John P. Swensen

GRAB Lab
Department of Mechanical Engineering & Materials Science
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Education

Ph.D. 2011 Mechanical Engineering Johns Hopkins University, Baltimore, Maryland, USA
Advisor: N. J. Cowan
Dissertation: Torsional Dynamics and Rotational Estimation of Tip-steerable Needles

M.S. 2009 Mechanical Engineering Johns Hopkins University, Baltimore, Maryland, USA

B.S. 2003 Electrical Engineering, Utah State University, Logan, Utah, USA

Positions Held

◇ Yale University

2014–present	Associate Research Scientist, GRAB Lab, Department of Mechanical Engineering & Materials Science PI: A. M. Dollar
2011–2014	Postdoctoral Associate, GRAB Lab, Department of Mechanical Engineering & Materials Science Advisor: A. M. Dollar

◇ Johns Hopkins University

2006–2011	Graduate Research Assistant, Locomotion in Mechanical and Biological Systems (LIMBS) Laboratory, Department of Mechanical Engineering Advisor: N. J. Cowan

◇ Ball Aerospace and Technologies Corp.

2004–2006	Engineer I, Software Engineering
2003–2004	Engineer Associate, Software Engineering

◇ Autonomous Solutions Inc.

2001–2003	Engineering intern (commercial continuation of work done as undergraduate research assistant)

◇ Utah State University

2001–2003	Team Leader, USU/Ball Aerospace Annual Robotics Competition
2000–2001	Undergraduate Research Assistant, Center for Self-Organizing and Intelligent Systems
1999	Undergraduate Research Volunteer, USUsat I

Awards and Honors

◇ **Rob Roy Fellowship**, Whiting School of Engineering, Johns Hopkins University, 2006-2007
◇ **Departmental Fellowship**, Department of Mechanical Engineering, Johns Hopkins University, 2006-2007
◇ **Magna Cum Laude**, Utah State University, 2003

Publications

Journal Articles

[J1] J. P. Swensen, A. I. Nawroj, P. E. I. Pounds, and A. M. Dollar. Active cells for redundant and configurable articulated structures. *Smart Materials and Structures* 23(10):104003, 2014, `http://stacks.iop.org/0964-1726/23/i=10/a=104003`.

[J2] J. Swensen, M. Lin, A. Okamura, and N. Cowan. Torsional dynamics of steerable needles: Modeling and fluoroscopic guidance. *Biomedical Engineering, IEEE Transactions on* PP(99):1–1, 2014.

[J3] A. I. Nawroj, J. P. Swensen, and A. M. Dollar. Electrically conductive bulk composites through a contact-connected aggregate. *PLoS ONE* 8(12):e82260, 12 2013, `http://dx.doi.org/10.1371%2Fjournal.pone.0082260`.

[J4] J. P. Swensen and A. M. Dollar. The connectedness of packed circles and spheres with application to conductive cellular materials. *PLoS ONE* 7(12):e51695, 12 2012, `http://dx.doi.org/10.1371%2Fjournal.pone.0051695`.

[J5] J. P. Swensen, L. U. Odhner, B. Araki, and A. M. Dollar. Printing 3D electrical traces in additive manufactured parts for injection of low melting temperature metals. *ASME Journal of Mechanisms and Robotics*, 2014.

Journal Articles (submitted)

[J1] J. P. Swensen, R. Balasubramanian, and A. M. Dollar. Performance of serial underactuated mechanisms: Number of degrees of freedom and actuators. *ASME Journal of Mechanisms and Robotics*, 2013.

Journal Articles (in prep)

[J1] J. P. Swensen and A. M. Dollar. Optimization of spring antagonists for nitinol shape memory alloy actuators.

[J2] A. I. Nawroj, J. P. Swensen, and A. M. Dollar. Low-order modeling of nitinol coils as a design tool for modular actuated structures.

[J3] V. Kallem, J. P. Swensen, M. Dewan, G. D. Hager, and N. J. Cowan. Encoding self movement via kernel projections.

[J4] J. P. Swensen, V. Kallem, and N. J. Cowan. State estimation and control for tip-steerable needles.

Chapters in Edited Volumes

[B1] 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* pp. 23–38, 2010.

[B2] R. J. Webster III, J. P. Swensen, J. M. Romano, and N. J. Cowan. Closed-form differential kinematics for concentric-tube continuum robots with application to visual servoing. *Experimental Robotics XI*, vol. 54, pp. 485–494, 2009.

Refereed Conference Articles

[C1] J. Swensen, A. Nawroj, P. Pounds, and A. Dollar. Simple, scalable active cells for articulated robot structures. *Robotics and Automation (ICRA), 2014 IEEE International Conference on*, pp. 1241–1246, May 2014.

[C2] J. Swensen and A. Dollar. Optimization of parallel spring antagonists for nitinol shape memory alloy actuators. *Robotics and Automation (ICRA), 2014 IEEE International Conference on*, pp. 6345–6349, May 2014.

