



# Randall Hellman

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## Summary

I am a robotics engineer who loves solving complicated problems in creative ways. I have focused on advancing robot haptics in the areas of perception, decision-making, and manipulation tasks using innovative custom hardware and software systems. In addition to my current work and research, I am experienced in the automotive, aerospace, and energy industries. I pride myself in my ability to learn new tools quickly and apply them to solve complex problems.

## Education

- 2016 **Ph.D. Mechanical and Aerospace Engineering, Arizona State University**  
“Haptic Perception, Decision-making, and Learning for Manipulation with Artificial Hands”
- 2015 **M.S. Mechanical and Aerospace Engineering, Arizona State University**
- 2008 **B.S. Mechanical Engineering, Purdue University**

## Experience

- 2017 - Present **Verb Surgical, Mountain View, CA**  
Sr. Mechatronics Engineer **Oct 2018 - Present**  
\* Driving new concepts and delivering functional prototypes.  
Mechatronics Engineer **Nov 2017 - Oct 2018**  
\* Developed prototypes for control of surgical robotic system along with meaningful contributions to the mechanical and sensing strategies.
- 2017 **Modbot, San Francisco, CA**  
Robotics and Controls Engineer  
\* Developed control algorithms for EtherCat servo controller written in XC.  
\* Create C/C++ ROS node for system level inspector and tuning.  
\* Implement sampling based planning algorithms for control of modular robots.  
\* Actualize hard real-time with RT Preempt for all time critical cyclic control loops.
- 2016-2017 **Biomechatronics Laboratory, University of California, Los Angeles**  
Postdoctoral Research Associate  
Developed systems for haptic search and retrieval of objects buried within granular material.
- 2014-2016 **Biomechatronics Laboratory, University of California, Los Angeles**  
Visiting Graduate Scholar  
Built systems for functional contour-following via haptic perception and reinforcement learning.

- 2009–2011      **Kiewit Energy, Houston, TX**  
 Field Engineer  
 Developed site tracking and progress database to be used for \$300 million refinery upgrade. Assembled research-informed reports on the development and technology of LNG supply chain for entry into new markets.
- 2008      **Kiewit Energy, Houston, TX**  
 Intern  
 Estimated new project bids and assisted in coordination of construction operations
- 2007      **Pacific Scientific Energetic Materials Co., Chandler, AZ**  
 Intern  
 Assisted in the integration of manufacturing resource planning software and aided in the integration of CamWorks in the machine shop
- 2006      **TRW Commercial Steering Division, West Lafayette, IN**  
 Intern  
 Involved in the development of a novel power steering systems for Class 8 trucks.

## Specialties

### Software

\* ROS, TensorFlow, MoveIt!, OpenCV, Matlab, Xcode, TrueStudio

### Design Software

\* Solidworks, Altium, Eagle PCB, G-code, DelCam

### Languages

\* C/C++, Python, Objective C, Swift

### Skills

\* Machine learning, reinforcement learning, running physical robotic systems, robot and sensor design, hard realtime programing, design for manufacturing, machining and manufacturing techniques, multirotors, motor controllers, digital control systems, rapid prototyping, STM32 mcu development

## Awards

- 2016      **Best poster award finalist**, Southern California Robotics Symposium  
 “Haptic Perception and Decision-making for a Functional Contour-Following Task”
- 2016      **Best power award**, UCLA, Industrial Advisory Board  
 “Haptic Perception and Online Policy Learning for Robot Hands”
- 2014      **Travel Fellowship**, Arizona State University Graduate College
- 2013      **University Graduate Fellowship**, Ira A. Fulton Schools of Engineering

2008

**1st Place Malott Innovation Award, ME Senior Design, Purdue University**

Team leader for senior design group project, “Hangar Mate,” a tow device capable of maneuvering a small aircraft until the plane could taxi on its own. <https://www.youtube.com/watch?v=U6u-OtfJN9I>

Patent Application

Santos, V.J. and **Hellman, R.B.** “Systems and methods for tendon-driven robotic mechanisms.” International Patent App. No. PCT/US13/63249, Oct. 3, 2013; U.S. Patent App. No. 14/676,658, April 1, 2015.

