [A17] N. Muramatsu, N. J. Cowan, and A. Patel. Head stabilization and tracking of the cheetah during pursuit. *Soc Int Comp Biol*, Jan. 2022.
- [A18] B. Li, M. S. Madhav, R. P. Jayakumar, F. Savelli, K. Wright, J. J. Knierim, and N. J. Cowan. Neural closed-loop manipulation of place cell firing in rodents using optic flow cues. *The Society for Neuroscience*, Nov. 2021.
- [A19] Y. Yang, M. Wilkinson, L. Whitcomb, and N. Cowan. Modeling nonlinearities of refuge tracking in *Eigenmannia virescens*. *Soc Int Comp Biol*, Jan. 2021.
- [A20] A. Bhat, M. S. Madhav, R. P. Jayakumar, N. J. Cowan, and E. S. Fortune. Efficient localization of weakly electric fish with an electrode array. *Soc Int Comp Biol*, Jan. 2021.
- [A21] C. S. Yang, N. J. Cowan, and H. A. M. Automatization of control under a complex visuomotor mapping. *Learning Manual Skills in Humans and Robots*, May 2020.
- [A22] Y. Yang, Y. Pan, I. Uyanik, and N. J. Cowan. The selection of stimuli affects non-parametric system identification for refuge tracking behavior in *Eigenmannia virescens*. *Soc Int Comp Biol*, Jan. 2020.
- [A23] I. Uyanik, S. Sefati, S. A. Stamper, K. Cho, M. M. Ankarali, E. S. Fortune, and N. J. Cowan. Variability in locomotor dynamics reveals the critical role of feedback in task control. *Soc Int Comp Biol*, Jan. 2020.

PATENTS

1. N. Navab, N. Cowan, B. Fuerst, E. Fortune. System and Method for Bioelectric Localization and Navigation of Interventional Medical Devices, 2013. U.S. patent #10,448,860 on 10/22/2019
2. R. J. Webster III, A. M. Okamura, N. J. Cowan, R. H. Taylor. Active cannula for bio-sensing and surgical intervention, 2005. U.S. patent #8,152,756.
3. R. J. Webster III, A. M. Okamura, N. J. Cowan, G. S. Chirikjian, K. Y. Goldberg, and R. Alterovitz. Distal bevel-tip needle control device and algorithm, 2005. U.S. patent #7,822,458.

GRANTS AND CONTRACTS

Pending

1. **R01NS102537; Impact Score: 27 (11.0 percentile):** 07/01/2017–06/30/2022
 Title: *A Control Theoretic Approach to Addressing Hippocampal Function*
 Investigators: Noah J. Cowan (PI) and James J. Knierim (PI)
 Agency: National Institutes of Health–NINDS
 Award: \$2,170,211 (direct costs; split between PI's)

Current

1. **FA9550-23-1-0722:** 7/01/2013–06/30/2024
 Title: *Multisensory Integration and Processing for Decision Making in Drosophila Flight*
 Investigators: JHU: Noah J. Cowan (JHU PI); Cornell: Itai Cohen (Grant PI); USC: Sung Soo Kim
 Agency: Air Force Office of Scientific Research
 Award: \$1.2M (\$387,380 to Cowan/JHU)
2. **JHU Discovery Award (One Neuro Initiative):** 7/01/2013–06/30/2024
 Title: *Does Cerebellar Dysfunction Impair Hippocampal Recalibration?*
 Investigators: Noah J. Cowan (PI), Amy J. Bastian and James J. Knierim
 Agency: Johns Hopkins University
 Award: \$150,000
3. **NIH U01:** 04/1/2023–03/26/2026
 Title: *Cross-modal sensory interactions, processing, and representation in the Drosophila brain*
 Investigators: JHU: Noah J. Cowan (JHU PI); Cornell: Itai Cohen (U01 PI); Harvard: Bradley Dickerson; CWRU: Jessica Fox; Vanderbilt: Marie Suver
 Agency: National Institutes of Health
 Award: \$1,179,895 (to NJC)
4. **ONR #N000142112431:** 06/03/2021–06/02/2026
 Title: *Control and Learning Enabled Verifiable Robust AI (CLEVR-AI)*
 Investigators: JHU: Noah J. Cowan and René; NEU: Mario Sznajder (PI), Octavia Camps, Milad Siami, and Eduardo Sontag; UC Berkeley: Peter Bartlett, U Michigan: Necmiye Ozay
 Agency: Office of Naval Research
 Award: \$7,500,000 (Subaward to JHU: \$1,800,000; to NJC: \$900,000)
5. **NSF #2011619:** 08/15/2020–07/31/2024
 Title: *CRCNS: Discovering how touch sensors in the bat's 'hand-wing' enable agile flight control*
 Investigators: Noah Cowan, Joseph Katz, Rajat Mital, Cynthia Moss (PI)
 Agency: National Science Foundation
 Award: \$1,350,000.00 (To NJC: \$280,967)
6. **ARO #72929-EG-MUR:** 09/01/2018–08/31/2023
 Title: *Science of Embodied Innovation, Learning and Control*
 Investigators: Daniel E. Koditschek (U Penn, PI); Juliy Baryshnikov (UIUC), Robert J. Full & Lucia Jacobs (UC Berkeley), and Noah J. Cowan and Jame J. Knierim (JHU)
 Agency: Army Research Office
 Award: \$7,500,000 (Subaward to JHU: \$956,999; to NJC: ≈\$500,000)

Completed

1. **R01MH118926:** 7/01/2018–3/31/2023
 Title: *CRCNS Research Proposal: Collaborative Research: Dynamics of Gain Recalibration in the Hippocampal-Entorhinal Path Integration System*
 Investigators: James J. Knierim (PI), Noah J. Cowan, Kechen Zhang, and Kathryn R. Hedrick
 Agency: National Institutes of Health–NIMH
 Award: \$1,488,302 (Suballocation to NJC: \$547,227)
2. **NSF #1830893:** 09/15/2018–08/31/2022
 Title: *EFRI C3 SoRo: Programming Thermobiochemomechanical (TBCM) Multiplex Robot Gels*
 Investigators: David Gracias dgracias@jhu.edu (PI), Noah Cowan, Thao (Vicky) Nguyen, Rebecca Schulman
 Agency: National Science Foundation
 Award: \$2,000,000 (Suballocation to NJC: ≈\$500,000)
3. **HD040289:** 09/01/2017–08/31/2022
 Title: *Mechanisms and Rehabilitation of Cerebellar Ataxia*
 Investigators: Amy J. Bastian (PI) and Noah J. Cowan
 Agency: National Institutes of Health–NINDS
 Award: \$30,000 (Amount of Subaward to Cowan, JHU)