[C3] J. P. Swensen and N. J. Cowan. An almost global estimator on $SO(3)$ with measurement on S^2. *Proc. of AACC American Control Conference (ACC), 2012*, pp. 1780–1786, 2012.

[C4] J. P. Swensen and N. J. Cowan. Torsional dynamics compensation enhances robotic control of tip-steerable needles. *Proc. of IEEE International Conference on Robotics and Automation (ICRA), 2012*, pp. 1601–1606, 2012.

[C5] V. Kallem, M. Dewan, J. P. Swensen, G. D. Hager, and N. J. Cowan. Kernel-based visual servoing. *Proc. IEEE/RSJ IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 1975–1980, Oct. 2007.

[C6] D. S. Acton, T. Towell, J. Schwenker, J. Swensen, D. Shields, E. Sabatke, L. Klingemann, A. R. Contos, B. Bauer, K. Hansen, P. D. Atcheson, D. Redding, F. Shi, S. Basinger, B. Dean, and L. Burns. Demonstration of the james webb space telescope commissioning on the JWST testbed telescope. *Proc. SPIE 6265, Space Telescopes and Instrumentation I: Optical, Infrared, and Millimeter*, vol. 6265, p. 21, 2006.

[C7] M. Torrie, D. Cripps, and J. Swensen. Joint architecture for unmanned ground vehicles (JAUGS) applied to autonomous agricultural vehicles. *Proc: Automation technology for off-road equipment*, pp. 1–12, 2002.

Conference Articles (submitted)

[D1] J. P. Swensen, L. U. Odhner, B. Araki, and A. M. Dollar. Injected 3D electrical traces in additive manufactured parts with low melting temperature metals. *IEEE International Conference on Robotics and Automation (ICRA)*, 2015.

[D2] A. I. Nawroj, J. P. Swensen, and A. M. Dollar. Compliant, articulated robotic structures using centimeter-scale active cells. *IEEE International Conference on Robotics and Automation (ICRA)*, 2015.

Contributed Articles Abstracts and Posters

[A1] A. I. Nawroj, J. P. Swensen, and A. M. Dollar. Development of Active-Cells for Macroscopically Deformable Structures. *Proc. ASME Conference on Smart Materials, Adaptive Structures, and Inteligent Systems (SMASIS)*, 2014.

[A2] J. P. Swensen and A. M. Dollar. Active-cells for the Construction of Redundant and Configurable Articulate Structures. *Proc. ASME Conference on Smart Materials, Adaptive Structures, and Inteligent Systems (SMASIS)*, 2013.

[A3] A. I. Nawroj, J. P. Swensen, and A. M. Dollar. A Bulk Conductive Polymer Using Embedded Macroscopic Copper Cells. *Proc. ASME Conference on Smart Materials, Adaptive Structures, and Inteligent Systems (SMASIS)*, 2013.

[A4] J. P. Swensen and A. M. Dollar. Towards hyper-redundant and super-configurable articulated structures. *Proc. ASME Conference on Smart Materials, Adaptive Structures, and Inteligent System (SMASIS)*, pp. 3888–3895, 2012.

[A5] J. P. Swensen and N. J. Cowan. Modeling, estimation, and control of tip-steerable needles with torsional dynamics, Sept 2011. Presented at the Needle Steering Demo Session of 2011 IEEE/RSJ International Conference on Intelligent Robotics and Systems.

[A6] J. P. Swensen, R. J. Webster III, and N. J. Cowan. Active cannulas: Applications to needle steering, Sept 2008. Presented at the Needle Steering Workshop at 2008 Medical Image Computing and Computer Assisted Intervention Society conference.

[A7] J. P. Swensen, R. J. Webster III, and N. J. Cowan. Image guidance of active cannulas, Jan 2009. Presented at the IEEE-RAS/IFRR Winter School of Robotics Science on Medical Robotics and Computer-Integrated Interventional Systems.

Invited Talks

- Steerable Needles, Actuated Structures, and Geometric Estimators & Control in Robotics, Faculty Candidate Seminar, Department of Mechanical Engineering, University of Delaware, 2014
- Steerable Needles, Actuated Structures, and Geometric Estimators & Control in Robotics, Faculty Candidate Seminar, Department of Mechanical, Aerospace and Nuclear Engineering (MANE), Rensselaer Polytechnic Institute, 2014
- Control and Estimation for Steerable Needles, Invited speaker at Pathways to Clinical Needle Steering, *International Conference on Robotics and Automations (ICRA)*, 2012
- Tip-Steerable Needles and Invariant Estimators, *Mechanical Engineering and Materials Science Seminar Series*, Yale University, 2011
- Tip-Steerable Needles, *Foundations of Robotics Seminar Series*, Carnegie Mellon University, 2011

Advising and Mentoring

Graduate Students (mentor)