Journal Publications

**Hellman, R.B.**, Cem, T., van der Schaar, M., and Santos, V.J. “Functional Contour-following via Haptic Perception and Reinforcement Learning.” (*revise and resubmit, IEEE Transactions on Haptics 2017*).

Overstreet, C.K., **Hellman, R.B.**, Ponce Wong, R.D., Santos, V.J., and Helms Tillery, S.I. “Discriminability of Single and Multichannel Intracortical Microstimulation within Somatosensory Cortex.” *Frontiers Bioeng. Biotechnol.* 2016:4:91. doi: 10.3389/fbioe.2016.00091.

**Hellman, R.B.**, Chang, E., Tanner, J., Helms Tillery, S.I., and Santos, V.J. “A robot hand testbed designed for enhancing embodiment and functional neurorehabilitation of body schema in subjects with upper limb impairment or loss.” *Front. Human Neurosci., Special Issue on “Proprioceptive dysfunction, related motor disorders and their neurological (robotic) rehabilitation”* 2015:9(26):1-10. doi: 10.3389/fnhum.2015.00026.

Ponce Wong, R.D., **Hellman, R.B.**, and Santos, V.J. “Spatial asymmetry in tactile sensor skin deformation aids perception of edge orientation during haptic exploration.” *IEEE Transactions on Haptics in March 2014. Special Issue on “Haptics in Rehabilitation and Neural Engineering,”* 2014:7(2):191–202.

Archival Conference Proceedings

Ponce Wong, R.D., **Hellman, R.B.** and Santos, V.J. “Haptic exploration of fingertip-sized geometric features using a multimodal tactile sensor.” *Proc SPIE Defense, Security and Sensing / Sensing Technology and Applications “Sensors for Next-Generation Robotics” Conference, Baltimore, MD, May 5-9, 2014. Podium.*

**Hellman, R.B.** and Santos, V.J. “Design of a back-driveable actuation system for modular control of tendon- driven robot hands.” *Proc IEEE RAS/EMBS Intl Conf on Biomedical Robotics and Biomechatronics, Roma, Italy, June 24-27, 2012. Podium.*

## Refereed Conference Proceedings

**Hellman, R.B.** and Santos, V.J. "Haptic Perception and Decision-Making for a Functional Contour-Following Task." *IEEE Haptics Symposium, Work-in-progress paper, Philadelphia, PA, April 8-11, 2016.*

**Hellman, R.B.** and Santos, V.J. "Development of probabilistic models for real-time perception of geometric features with a sensorized artificial finger." *Workshop on "Robotic Hands, Grasping and Manipulation," IEEE/RAS Intl Conf on Robotics and Automation, Seattle, WA, May 30, 2015.*

**Hellman, R.B.**, Chang, E., Tanner, J., Helms Tillery, S.I., and Santos, V.J. "A robot hand testbed for enhancing embodiment and functional neurorehabilitation of body scheme in upper limb amputees." *Myoelectric Controls Symposium, New Brunswick, Canada, Aug. 18-22, 2014.*

**Hellman, R.B.**, Chang, E., and Santos, V.J. "Tendon-driven testbed for haptic exploration and sensory event-driven grasp and manipulation." *IEEE Haptics Symposium, Houston, TX, Feb. 23-26, 2014, Hardware demonstration D78.*

Overstreet, C.K., Ponce Wong, R.D., **Hellman, R.B.**, Santos, V.J., and Helms Tillery, S.I. "Discrimination of multichannel ICMS driven by a tactile sensor." *Proc Ann. Mtg. of Soc for Neuroscience, San Diego, CA, Nov. 9-13, 2013.*

## Conference Proceedings

**Hellman, R.B.** and Santos, V.J. "Haptic perception, decision-making, and reinforcement learning for manipulation of a deformable object." *NSF National Robotics Initiative PI Mtg, Arlington, VA, Nov. 5-6, 2015.*

**Hellman, R.B.**, Ponce Wong, R.D., and Santos, V.J. "Haptic exploration and decision making with a highly sensorized robot hand." *UCLA Engineering Tech Forum – "Robotics and Technologies of the Future," University of California, Los Angeles, Feb. 3, 2015.*

Ponce Wong, R.D., **Hellman, R.B.**, and Santos, V.J. "Context-driven haptic inquiry of objects based on task requirements for artificial grasp and manipulation." *NSF National Robotics Initiative PI Mtg, Arlington, VA, Nov. 19-20, 2014.*