4. **R01NS102537:** 07/01/2017–06/30/2022
Title: *A Control Theoretic Approach to Addressing Hippocampal Function*
Investigators: Noah J. Cowan (PI) and James J. Knierim
Agency: National Institutes of Health–NINDS
Award: \$2,095,459 (to NJC: ≈\$1,000,000)
5. **NSF #1825489:** 08/01/2018–07/31/2021
Title: *Collaborative Research: Identifying Model-Based Motor Control Strategies to Enhance Human–Machine Interaction*
Investigators: James S. Freudenberg (PI), Noah J. Cowan, R. Brent Gillespie, and Amy J. Bastian
Agency: National Science Foundation
Award: \$381,470 (Amount to NJC, JHU)
6. **NSF-IOS #1557858:** 04/01/2016–03/31/2020
Title: *Collaborative Research: Neural Mechanisms of Active Sensing*
Investigators: Noah J. Cowan (PI) and Eric S. Fortune
Agency: National Science Foundation
Award: \$425,000 (To JHU)
7. **1R21NS103113:** 07/01/2017–06/30/2019
Title: *Using Feedback Control to Suppress Seizure Genesis in Epilepsy*
Investigators: Sridevi Sarma (PI), Noah J. Cowan
Agency: National Institutes of Health–NINDS
Award: \$410,437 (To NJC: ≈\$29,000)
8. **NSF-REU #1460674 :** 4/1/2015–3/31/2018
Title: *Research Experience for Undergraduates (REU) Site for Computational Sensing and Medical Robotics (CS&MR)*
Investigators: Ralph Etienne-Cummings (PI) and Sridevi Sarma (Co-PI). N. J. Cowan’s Role: Senior Personnel.
Agency: National Science Foundation
Award: \$412,151 (To NJC: \$0)
9. **1R21NS095075-01:** 9/01/2015–08/31/2016
Title: *A Control Theoretic Approach to Addressing Hippocampal Function*
Investigators: Noah J. Cowan (PI) and James Knierim
Agency: National Institutes of Health–NINDS
Award: \$445,500 (≈ split between PI’s)
10. **JSMF Scholar Award in Complex Systems Science:** 09/01/2012–8/31/2017
Title: *Decoding Complex Animal Behavior Via Sparsity*
Investigators: N. J. Cowan (PI)
Agency: James S. McDonnell Foundation
Award: \$450,000
11. **ARO#15086871:** 5/1/2016–9/30/2017
Title: *Dynamic tuning of instabilities for high power movements in deformable structures*
Investigators: Barry Trimmer (PI), Robert Shepherd, Eric Tytell, and Noah J. Cowan (JHU PI)
Agency: Army Research Office
Award: \$55,231 (to JHU)
12. **JHU Discovery Award:** 9/1/2016–8/30/2017
Title: *The Bat Hand-wing: A Model System for Sensing and Feedback Control in Animals*
Investigators: C. Moss (PI), Rajat Mittal, Joseph Katz, Noah Cowan, Susanne Sterbing-D’Angelo
Agency: Johns Hopkins University
Award: \$100,000 (To NJC: ≈\$15K)
13. **JHU Discovery Award:** 7/01/2015–06/30/2016
Title: *Engineering Approaches to Studying Spatial Representations in the Brain*
Investigators: Noah J. Cowan (PI) and James Knierim
Agency: Johns Hopkins University
Award: \$100,000

14. **JHU Science of Learning Institute:** 06/1/2013–5/31/2015
Title: *The cognitive timeline: Role of the hippocampus in reducing interference*
Investigators: James Knierim (PI), Noah J. Cowan, and Michael Yassa
Agency: Johns Hopkins University
Award: \$160,000
15. **NSF-BCS #1230493:** 8/1/2012–7/31/2015
Title: *Understanding the Rules for Human Rhythmic Motor Coordination: From Walking to Juggling*
Investigators: N. J. Cowan (JHU PI), J. Jeka, T. Kiemel (Project PI), N. M. Wereley
Agency: National Science Foundation
Award: \$672,413 (To NJC: \$232,079)
16. **ONR N000141110525:** 07/01/2011–06/30/2014
Title: *Multisensory Integration in MSTd for Navigation and Control*
Investigators: N. J. Cowan (PI), E. Tytell, C. J. Duffy
Agency: Office of Naval Research
Award: \$751,925 (To NJC: \$355,000)
17. **NSF-CBET #0941674:** 10/1/2009–9/30/2013
Title: *Cyber-Enabled Discovery in Neuromechanical Systems*
Investigators: N. J. Cowan (JHU PI), E. S. Fortune, G. Lauder, M. MacIver (Program PI), N. Patankar
Agency: National Science Foundation
Award: \$1,400,000 (To NJC: \$318,000)
18. **NSF-IIS #0845749:** 3/1/2009–2/28/2014
Title: *PECASE: Sensory Guidance of Locomotion: From Neurons to Newton's Laws*
Investigators: N. J. Cowan (PI)
Agency: National Science Foundation
Award: \$500,000
19. **William R. Kenan, Jr. Fund for Teaching:** 7/1/2011-6/30/2012
Title: *A Hands-On Introduction to Animal Sensors and Actuators for Engineering Students*
Investigators: N. J. Cowan
Agency: William R. Kenan, Jr. Fund
Award: \$4,800
20. **ONR N000140910531:** 1/31/2009–9/30/2011
Title: *Kalman Filters in Brain Circuits: Multisensory Control in Weakly Electric Knifefish*
Investigators: N. J. Cowan (PI) and E. S. Fortune
Agency: Office of Naval Research
Award: \$611,132 (To NJC: \$460,352)
21. **NSF-IOS #0817918:** 9/1/2008–8/31/2011
Title: *Enhancement of Electrosensory Function via Social Interaction*
Investigators: N. J. Cowan and E. S. Fortune (PI)
Agency: National Science Foundation
Award: \$428,408 (To NJC: \$204,900)
22. **NIH-NIBIB R01 #EB006435:** 8/15/2006–5/31/2011
Title: *Steering Flexible Needles in Soft Tissue*
Investigators: N. J. Cowan, G. S. Chirikjian, G. Fichtinger, K. Goldberg, A. M. Okamura (PI)
Agency: National Institutes of Health–NIBIB
Award: \$2,446,313 (To NJC: \$482,717)
23. **NSF-IIS: REU Extension to #0845749:** 3/1/2009–2/28/2010, \$8,000
24. **NSF-CBET #0651803:** 8/15/2007–7/31/2010
Title: *Active Cannulas for Bio-Sensing and Surgery*
Investigators: N. J. Cowan (PI), A. M. Okamura, and R. J. Webster III
Agency: National Science Foundation
Award: \$240,000 (To NJC: \$59,411)
25. **NSF-ENG #0748338:** 10/1/2008–9/30/2009
Title: *Manipulating and Perceiving Simultaneously*
Investigators: N. J. Cowan, G. D. Hager (PI), and A. M. Okamura