- Ahsan Nawroj, Mechanical Engineering, Yale University, Ph.D expected 2017

Undergraduate Students (mentoring and supervising)

- Gerardo Carranza, Mechanical Engineering, Yale University Class of 2017
- Tom Bu, Mechanical Engineering, Yale University Class of 2017
- Andrew Black, Mechanical Engineering, Yale University Class of 2016
- Chinmay Jaju, Mechanical Engineering, Yale University Class of 2015
- Usman Anwer, Mechanical Engineering, Yale University Class of 2013

Instruction and Course Development

Johns Hopkins University, 2006–present

- **ME 530.489:** *The Kalman Filter* (co-developed and co-instructed)
  - *Semesters taught (enrollment):* Intersession 2011 (20)
  - *Course description:* Since its advent, the Kalman filter has been the workhorse for estimation of dynamical systems spanning virtually all engineering disciplines: spacecraft, airplanes, submarines, automobiles, factory automation, electronics, and more. This one credit course teaches the derivation of the Kalman filter from first principles. It covers the necessary basic probability theory and culminates with a discussion of Dr. Kalman's seminal paper on the subject, written while he was living in Baltimore in 1960.
- **ME 530.241:** *Electronics and Instrumentation* Final project advisor
  - *Semester:* Spring 2008
  - *Course responsibilities:* The final project was to develop a field-ready instrumentation amplifier for measuring electric signals in weakly electric knifefish. My role as project advisor was to teach the use of PCB software, give instruction on proper component selection and circuit layout techniques, and oversee the design, population, and testing of the student groups' circuits.
- **ME 530.241:** *Electronics and Instrumentation* Course teaching assistant
  - *Semester:* Fall 2006
  - *Course responsibilities:* I was responsible for conducting lab sessions, grading homework, holding office hours, and delivering test review sessions.

Ball Aerospace and Technologies Corp., 2003–2006

- **Embedded Linux: An IR&D alternative to VxWorks** *Co-instructor* (1995). A 3 lecture series on the development and use of embedded real-time Linux as an alternative to VxWork for cost reduction in internal research and development projects, as well as other non-flight-rated systems.
- **MicroC OS II: The Real Time Kernel** *Book club moderator* (1996). Led a book club that investigates the low level details of implementing a real-time operating system and practical consequences of real-time systems.

Professional Activities

Advisory Committees

- Industrial Advisor to the Department of Electrical Engineering at Utah State University while working at Ball Aerospace and Technologies Corp., 2005-2006

Technical Reviews

- Journal reviews:
  IEEE Transactions on Robotics
- Reviewer for several annual conferences, including IEEE International Conference on Biomedical Robotics and Biomechatronics, IEEE International Conference on Advanced Robotics, IFAC American Controls Conference, IEEE/RSJ International Workshop on Intelligent Robots and Systems, IEEE International Conference on Computer Vision, Workshop on the Algorithmic Foundations of Robotics, IEEE Conference on Decision and Control, and The International Symposium of Robotics Research, Robots: Science and Systems.

Workshops and Tutorials

- Needle Steering Workshop Invited Speaker, *IEEE International Conference on Robotics and Automations (ICRA)*, 2012
- Speaker, *Sixth NSF/Northeast Control Workshop*, 2010
- Workshop Attendee, Speaker, and Poster Presenter, *Winter School on Medical Robotics and Computer-Integrated Interventional Systems*, 2009
- Needle Steering Workshop and Poster Presenter, *Medical Image Computing and Computer Assisted Intervention (MICCAI) conference*, 2008

Professional Memberships

- Institute for Electrical and Electronic Engineers (IEEE; Control Systems and Robotics & Automation Societies)
- American Society of Mechanical Engineers (ASME)
- Active contributor to the GNU Octave software for numerical computing

University Service

Yale University, School of Engineering & Applied Science (ME)

2013–2014 Mentor - Software, Data, and Telemetry, Bulldog Racing Team, SAE FormulaHybrid

Johns Hopkins University, Department of Mechanical Engineering (ME)

2008–2011 Website Administrator, Mechanical Engineering Graduate Student Association (MEGA)

2006–2011 Committee Member, Mechanical Engineering Graduate Student Association (MEGA)

Utah State University, Department of Electrical and Computer Engineering (ECE)

1999-2003 Active Member IEEE (Treasurer: 2001-2002; Public Relations: 2002-2003)

Utah State University, College of Engineering

2000–2001 Student Advisory Council

Miscellaneous

Fluent in Spanish

1997–1999 Lived and worked in the Caribbean coastal region of Colombia S.A.

Amateur Filmmaker

2008–present Filmed, produced, and sell an educational film entitled *Physics and the Pinewood Derby* `http://www.pinewoodphysics.com`.

iOS and Android App Developer

2010–present	Developed games and other apps during grad school as a stress reliever `http://www.swengames.com`.
2013–present	Developed app for tracking childhood vaccinations using Android phones and RFID tags `http://www.khushibaby.org`.