

SAMUEL B. SCHORR

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EDUCATION

Stanford University, Collaborative Haptics and Robotics in Medicine Lab, Stanford, CA *Expected 2017*
PhD Candidate in Mechanical Engineering

Thesis: “Fingerpad Skin Deformation for Sensory Substitution of Force in Teleoperation and Virtual Reality”

Stanford University, Stanford, CA *2013*

Master of Science in Mechanical Engineering

Depth: Mechatronics, Robotics, and Control

University of Texas at Austin, Austin, TX *2011*

Bachelor of Science in Mechanical Engineering

Senior Design Project: “Design of a Remote Activation System for Packers in Open-Perforation Wells Using Magnetic Inductance Repeaters”

RESEARCH

**Skin Deformation for Sensory Substitution of Force
in Teleoperation and Virtual Reality**

February 2012 - Present

- Designed and constructed skin deformation devices for both wearable and manipulator grounded applications.
- Implemented 3D tracking of fingers and skin deformation device control to convey force information during teleoperation and in virtual reality.
- Researched the ability of human participants to use 3-DoF skin deformation feedback for force-sensitive teleoperated and virtual tasks.
- Investigated human perception of mass while manipulating objects in virtual reality with skin deformation feedback.

WORK EXPERIENCE

Intuitive Surgical

March 2015 - September 2015

New Product Development Engineering Intern

Sunnyvale, CA

- Designed and constructed (prototyping through molding) novel mechanical and electromechanical systems for support of new products and tools.
- Developed methods for camera-tool registration and calibration during tool construction.

ConocoPhillips

May 2011 - August 2011

Natural Gas Upstream Engineering Intern

Farmington, NM

- Modeled pipeline network using stored production data to determine locations where stagnant water was restricting production.
- Developed a water removal plan to recover \$200,000 in lost production.

ConocoPhillips

May 2010 - August 2010

Reliability Engineering Intern

New Orleans, LA

- Evaluated Hydrofluoric Acid lines at increased risk of corrosion due to insulation coverage.
- Performed risk analysis and created a priority list of pipeline changes.

AWARDS AND HONORS

- Link Foundation Modeling, Simulation and Training Fellowship (3/2016)
- IEEE Human-Robot Interaction Pioneers Workshop and Travel Award (5/2015)
- IEEE ICRA Travel Award (5/2013)
- NSF Graduate Research Fellowship (4/2012)
- Stanford Graduate Fellowship (9/2011)
- University Honors (8/2007-5/2011)
- Invited to join Tau Beta Pi (8/2010)
- Dedman Merit Scholarship (8/2007)
- Cockrell Scholarship in Engineering (8/2007)
- National Merit Scholarship (8/2007)
- Eagle Scout Award (8/2007)

SKILLS

Robotic System Feedback Control and Design, Kinesthetic and Tactile Haptic Feedback Systems, Mechatronics and Embedded System Design, Mechanical System Design (SolidWorks), Haptic Display Programming (C++), Data Analysis and Statistics(MATLAB)

JOURNAL ARTICLES

S. B. Schorr and A. M. Okamura, “A wearable 3-degree-of-freedom skin deformation device for conveying force information in virtual reality,” submitted to *IEEE Transactions on Haptics*.

S.B. Schorr, Z.F. Quek, I. Nisky, W.R. Provancher, and A.M. Okamura, “Tactor-induced skin stretch as a sensory substitution method in teleoperated palpation”, *IEEE Transactions on Human-Machine Systems*, vol. 45, no. 6, pp. 714-726.

Z.F. Quek, **S.B. Schorr**, I. Nisky, W.R. Provancher, and A.M. Okamura, “Sensory substitution and augmentation using 3-degree-of-freedom skin deformation feedback”, *IEEE Transactions on Haptics*, vol. 8, no. 2, pp.209-221, 2015.

Z.F. Quek, **S.B. Schorr**, I. Nisky, A.M. Okamura, and W.R. Provancher, “Augmentation of stiffness perception with a 1-DoF skin stretch device”, *IEEE Transactions on Human-Machine Systems*, vol. 44, no. 6, pp.731-742, 2014.

PEER-REVIEWED CONFERENCE PAPERS

S. B. Schorr and A. M. Okamura, “Fingertip tactile devices for virtual object manipulation and exploration,” accepted to *ACM Conference on Human Factors in Computing Systems 2017*.

S. B. Schorr, Z. F. Quek, W. R. Provancher, and A. M. Okamura, “Environment perception in the presence of kinesthetic or tactile guidance virtual fixtures”, in *IEEE International Conference on Human-Robot Interaction*, pp.287-294, 2015.