- Agency: National Science Foundation
Award: \$200,000 (to NJC: \$75,000)
26. **NSF-CBET: REU Extension to #0651803:** 8/15/2007–7/31/2008, \$3,000
 27. **WSE/APL Partnership Fund:** 9/1/2006–12/31/2007, \$75,000
Title: *Ribbon-Finned Propulsion for Dynamic Maneuvers of Underwater Vehicles*
 28. **NSF-ENG #0625708:** 10/1/2006–9/30/2007
Title: *Vision-Based Control of Mechanical Systems via Sampling Kernels*
Investigators: N. J. Cowan (PI) and G. D. Hager
Agency: National Science Foundation
Award: \$64,927 (To NJC: \$32,464)
 29. **NSF-IOB #0543985:** 4/01/2006–3/31/2009
Title: *Multisensory Control of Tracking Behavior in Weakly Electric Fish*
Investigators: N. J. Cowan (PI) and E. S. Fortune
Agency: National Science Foundation
Award: \$486,198 (To NJC: \$228,140)
 30. **NSF-IOB: REU Extension to #0543985:** 4/1/2008–3/31/2009, \$6,000
 31. **NSF-IOB: REU Extension to #0543985:** 4/1/2006–3/31/2007, \$6,000
 32. **NSF-IOB: REU Extension to #0543985:** 4/1/2007–3/31/2008, \$6,000
 33. **Subaward to NSF ERC Core Grant #9731478 (Taylor, PI):** 9/1/2006–8/31/2007, To NJC: \$32,616
 34. **NIH R21 #EB003452:** 4/1/04–3/31/2006
Title: *Biomechanical Modeling for Steerable Needles*
Investigators: N. J. Cowan, G. S. Chirikjian, K. Goldberg, A. M. Okamura (PI)
Agency: National Institutes of Health–NIBIB
Award: \$384,323 (To NJC: \$120,000)

INVITED SEMINARS

Plenary and Keynote Lectures

- ◇ Keynote Speaker, *Society of Integrative and Comparative Biology*, SE Regional Meeting, Atlanta, GA, 2015
- ◇ Keynote Speaker, *IEEE Baltimore EDS society*, Chapter Meeting, Linthicum, MD, 2015
- ◇ Keynote Speaker, *International Conference on Advanced Robotics (ICAR)*, Istanbul, Turkey, 2015
- ◇ Keynote Speaker, *Annual Awards Dinner*, IEEE Baltimore Section, Baltimore, MD, 2015
- ◇ “Tandem Talk” with Volker Dür, *International Symposium on Adaptive Motion of Animals and Machines*, Darmstadt, Germany, 2013
- ◇ Early Career Spotlight Lecture, *Robotics: Science and Systems Conference*, Atlanta, GA, 2007
- ◇ Plenary Lecture, *International Consortium on Biomimetic Technology for Vibrissal Active Touch (BIOTACT)*, Garmisch, Germany, 2010

Departmental Colloquia & Seminars

- ◇ *Mechanical Engineering Seminar Series*, University of Nevada, Reno, 2023
- ◇ *Maryland Robotics Center Seminar Series*, University of Maryland, College Park, 2023
- ◇ *Electrical and Electronics Engineering Department Seminar*, Hacettepe University, Ankara, Turkey, 2023
- ◇ *ROMER Talk*, Center for Robotics and Artificial Intelligence, Middle East Technical University, Ankara, Turkey, 2023
- ◇ *Electrical and Electronics Engineering Department Distinguished Seminar Series*, Bilkent University, Ankara, Turkey, 2023
- ◇ *Quantitative Ecology, Ethology, and Evolution Seminar*, Harvard University, Cambridge, MA, 2023
- ◇ *Experimental Robotics Seminar Series*, Northeastern University, Boston, MA, 2023
- ◇ *ABC Robotics Seminar Series*, Ben Gurion University of the Negev, Beer Sheva, Israel (via zoom), 2021
- ◇ *Robotics Club Seminar*, Johns Hopkins University, Baltimore, MD (via zoom), 2020

- ◇ *Robotics Seminar*, University of Utah, Salt Lake City, UT (via zoom), 2020
- ◇ *Electrical and Computer Engineering Seminar*, University of Washington, Seattle, WA (via zoom), 2020
- ◇ *Mechanical Engineering Seminar*, Johns Hopkins University, Baltimore, MD (via zoom), 2020
- ◇ *Biomechanics Seminar Series*, US Naval Academy, Annapolis, MD, 2019
- ◇ *Department of Mechanical Engineering*, Yale University Minnesota, New Haven, CT, 2019
- ◇ *BIRS Workshop on Optimal Neuroethology of Movement and Motor Control*, Banff International Research Station for Mathematical Innovation and Discovery (BIRS) Banff, Canada, 2019
- ◇ *Center for Neural Engineering Seminar*, University of Minnesota, Minneapolis, MN, 2018
- ◇ *Department of Mechanical Engineering*, Ohio State University, Columbus, OH, 2018
- ◇ *Control Systems Seminary*, University of Michigan, Ann Arbor, MI, 2018
- ◇ *Mathematical Biology Seminar*, New Jersey Institute of Technology, Newark, NJ, 2017
- ◇ *Electrical and Computer Engineering Seminar*, Ohio State University, Columbus, OH, 2017
- ◇ *Robotics Institute Seminar*, Carnegie Mellon University, Pittsburgh, PA, 2017
- ◇ *Janelia Research Campus Seminar*, Ashburn, VA, 2017
- ◇ *Applied Mathematics*, University of Waterloo, Waterloo, ON, 2016
- ◇ *Mechanical Engineering Seminar*, Penn State University, State College, PA, 2016
- ◇ *Biophysics Colloquium*, Georgia Institute of Technology, Atlanta, GA, 2015
- ◇ *Biology Colloquium*, Muhlenberg College, Allentown, 2015
- ◇ *GRASP Laboratory Seminar Series*, University of Pennsylvania, Philadelphia, 2015
- ◇ *Biotechnology Seminar Series*, University of Nebraska, Lincoln, 2015
- ◇ *Rehabilitation Science Research Seminar*, University of Maryland School of Medicine, Baltimore, 2014
- ◇ *Neuroscience Retreat*, Johns Hopkins University, Baltimore, 2014
- ◇ *Applied Dynamics Seminar Series*, University of Maryland, College Park, 2014
- ◇ *Joint seminar for CiBER-IGERT and the Control Theory Seminar Series*, University of California, Berkeley, CA, 2014
- ◇ *Neuroscience Seminar Series*, Baylor College of Medicine, Houston, TX, 2013
- ◇ *Biorobotics Seminar Series*, Arizona State University, Tempe, AZ, 2013
- ◇ *Coordinated Science Lab*, University of Illinois, Champaign, IL, 2013
- ◇ *Engineering Seminar*, Howard Community College, Laurel, MD, 2013
- ◇ *Robotics Seminar*, University of Maryland, College Park, MD, 2012
- ◇ *Biology Seminar*, University of Washington, Seattle, WA, 2011
- ◇ *Psychology Seminar*, University of Washington, Seattle, WA, 2011
- ◇ *Civil Engineering Seminar Series*, Johns Hopkins University, Baltimore, MD, 2010
- ◇ *Robotics and Intelligent Machines (RIM) Seminar Series*, Georgia Institute of Technology, Atlanta, GA, 2009
- ◇ *Laboratory for Computational Sensing and Robotics (LCSR) Seminar Series*, Johns Hopkins University, Baltimore, MD, 2009
- ◇ *Machines and Organisms Seminar Series*, Cornell University, Ithaca, NY, 2008
- ◇ *Theoretical and Applied Mechanics Seminar Series*, Cornell University, Ithaca, NY, 2008
- ◇ *Computer Science and Artificial Intelligence Lab Colloquium*, MIT, Cambridge, MA, 2008
- ◇ *Control Systems Seminar Series*, University of Michigan, Ann Arbor, 2007
- ◇ *Mechanical & Aerospace Eng. Seminar Series*, George Washington University, Washington, DC, 2007
- ◇ *Johns Hopkins Student Research Group*, Johns Hopkins University, Baltimore, MD, 2007
- ◇ *Electrical Engineering Seminar Series*, Harvard University, Cambridge, MA, 2006
- ◇ *Biomedical Engineering Seminar Series*, Northwestern University, Evanston, IL, 2006
- ◇ *GRASP Laboratory Seminar Series*, University of Pennsylvania, Philadelphia, 2004
- ◇ *Mechanical Engineering Seminar Series*, Ohio State University, Columbus, 2004
- ◇ *Control Systems Seminar Series*, University of Washington, Seattle, 2003
- ◇ *Mechanical Engineering Seminar Series*, Johns Hopkins University, Baltimore, MD, 2003
- ◇ *Computer Vision Seminar Series*, University of California at Berkeley, 2002
- ◇ *Mechanical Engineering Seminar Series*, Johns Hopkins University, Baltimore, MD, 2001
- ◇ *Electrical Engineering Symposium*, Ohio State University, Columbus 2001