Chang, E., **Hellman, R.B.**, and Santos, V.J. "Development of an anthropomorphic robot hand testbed for artificial grasp and manipulation." *Proc Fulton Undergrad. Res. Symp., Arizona State University, Tempe, AZ, April 11, 2014.*

**Hellman, R.B.**, Chang, E., Tanner, J., Helms Tillery, S.I., and Santos, V.J. "Tendon-driven testbed for haptic exploration and sensory event-driven grasp and manipulation." *Piper Health Solutions Workshop on Rehabilitation Robotics, Tempe, AZ, Feb. 28 - Mar. 1, 2014.*

**Hellman, R.B.**, Chang, E., Tanner, J., Helms Tillery, S.I., and Santos, V.J. "Tendon-driven testbed for haptic exploration and sensory event-driven grasp and manipulation." *DARPA MTO Sensorimotor Prosthetics Workshop, Scottsdale, AZ, Feb. 13, 2014.*

Overstreet, C.K., **Hellman, R.B.**, Ponce Wong, R.D., Helms Tillery, S.I., and Santos, V.J. "CPS challenges in human-machine interfaces: Context-dependent control of smart artificial hands through enhanced touch perception and mechatronic reflexes." *NSF Cyber-Physical Systems PI Meeting, Arlington, VA, Oct. 17-18, 2013.*

Ponce Wong, R.D., **Hellman, R.B.**, and Santos, V.J. "Context-driven haptic inquiry of objects based on task requirements for artificial grasp and manipulation." *NSF National Robotics Initiative PI Meeting, Arlington, VA, Oct. 1-2, 2013.*

**Hellman, R.B.** and Santos, V.J. "Design of a remote actuation module with self-contained, direct tendon force sensing for artificial hands." *Piper Health Solutions Workshop on Rehabilitation Robotics, Tempe, AZ, Feb. 22-23, 2013.*

Ponce Wong, R.D., **Hellman, R.B.**, and Santos, V.J. "Use of multimodal tactile sensor data for artificial grasp and manipulation." *Piper Health Solution Workshop on Rehabilitation Robotics, Tempe, AZ, Feb. 22, 2013.*

Tanner, J., **Hellman, R.B.**, Helms Tillery, S.I., and Santos, V.J. "CPS challenges in human-machine interfaces: Context-dependent control of smart artificial hands through enhanced touch perception and mechatronic reflexes." *NSF Cyber-Physical Systems PI Meeting, National Harbor, MD, Oct. 3-5, 2012.*

## Invited Talk

"Development of Haptic Perception and Manipulation Capabilities for Robot Hands," *Interaction Lab, University of Southern California, Los Angeles, CA, December 2015.*

## Editorial Experience

Journal of Biomechanics, Robotica

## Teaching Experience

Guest Lecturer

- \* Systems and Controls (Spring 2014): Undergraduate, junior level
- \* Mech Design/Control Robots (Fall 2013): Graduate level

Instructor

- \* Thermofluids I (Undergrad Spring 2012)

## Professional Memberships

IEEE Student Member, Robotics and Automation Society

American Society of Mechanical Engineers, Community Service Chair (Spring 08)

Alpha Kappa Psi, Professional Business Fraternity

## Media Coverage (highlights)

- 2016 ScienceNews, “For robots, artificial intelligence gets physical” (<https://www.sciencenews.org/article/robots-artificial-intelligence-gets-physical?tgt=nr>)
- 2016 Front page article on Daily Bruin, “UCLA lab working to create machines that simulates touch” (<http://dailybruin.com/2016/04/17/ucla-lab-working-to-create-machine-that-simulates-touch/>)
- 2015 PCMag article titled, “Up close with the 'BairClaw' robot hand” (<http://www.pcmag.com/article2/0,2817,2484955,00.asp>)
- 2015 National Science Foundation Science Nation video titled, “*Giving robots and prostheses the human touch,*” as part of National Robotics Week. Video: <https://youtu.be/Qmyri62ISKo>
- 2013 Educational television show, “*STEM Journals,*” Phoenix, AZ featured in a “biomechanics” episode. Video: <http://www.cox7.com/biomechatronics>
- 2013 Arizona State University Alumni Mag., Vol. 14, Featured as part of an article on biomimicry