S. B. Schorr, Z. F. Quek, W. R. Provancher, and A. M. Okamura, “Tactile Skin Deformation Feedback for Conveying Environment Forces in Teleoperation”, in *IEEE International Conference on Human-Robot Interaction Extended Abstracts*, pp.195-196, 2015.

M. Lin Yang*, **S. B. Schorr***, and A. M. Okamura, “The effect of manipulator gripper stiffness on teleoperated task performance”, in *IEEE World Haptics*, pp.494-499, 2015.

Z. F. Quek, **S. B. Schorr**, I. Nisky, W. R. Provancher, and A. M. Okamura, “Sensory substitution of force and torque using 6-DoF tangential and normal skin deformation feedback”, in *IEEE International Conference on Robotics and Automation*, pp.264-271, 2015.

Z. F. Quek, **S. B. Schorr**, I. Nisky, W. R. Provancher, and A. M. Okamura, “Sensory substitution using 3-degrees-of-freedom tangential and normal skin deformation feedback”, in *IEEE Haptic Symposium*, pp. 27-33, 2014. (**Best Student Paper Award**)

Z. F. Quek, **S. B. Schorr**, I. Nisky, A. M. Okamura, and W. R. Provancher, "Sensory augmentation of stiffness using fingerpad skin stretch", in *IEEE World Haptics*, pp. 467-472, 2013.

S. B. Schorr, Z. F. Quek, I. Nisky, W. R. Provancher, and A. M. Okamura, "Sensory substitution via cutaneous skin stretch feedback", in *IEEE International Conference on Robotics and Automation*, pp.2341-2346, 2013.

*These authors contributed equally to this work.

TECHNICAL TALKS AND POSTER PRESENTATIONS

"Wearable Skin Deformation as Force Feedback in Virtual Reality." Poster presentation at the Stanford Center for Image Systems Engineering Affiliates Meeting, Stanford, CA, December 13, 2016.

"Wearable Skin Deformation as Force Feedback in Virtual Reality." Poster presentation at Bay Area Robotics Symposium, Stanford, CA, November 18, 2016.

"New approaches to haptics for teleoperation and virtual reality." Presentation at IEEE Control Systems and IEEE Robotics & Automation Society technical Meeting, Sunnyvale, CA, April 27, 2016.

"Tactile skin deformation feedback for conveying environment forces and collaborative intent in teleoperation." Paper presentation at International Conference on Human-Robot Interaction, Portland, OR, March 13, 2015.

"Skin stretch as a sensory substitution method in teleoperated palpation." Poster presentation at Pioneers Workshop, International Conference on Human-Robot Interaction, Portland, OR, March 13, 2015.

"Tactile feedback for conveying force information in teleoperation." Presentation at Stanford/Berkeley collaboration meeting, Berkeley, CA, December 8, 2014.

"Tactor-induced skin stretch as a sensory substitution method in teleoperated palpation." Presentation at Stanford Robotics Seminar, Stanford, CA, May 16, 2014.

"Skin stretch as a sensory substitution method in teleoperated palpation." Presentation at the Summer School on Surgical Robotics at CMU, Pittsburgh, PA, July 22, 2014.

"Sensory substitution via cutaneous skin stretch feedback." Poster presentation at IEEE International Conference on Robotics and Automation, Karlsruhe, Germany, May 8, 2013.

"Skin stretch feedback as a possible sensory substitute for force feedback." Presentation at Bio-X Symposium, Stanford, CA, August 12, 2012.

TEACHING AND MENTORING

Teaching Assistant

September 2015 - December 2015

Design and Control of Haptic Systems

Stanford, CA

- Served as a teaching assistant for a graduate course on the design and control of haptic systems.
- Responsibilities included 1-on-1 teaching, lecturing, and grading.

Stanford Mechanical Engineering Summer Undergraduate Research Institute

June 2014 -

September 2014

Undergraduate Mentor

Stanford, CA

- Served as a mentor for two undergraduate researchers interested in pursuing a PhD.
- Developed a summer long project for the creation of a novel gripper interface for robotic manipulators.
- Resulted in a publication at IEEE World Haptics 2015.

Student Engineers Educating Kids

August 2009 - May 2011

Mentor and Tutor

Austin, TX

- Served as a mentor for middle school students in underprivileged areas.
- Held weekly tutoring sessions for science and math.
- Staffed science activity days for visiting students from surrounding middle schools.