Invited Talks at Symposia, Workshops, Tutorials, and Conferences

- ◇ Invited Speaker, *Reflexive Mobility and Control Workshop*, Army Research Lab, 2023.
- ◇ Invited Speaker, *International Conference on Active Sensing: From Animals to Robots*, Weizmann Insitute of Science, 2023
- ◇ **Cancelled due to COVID-19** *Karniel Motor Control Workshop*, Ben-Gurion University of the Negev, Be'er Sheva, Israel, TBD
- ◇ **NSF Workshop Series** (Virtual), *Models of control: central versus decentralized control, integration of feedforward and feedback control mechanisms*. National Science Foundation, 2022
- ◇ **NSF Workshop Spatial Navigation for Biologically Inspired Smart Robotics** (Virtual), National Science Foundation, 2021
- ◇ Invited Speaker, *Summer School on "Robotics-Biology Symbiosis"*, Imperial College, London, 2017
- ◇ *Winter Workshop on Locomotion*, Tulane University, New Orleans, LA, 2017
- ◇ Invited Speaker, *Dynamic Walking Conference*, Ann Arbor, MI, 2016
- ◇ Invited Speaker, *Dynamic Walking Conference*, Columbus, OH, 2015
- ◇ Invited Speaker, *Robotics-Inspired Biology Workshop*, International Conference on Robotics and Automation (ICRA), Seattle, WA, 2015.
- ◇ *Workshop on Distributed Sensing, Actuation, and Control*, University of Maryland, College Park, MD, 2014.
- ◇ *Dynamics Days*, Georgia Institute of Technology, Atlanta, GA, 2014
- ◇ *Grand Challenges in Organismal Biology: Walking the Tightrope between Stability and Change*, Symposium at the Society for Integrative and Comparative Biology (SICB) Annual Meeting, Austin, TX, 2014
- ◇ *AMS sectional meeting*, Temple University, 2013.
- ◇ *Grand Challenges in Organismal Biology: Walking the Tightrope between Stability and Change*, Cold Spring Harbor, NY, 2013
- ◇ *Yale Workshop on Adaptive and Learning Systems*, Yale, New Haven, Connecticut, 2013
- ◇ Invited Speaker, *Dynamic Walking Conference*, Pensacola, FL, 2012.
- ◇ *Winter Workshop on Locomotion*, Princeton, Princeton, New Jersey, 2012
- ◇ Invited Speaker, *EU-US Frontiers of Engineering Workshop*, sponsored by the NAE and Euro-CASE, Cambridge, England, 2010
- ◇ *Yale Workshop on Adaptive and Learning Systems*, Yale, New Haven, Connecticut, 2008
- ◇ *Workshop on the Neuromechanics of Locomotion*, Mathematical Biosciences Institute, Ohio State University, Columbus, 2008
- ◇ *Needle Steering Workshop, Medical Image Computing and Computer Assisted Intervention (MICCAI)*, 2008
- ◇ *Tutorial on Computer-Integrated Surgery & Interventional Robotics, IEEE International Conference on Robotics and Automation (ICRA)*, Rome, Italy, 2007
- ◇ *Active Sensation Workshop*, Computational Systems Neuroscience Meeting, Park City, UT, 2007
- ◇ *Forty-Fifth Annual Allerton Conference on Communication, Control, and Computing*, Urbana, IL, 2007
- ◇ *Neuromorphic Engineering Workshop*, Telluride, Colorado, 2005
- ◇ *Control of Robotic Systems for Manipulation and Cooperation*, Bertinoro, Italy, 2003
- ◇ *Control Workshop*, Ohio State University, Columbus, 2000
- ◇ *Industrial Partners of Computer Science (IPoCSE) Symposium*, Ann Arbor, MI, 2000

Other Invited and Outreach Presentations

- ◇ Inagural Online Speaker, Center for Talented Youth, 2020. Over 500 attendees.
- ◇ Presenter, i2Camp STEM Summer Camp, Baltimore, MD, 2014
- ◇ Presenter, Science Day, School of the Cathedral of Mary Our Queen, Baltimore, MD 2014
- ◇ Presenter / Panelist, *Specific Aims 101*, Sponsored by the Homewood Postdoctoral Association, Johns Hopkins University, Baltimore, MD, 2014
- ◇ *Meyerhoff Scholars Bridge Program*, University of Maryland Baltimore County, Johns Hopkins University, Baltimore, MD, 2009, 2014
- ◇ Presenter / Panelist, *Writing a Successful NSF Proposal*, Sponsored by the Homewood Postdoctoral Association, Johns Hopkins University, Baltimore, MD, 2010

ADVISING AND MENTORING

Current Ph.D. Students

- ◇ Shahin Lashkari, Ph.D. Expected 2022. **Awards:** Creel Family Teaching Award.
- ◇ Yu Yang, Ph.D. Expected 2023
- ◇ Siming Deng, Ph.D. Expected 2023
- ◇ Di Cao, Ph.D. Expected 2023. **Awards:** Creel Family Teaching Award.
- ◇ Michael Wilkinson, Ph.D. Expected 2024. **Awards:** NSF Fellowship (Honorable Mention)
- ◇ Brian Woronovicz, Ph.D. Expected 2025

Current Postdoctoral Fellows

- ◇ Gorkem Secer, Ph.D., starting January 2020
- ◇ Ravi Jayakumar, Ph.D., 2019–present (Co-advised with James Knierim)

Previous Ph.D. Students

- ◇ Christopher Yang (co-mentor), Ph.D., 2022; Primary Advisor: Adrian Haith.
Awards: LINK Foundation Fellowship.
Research Scientist, Lockheed Martin.
- ◇ Ravi Jayakumar, Ph.D., 2019
“State Estimation in Complex Biological Systems”
Postdoctor fellow at Johns Hopkins University
- ◇ Robert Nickl, Ph.D., 2018
“Spatial and Timing Regulation of Upper-Limb Movements in Rhythmic Tasks”
Awards: NSF Fellowship, LINK Foundation Fellowship
Postdoctoral Fellow at Johns Hopkins University
- ◇ Erin Sutton, Ph.D., 2017
“Bioelectric Sensing and Navigation: Multimodal Control in Electric Fish and Catheter Navigation”
Awards: NSF Fellowship, ARCS Foundation Fellowship
Senior Professional Staff at the Johns Hopkins Applied Physic Laboratory
- ◇ Amanda Zimmet (Co-advised with Amy Bastian), 2017
“Feedback Control in the Cerebellum”
Postdoctoral Fellow at the University of Virginia
- ◇ M. Mert Ankarali, Ph.D., 2015.
“Variability, Symmetry, and Dynamics in Human Rhythmic Motor Control”.
Awards: 2015 Siebel Scholar **Assistant Professor** of Electrical and Electronics Engineering at Middle East Technical University, Ankara, Turkey.
- ◇ Alican Demir, Ph.D, 2015.
“Bio-inspired antennal tactile sensing”.
Engineer at Clearguide Medical, Inc.
- ◇ Manu Madhav, Ph.D., March 2014.
“Nonlinear processing of sensory interference drives social behavior in weakly electric fish.”
Awards: Kavli Postdoctoral Fellow (while a postdoc jointly in my lab) **Assistant Professor** of Biomedical Engineering at the University of British Columbia.
- ◇ Shahin Sefati, Ph.D., July 2014.
“Modeling Complex Biological and Mechanical Movements: Application to Animal Locomotion and Gesture Classification in Robotic Surgery.”
Engineer at Comcast Research.
- ◇ Eatai Roth, Ph.D. July 2012.
“Task-Level Models for Image-Stabilization Behaviors in Animals”.
Awards: NSF Graduate Research Fellowship. ARCS Foundation Fellowship. **Assistant Professor** of Intelligent Systems Engineering at Indiana University, Bloomington (2017-2021)
- ◇ John Swensen, Ph.D. December 2011.
“Torsional Dynamics and Rotational Estimation of Tip-steerable Needles.”
Associate Professor at Washington State University.

- ◇ Robert J. Webster III, Ph.D. December 2007 (Co-advised with Prof. Allison Okamura).
“Design and Mechanics of Continuum Robots for Surgery”.
Awards: Dick Volz Best US PhD Thesis in Robotics and Automation in 2011. NSF GRFP.
Professor of Mechanical Engineering at Vanderbilt University.
- ◇ Vinutha Kallem, Ph.D. July 2008.
“Vision-Based Control on Lie Groups with Application to Needle Steering”.
Senior Product Manager, Cruise Automation
- ◇ Jusuk Lee, Ph.D. January 2009.
“Identifying Feedback Control Strategies of Running Cockroaches and Humans”.
Engineer with the Mechatronics & Manufacturing Technology Center, Samsung Electronics.

Previous M.S. Thesis Students

- ◇ Landon Unninayar, M.S. 2004. Now a mechanical engineer at iRobot corporation.
- ◇ Brett Kutscher, M.S. 2004. Now a software engineer at General Dynamics Robotic Systems.
- ◇ Alican Demir, M.S. 2009. Now a Ph.D. student in Dr. Cowan’s laboratory.
- ◇ Avik De, M.S. 2010. Now a Ph.D. student at the University of Pennsylvania.
- ◇ Eva Siehmann, M.S. 2013; performed her thesis research at Johns Hopkins under Dr. Cowan’s supervision. Thesis was awarded at Westphalian University of Applied Sciences, Gelsenkirchen. Eva recieved the Lorenz-Wegen award for best thesis at her university for her work done at JHU.
- ◇ Abhinav Kunapareddy, M.S. 2016.

Previous Postdoctoral Fellows and Research Scientists

- ◇ Manu Madhav, Ph.D., 2014–2020 (Co-advised with James Knierim). Also my PhD student.
Assistant Professor of Biomedical Engineering at the University of British Columbia.
- ◇ Ismail Uyanik, Ph.D., 2017–2019.
Assistant Professor of Electrical and Electronics Engineering at Hacettepe University. Awarded “Ben Barres Spotlight Award” for his eLife paper.
- ◇ Sarah Stamper, Ph.D., 2012–2015. Associate Director of Research at Art & Science Group. Awarded “International Society for Neuroethology, Young Investigator Award”
- ◇ Andrew Lamperski, Ph.D., 2012.
Assistant Professor of Electrical and Computer Engineering, University of Minnesota.
- ◇ Eric Tytell, Ph.D. (co-mentored with Prof. Eric Fortune), 2010-2012.
Associate Professor of Biology at the Tufts.
- ◇ Sean Carver, Ph.D. (co-supervised with Prof. Eric Fortune), 2006–2009, 2010-2013.
Professorial Lecturer in Mathematics at American University (20013-2020).
- ◇ Kyle Reed, Ph.D. (co-supervised with Prof. Allison Okamura), 2007–2009.
Associate Professor of Mechanical Engineering at the University of South Florida.
- ◇ Terence Mitchell, Ph.D. (co-supervised with Prof. Eric Fortune), 2009-2011.
Associate Professor of Anatomy at Campbell University School of Osteopathic Medicine.
- ◇ Erion Plaku, Ph.D. (co-supervised with Profs. Allison Okamura and Greg Hager), 2008–2010
Associate Professor of Computer Science at George Mason University.
- ◇ Jacopo Piazzi, Ph.D. 2003.

Undergraduate and High School Students

Advised at least 75 undergraduate researchers including several students with NSF REU’s (16, including 2 minorities and 8 women), Howard Hughes Fellows (2), and Provost Undergraduate Research Awards (6). Many of these undergraduates have coauthored conference and journal papers. Advised 13 high school students, in cooperation with two local programs, the Ingenuity Project at Baltimore Polytechnic Institute (6, including one female minority), and the Women in Science and Engineering program with Garrison Forest school (6). Two of these high school students have co-authored peer-reviewed conference papers.

Dissertation Committees

- ◇ At **Johns Hopkins University**: Yu Zhou (2004), Jin Seob Kim (2005), James Kinsey (2006), Aris Skliros (2007), Yan Liu (2007), Maneesh Dewan (2007), Wooram Park (2008), Kiju Lee (2008), Stephen Martin (2008), Sarah Webster (2010), Georgios Kaloutsakis (2010), Matthew Moses (2011), Michael Kutzer (2012), Sarah Stamper (2012), Jean Michelle Mongeau (UC Berkeley external member, 2013), Giancarlo Troni (2013), Thomas Wedlick (2013), Christopher McFarland (2013), Ryan Murphy (2015), Qianli Ma (2017), Joshua Davis (2018), Andrew Spielvogel (2020), Sipu Ruan (2020), Hasan Oral (2020), Daniel Ehrans (2021), Iven (Chao) Yu (2021), Brittney Boubllil (2021), Rick Han (2022), Mohit Singhala (2022), Thomas Mitchel (2022), Hongtao Wu (2022), Chris Yang (2022; co-mentor), Gabriel Baraban (2022), Qiyuan Fu (2023), Isis Wyche (expected 2023), Crane Chen (expected 2023), Qihan Xuan (expected 2023), Christopher Hunt (expected 2023).
- ◇ At other institutions: Jean-Michele Mongeau (University of California, Berkeley; 2013), David Logan (University of Maryland, Collge Park; 2014).

Graduate (Doctoral) Board Oral (GBO/DBO) Committees

65 exam committes from 2003-2023: 11 as Chair, 9 as External Member, 45 as Internal Member.

INSTRUCTION AND CURRICULUM DEVELOPMENT

The University of Washington, 2011

- ◇ **(unregistered course)** *Feedback Control of Mechanical Systems for Biologists* (new course)
 - *Semester taught (attendees)*: Spring 2011 (\approx 15 students, postdocs, and faculty)
 - *Course description*: Weekly lectures, practice problems, and sample code provide a theoretically rigorous, experimentally motivated introduction to feedback control of mechanical systems. The course emphasizes the art of applying control theoretic concepts to biology, drawing on recent literature as well as numerous examples from on going work at Johns Hopkins and the University of Washington.

Johns Hopkins University, 2003–present

Key: EN.530=Mechanical Engineering

- ◇ **Robotics MSE** (Administered 2013–2018)
 - The Robotics MSE at Johns Hopkins is a multidisciplinary Master’s program that recruits students locally via JHU’s BS/MSE program, nationally, and internationally.
 - The MSE incorporates courses from Mechanical Engineering, Electrical and Computer Engineering, Computer Science, and Biomedical Engineering, and Applied Math and Statistics.
 - The program has grown since its inception in 2013 to approximately 20 new students to be enrolled in Fall 2016.
 - The minor was approved by the Academic Council in Spring 2010.
- ◇ **Robotics Minor** (Co-Developed with Greg Hager, Minor Advisor from 2010–2018)
 - The Robotics Minor at Johns Hopkins is a multidisciplinary minor that emphasizes an interdisciplinary curriculum focused on three core technical areas: 1) Robot kinematics and dynamics; 2) Systems theory, signal processing, control; 3) Computation and sensing.
 - The minor incorporates courses from Mechanical Engineering, Electrical and Computer Engineering, Computer Science, and Biomedical Engineering, and Applied Math and Statistics.
 - The minor is open to all undergraduates at Johns Hopkins and is offered by the faculty of the [Laboratory for Computational Sensing and Robotics \(LCSR\)](#).
 - The minor was approved by the Academic Council in Spring 2010.
- ◇ **EN.530.485** *Physics and Feedback in Living Systems* (new course)
 - *Semesters taught (enrollment)*: Fall 2013 (9), Fall 2015 (10)
 - *Course description*: The complex mechanisms of living systems cannot be reduced to a set of base pairs: genes are only one part of mystery of life. Rather, organisms must develop, move, interact, and function in their natural environment, and thus are constrained by the laws of physics. For example, during locomotion an animal must accelerate according to Newton’s laws by applying forces between itself and the environment. Beyond physical principles alone, biological systems

extensively use feedback to enhance stability and facilitate adaptation in the presence of a changing world. This course examines the critical roles that physical principles and feedback mechanisms play in life, with special emphasis on animal locomotion and its control.

- ◇ **EN.530.202** *Mechanical Engineering: Dynamics*
 - *Semesters taught (enrollment)*: Spring 2023 (56)
 - *Course description*: Basic principles of classical mechanics applied to the motion of particles, system of particles and rigid bodies. Kinematics, analytical description of motion; rectilinear and curvilinear motions of particles; rigid body motion. Kinetics: force, mass, and acceleration; energy and momentum principles. Introduction to vibration.
- ◇ **EN.530.212** *ME Dynamics Laboratory*
 - *Semesters taught (enrollment)*: Spring 2023 (56)
 - *Course description*: Laboratory companion course for 530.202, ME Dynamics.
- ◇ **EN.530.420** *Robot Sensors and Actuators*
 - *Semesters taught (enrollment)*: Fall 2012 (64)
 - *Course description*: Introduction to modeling and hands-on use of actuators and sensors including DC brush motors, stepper motors, position sensors (such as encoders, synchros, resolvers), and sonar sensing. Integration of these sensors and actuators into mechatronic systems using microcontrollers, including digital I/O, analog/digital conversion.
 - *Final Project*: Implemented an ambitious course final project involving Molecular gastronomy in collaboration with Chef Jerry Pellegrino. See full video here: <http://www.youtube.com/watch?v=X6XBoEyC8HY>
- ◇ **EN.530.241**: *Electronics and Instrumentation* (redeveloped course)
 - *Semesters taught (enrollment)*: Fall 2004 (26), Fall 2005 (38), Fall 2006 (29), Spring 2007 (34), Spring 2008 (28)
 - *Course description*: Undergraduate, laboratory-based introduction to basic analog electronics and instrumentation with emphasis on basic electronic devices and techniques relevant to mechanical engineering.
 - *Modification*: Interdisciplinary labs and examples are drawn from biology, specifically instrumentation for weakly electric knifefish. The final project is to develop a field-ready instrumentation amplifier for measuring electric signals in weakly electric knifefish.
- ◇ **EN.530.343**: *Design and Analysis of Dynamic Systems* (existing course)
 - *Semester taught (enrollment)*: Spring 2009 (39), Spring 2010 (38), Spring 2017 (79), Spring 2019 (47)
 - *Course description*: Modeling and analysis of damped and undamped, forced and free vibrations in single and multiple degree-of-freedom linear dynamical systems. Introduction to stability and control of linear dynamical systems.
- ◇ **EN.530.616**: *Introduction to Linear Dynamical Systems* (redeveloped course)
 - *Semesters taught (enrollment)*: Spring 2007 with René Vidal (15), Fall 2008 (18), Fall 2009 (8), Spring 2019 (14), Fall 2022 (18)
 - *Course description*: A beginning graduate course in linear systems theory.
 - *Modification*: Course emphasizes a linear-algebraic perspective on linear systems theory.
- ◇ **EN.530.646** *Robot Devices, Kinematics, Dynamics, and Control* (redeveloped course)
 - *Semesters taught (enrollment)*: Spring 2005 (14), Fall 2008 (13), Fall 2012 (18), Fall 2014 (31), Fall 2015 (34), Fall 2016 (48), Fall 2017 (TBD)
 - *Course description*: A beginning graduate course that provides an introduction to the mathematical and physical principles used in robotics. Beginning Fall 2015, this course has been redeveloped to incorporate a hardware component using the 6DOF UR5 robot.
 - *Modification*: Course emphasizes a Lie-group-theoretic approach to robotics.
- ◇ **EN.530.676**: *Locomotion in Mechanical and Biological Systems* (new course)
 - *Semesters taught (enrollment)*: Spring 2004 (21), Spring 2006 (6), Fall 2011 (12), Spring 2018 (5), Spring 2020 (9), Spring 2022 (13).
 - *Course description*: Graduate course on mechanics and control in locomotion. Topics include modeling (e.g. Lagrangian mechanics, gray-box modeling), dynamical systems theory (nonholonomic systems, piecewise holonomy, Poincaré analysis, and Floquet theory), design (control synthesis, mechanical design), and data analysis from real animal locomotor control experiments.

- ◇ **EN.530.677: *Feedback Control of Walking and Running*** (new course)
 - *Semester taught (enrollment)*: Spring 2008 (7)
 - *Course description*: Graduate course on the modeling, control, and adaptation of human and robotic bipedal walking and running. Topics include basic manifold theory, Hamiltonian and Lagrangian mechanics, impacts and conservation of momentum, limit cycles and Poincaré analysis, hybrid zero dynamics. The course culminates in a formal treatment of feedback control of walking and running for robotics as well as recent models of human locomotor control being developed by my laboratory.
- ◇ **EN.530.649: *System Identification*** (new course)
 - *Semester taught (enrollment)*: Spring 2012 (15), Spring 2014 (7), Spring 2015 (3), Spring 2021 (10)
 - *Course description*: This course covers several fundamental approaches system identification, including spectral, prediction error, subspace, and “online” (adaptive) identification methods. The emphasis will be on LTI systems, but some time will be devoted to system identification for classes of nonlinear dynamical systems, such as those that are linear in parameters. Prerequisites: 580.616/530.616, Introduction to Linear Dynamical Systems.

Guest Lectures at Johns Hopkins University, 2003–present

Key: EN.613=Computer Science; AS.200=Psychological and Brain Sciences

- ◇ **EN.600.436: *Algorithms for Sensor-Based Robotics*** (guest lecture)
 - *Semester of guest lecture (attendance)*: Fall 2004 (30), Fall 2012 (30)
 - *Description*: Lecture on Navigation Functions as a method for robot motion planning.
- ◇ **AS.200.613: *Fundamentals of Psychological & Brain Sciences*** (guest lecture)
 - *Semester of guest lecture (attendance)*: Fall 2012 (20)
 - *Description*: Lecture introducing the concept of dynamical systems to graduate students in the Psychological and Brain Sciences department assuming little or no prior background in this area.

The University of Michigan, 1995–1997, Graduate Student Instructor

- ◇ **EECS 215 *Introduction to Electronic Circuits*** (1995). Laboratory instructor for introductory undergraduate Electrical Engineering circuits lab.
- ◇ **EECS 460: *Control Systems Analysis and Design*** (1996). Session instructor for introductory course in classical control systems theory and design.
- ◇ **EECS 463: *Modern Control Systems Design Lab*** (1997). Laboratory instructor for advanced undergraduate team-based laboratory course in control systems design.
- ◇ **Co-developed EECS 461: *Embedded Control Systems*** (1999-2000). Co-developed this new course with J. Freudenberg and B. Gillespie. A team-based laboratory course that teaches the integration of real-time software and hardware systems, mechanical design, and systems theory. Course received [writeup in Mathworks newsletter](#).

Specialty Courses, Short Courses, etc

- ◇ **The Math, Science, Robotics, and Practice of Juggling.**
 - *Semester taught (enrollment)*: Fall 2014 (13)
 - *Course description*: Three week course taught as part of the [Odyssey](#) program at [Johns Hopkins University](#). In this hands-on course, students learn about the math, science, and engineering of juggling, as well as learn the craft of juggling itself.

PROFESSIONAL ACTIVITIES

Special Courses Taken

- ◇ Neural Systems and Behavior, Marine Biological Laboratory, Woods Hole, MA, 2010

Advisory Committees

- ◇ Scientific Advisor to the International Consortium on Biomimetic Technology for Vibrissal Active Touch (BIOTACT), 2009–2010

International Program Chairs

- ◇ General Co-Chair: 15th International Conference on Climbing and Walking Robots (CLAWAR), 2012
- ◇ Area Chair: Robotics: Science and Systems (RSS) Conference, 2012

Editorships, Technical Reviews, and Program Committees

- ◇ Editorships
 - Board of Reviewing Editors for eLife, October 2019–present.
- ◇ Journal reviews (partial list):
 - *Multidisciplinary Journals*: Science, Nature, Proc Nat Acad Sci, J Roy Soc Interface, PLoS ONE, Biol Cybern, Bioinspiration Biomim
 - *Biological Journals*: Curr Biol, eLife, Biol Letters, PLoS Biol, J Exp Biol, PLoS Comp Biol, J Insect Behav, Proc R Soc B
 - *Neuroscience Journals*: Exp Brain Res, J Neurosci, J Neurophys
 - *IEEE Transactions Journals*: Robotics, Autom Sci Eng, Oceanic Engineering, Autom Control, Biomed Circuits Syst
 - *Other Engineering Journals*: Science Robotics, Int J Robot Res, Automatica, Auton Robot
- ◇ Conference and Workshop Program Committees
 - Living Machines: 2012, 2013
 - Robotics: Science and Systems (RSS) Program Committee: 2005, 2009, 2011, 2013
 - Workshop on the Algorithmic Foundations in Robotics (WAFR), 2008
 - Workshop on Dynamic Vision at European Conference on Computer Vision (ECCV), 2005, 2006, 2007
 - International Conference on Robotics and Automation (ICRA), 2006, 2008, 2010
 - International Conference on Advanced Robotics (ICAR), 2007
 - Fast Motions in Robotics and Biomechanics, 2005
 - Intelligent Robots and Systems (IROS), 2005
 - Robot Motion and Control (RoMoCo) International Scientific Committee, 2005, 2009, 2011, 2024
- ◇ Major Grant Reviews:
 - NIH ZRG1 F02B-Y Fellowship Study Section, 2022.
 - NSF/NIH CRCNS Panelist, 2020.
 - NIH LAM–Neurobiology of Learning and Memory Study Section, 2017.
 - NSF Site Visitor, 2015.
 - NSF College Of Reviewers, 2013–present
 - NSF Panelist (2004, 2007, 2009, 2010, 2012, 2015, 2017) and ad hoc reviewer
 - Israeli Science Foundation ad hoc reviewer, 2015-2017.
 - Canada Foundation for Innovation (2012) ad hoc reviewer

Workshops and Tutorials

- ◇ Co-Organizer (with Xinyan Deng and Soon-Jo Chung) Bio-Inspired Robotics Workshop, Robot Science and Systems (RSS) 2012
- ◇ Organizer, Ribbon-Fin Propulsion Workshop I, Johns Hopkins University, March 23-24, 2007
- ◇ Co-Organizer (with Hong Zhang) Vision-based Control of Mobile Robots, *IEEE/RSJ International Conference on Intelligent Robots and Systems*, Las Vegas, NV, October 2003

Professional Memberships

- ◇ Fellow, IEEE
- ◇ Member, American Association for the Advancement of Science (AAAS)
- ◇ Society for Integrative and Comparative Biology (SICB)
- ◇ Society for Neuroscience (SfN)

SERVICE AND OUTREACH

Fostering Research in the Baltimore Area

2013–2014	STEM Achievement in Baltimore Elementary Schools (SABES), Team Lader
2006–present	Faculty Mentor, Baltimore Ingenuity Project
2005–present	Faculty Mentor, Women in Science and Engineering Program
2011–2013	Faculty Mentor, Minority Access to Research Careers (MARC) program
2013	Judge, 20th Annual Undergraduate and Graduate Research Symposium, Morgan State University

Johns Hopkins University, Department of Mechanical Engineering (ME)

2011–2014,	Chair, Graduate Recruiting Committee
2022–2023	
2014–2015	Chair, Robotics Faculty Search Committee
2011–2014	Chair, Graduate Recruiting Committee
2013–present	Member, ME Web / ME News Letter Committee
2013–present	Member, Grad Program, Affairs + MEGA Committee
2013	Bio Faculty Search Committee, Mechanical Engineering
2012	Bio Faculty Search Committee, Mechanical Engineering
2011–2012	Member, Grad Program and Affairs Committee
2005–2010	Web/Publicity Committee
2003–2017	Advisor, Tau Alpha Chapter of Pi Tau Sigma
2003–2010	Computing Facilities Committee (Chair: 2004–2006, 2008–2009)
Fall 2004	Chair, ME Seminar Series

Johns Hopkins University, Laboratory for Computational Sensing and Robotics (LCSR)

2022–2023	Chair, Graduate Fellowship Committee
2013–2017	Deputy Director, LCSR
2013–2019	Chair, Graduate Recruiting Committee
2013–2019	Laboratory Safety Coordinator

Johns Hopkins University, G.W.C. Whiting School of Engineering (WSE)

2023	Committee on Existing Space
2021–present	Whiting School of Engineering Senate. Committees: ◇ Member, Subcommittee on First-Year Experience (2021–2022).
2016	Member, Computer Science Department Review Committee.
2010–present	WSE IT Faculty Advisory Committee
2010–2012	Program Coordinator, Robotics Minor
2012	Faculty Search Committee, Laboratory for Computational Sensing and Robotics (LCSR)
2007–2010	WSE Communications Committee
2009	Reviewer, Student Initiatives Fund
2009	Faculty Advisor, Shaffer Hall Lobby Working Group
2008	Selection Committee, Vredenburg Scholarship
2005	Selection Committee, Westgate Scholarship

Johns Hopkins University

- 2023–present Member, Race Neutral Alternatives Admissions Group. Member, Subcommittee on *Yield Programming*.
- 2022–present Member, Johns Hopkins University Council. Committees:
 - ◊ Member, Subcommittee on *Concur* (2023–present).
- 2022 Member of Faculty discussion group on postdoc family health insurance
- 2020 Selection committee for Provost’s PhD professional development innovation initiative (ad hoc)
- 2020 Reviewer for Provost’s Undergraduate Research Awards
- 2017–2021 Member, Homewood Graduate Board.
- 2017–2021 Member, Doctor of Philosophy Board.
- 2014–2020 Member, JHU Library Advisory Committee (LAC).
- 2010–2018 Faculty Advisor, Homewood Postdoctoral Association
- 2011–2014 Member, [Homewood Academic Computing Advisory Committee \(HAC\)](#).
- 2011–2013 PI Partner, Financial Reporting Project
- 2009 Grant Preparation, Submission, and Award Faculty Working Group
- 2010 PI Partner, Best Environment for Research and Scholarship (BERS)

The University of Michigan

- 2000–2001 Mentor, Systems Division Mentorship Program
- 1996–2000 Staff mentor, [University of Michigan Mentorship Program](#)
- 1998–1999 EECS Department Representative, ASEE Student Chapter

The Ohio State University

- 1992–1995 Active Member Eta Kappa Nu, Gamma Chapter at Ohio State University (President: 1994–1995; Vice President: 1993–1994)

SELECTED POPULAR PRESS

- 2023 Press for Biswas et al, 2023, *Nat. Mach. Intell.*
 - ◊ Hopkins News-Letter “Hopkins lab proposes novel solution to the explore/exploit trade-off”
 - ◊ COSMOS “From humans to amoeba, we all shimmy like these electric fish”
- 2019 [Animogic episode on electric fish](#) features content from LIMBS lab and Fortune Lab.
- 2019 Press for Jayakumar, Madhav, et al, *Nature*, 2019:
 - ◊ Popular Science “Tricking rats with augmented reality unlocked a secret about our own brains” by Kat Eschner
- 2018 NIH Director’s Blog: “From Juggling to Biomechanics” by Dr. Francis Collins
- 2014 Press for Ankarali et al, *J Neurophysiol*, 2014:
 - ◊ YouTube Video: “Juggling Study May Shed Light on How Our Senses Help Us Run”.
- 2013 Press for Dyhr et al, *J Exp Biol*, 2013:
 - ◊ BBC News, *Science and Environment*: “Footage reveals how insects use their bodies to hover”.
 - ◊ Highlighted in *Inside JEB*: “The Abdomen: The Secret to Stabilising Flight”.
 - ◊ io9.com: “Roboticists discover the secret of insect flight, and it’s not wings”.
- 2012–2013 Press on Electric Fish:
 - ◊ Futurity.org: “‘Double-play’ motion keeps critters stable and agile”
Associated YouTube video: <https://www.youtube.com/watch?v=1RHRZTIvg-w>
 - ◊ Science Nation video produced for the National Science Foundation:
“Electric Fish Charges up Research on Animal Behavior - Science Nation”
- 2012–2013 Press related to course project for 530.420 Robot Sensors and Actuators:

- ◇ “A quest for the perfect piece of toast”, JHU Magazine.
- ◇ “Johns Hopkins Students Engineer the Perfect Toast”, Baltimore Fish Bowl.
- ◇ “Engineering students get deliciously inventive”, Hopkins Gazette
- ◇ Associated Youtube video: <http://www.youtube.com/watch?v=X6XBoEyC8HY>

2012 “Bio Bots”, Johns Hopkins Engineering Magazine



2012 “Hammer Flip”, Provost’s Project on Innovation. Associated youtube video:
<http://www.youtube.com/watch?v=XNGRgCXfk4>

2005-2006 Press on Cockroach Navigation / Locomotion:

- ◇ Science Magazine: “Scurrying Roaches Outwit Without Their Brains”
- ◇ National Geographic News: “Cockroaches Inspire Robot Antenna Design.”
- ◇ Inside JEB: “Keeping Cockroaches On Course”