Stephen A. Mascaro

Associate Professor (Lecturer)
Department of Mechanical Engineering, University of Utah
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Education

MASSACHUSETTS INSTITUTE OF TECHNOLOGY Cambridge, MA

- **Ph.D.** in Mechanical Engineering, February 2002. Thesis: Design and Analysis of Fingernail Sensors for Measurement of Fingertip Touch Force and Finger Posture. Major in System Dynamics and Control.
- **M.S**. in Mechanical Engineering, February 1997. Thesis: Force Guided Docking Control of an Omnidirectional Holonomic Vehicle and its Application to Wheelchairs.

CLARKSON UNIVERSITY Potsdam, NY

B.S. in Mechanical Engineering, May 1995. Emphasis on design and mechanics.

HOUGHTON COLLEGE Houghton, NY

B.A. in Physics, May 1995. Pre-engineering 3-2 program. Minor in Mathematics.

Awards/Honors

- Top 15% Instructor Award, University of Utah, College of Engineering, Spring 2010, Fall 2012, Spring 2022.
- Finalist for Best Conference Paper Award, IEEE International Conference on Robotics and Automation, 2003.
- Best Conference Paper Award, IEEE International Conference on Robotics and Automation, 1999.
- Goddard Award for Best Research Contribution, NASA Academy, 1995.

Appointments

1/23-present	Associate Professor (Lecturer), Mechanical Engineering, U. of Utah
7/13-12/22	Associate Professor, Mechanical Engineering, University of Utah
1/05-6/13	Assistant Professor, Mechanical Engineering, University of Utah
8/03-12/04	Assistant Professor, Mechanical Engineering, North Dakota State U.
1/02-7/03	Postdoctoral Associate, Mechanical Engineering, MIT
9/95-1/02	Graduate Research Assistant, Mechanical Engineering, MIT
6/95-8/95	Research Assistant, Goddard Space Flight Center, NASA

Research

UNIVERSITY OF UTAH Salt Lake City, UT

Continuing research on biorobotics with projects in bioinstrumentation, biomanipulation, and bioinspiration. Bioinstrumentation projects include the development of a fingernail imaging system for unconstrained grasp force measurement. Biomanipulation projects include the application of a 6-axis magnetic levitation device to apply forces to the human fingertip for calibration of fingernail imaging, and the application of force feedback for teleoperation of omnidirectional robots. Bioinspiration projects include the design and modeling of an anatomically correct robot hand, and the design and control of artificial muscles systems for powering robot hands and hand exoskeletons.

MIT Department of Mechanical Engineering Cambridge, MA
Supervisor: Professor H. Harry Asada

- Researched novel idea of new high-speed modular wet Shape Memory Alloy actuator arrays, where SMA wires are embedded in a network of artificial blood vessels using a scalable architecture. *Spring 2002 – Summer 2003.*
- Designed a new type of sensor that detects fingertip touch force and finger posture by measuring the pattern of coloration or blood volume beneath the human fingernail. Analyzed two-dimensional spatial array of data from multiple experimental subjects in order to characterize relationship between finger actions and sensor response. Biomechanical and hemodynamic modeling and simulation of the human fingertip was also performed in order to understand the mechanism of fingernail color change. Results of the data analysis and model simulation were used to define design principles and create methods for sensor calibration. The sensor was applied as a novel device for human-machine interaction, including a wearable computer mouse. *Summer 1997 - Fall 2001.*
- Designed an omnidirectional ball-wheeled robotic vehicle for application to a transformable wheelchair system. Designed unique force-sensor arrangements, as well as control algorithms that allowed the robotic wheelchair to autonomously navigate and compliantly dock with stationary fixtures. *Fall 1995 – Spring 1997.*

GODDARD SPACE FLIGHT CENTER, NASA Greenbelt, MD
Research Assistant, NASA Academy Program. Modeled and designed a 10 Kelvin miniature radiative cooler for a space telescope. ***Winner of the Goddard Award for best research contribution.*** *Summer 1995*.

CLARKSON UNIVERSITY Potsdam, NY
Undergraduate Research Assistant, Department of Mechanical and Aeronautical Engineering. Analyzed stress-strain relationships and crack growth in fatigued nickel specimens. *Summer 1994*.

Teaching

UNIVERSITY OF UTAH Salt Lake City, UT
ME EN 1010 Computer-Based Problem Solving for Eng Systems. *Spring 2013/14.*
ME EN 3200/3210/3230 Mechatronics. *Fall 2008/15/17-19/21-22 and Spring 2009/23*.
ME EN 5205/6205 System Dynamics. *Fall 2009/11/12/16/20/22*.
ME EN 5200/6200 Classical Control Systems. *Fall 2005/06.*
ME EN 5210/6210 State Space Control. *Spring 2006/07.*
ME EN 5220/6220 Introduction to Robotics. *Fall 2007.*
ME EN 5230/6230 Introduction to Robot Control. *Spring 2008/10-13/16-23.*

NORTH DAKOTA STATE UNIVERSITY Fargo, ND
ME 412 Engineering Measurements. *Spring 2004/Fall 2004*.
ME 213 Modeling for Engineers. *Fall 2003/04*.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY Cambridge, MA
Laboratory Instructor for 2.671 Measurement and Instrumentation, *Spring 2002*.
Teaching Assistant for 2.151 Advanced System Dynamics and Control. *Spring 2000*.

Stephen A. Mascaro

Journal Publications

- Fallahinia, N. and Mascaro, S., 2022. "Real-Time Grasp Force Sensing Using Fingernail Imaging via Deep Neural Networks," *IEEE Robotics and Automation Letters*, vol. 7, no. 3, pp. 6558-6565.
- Tigue, J., Rockwell, W.B., Foreman, K.B., and Mascaro, S., 2022. "Investigating the Effects of Flexor Tendon Shortening on Active Range of Motion after Finger Tendon Repair," *The Anatomical Record*, vol. 305, no. 5, pp. 1231-1244.
- Fallahinia, N. and Mascaro, S., 2020. "Feasibility Study of Force Measurement for Multi-Digit Unconstrained Grasping via Fingernail Imaging and Visual Servoing," *ASME Letters in Dynamic Systems and Control*, vol. 1, no. 2, 6 pp.
- Tigue, J., King, R., and Mascaro, S., 2020. "Simultaneous Kinematic and Contact Force Modeling of a Human Finger Tendon System Using Bond Graphs and Robotic Validation," *ASME Journal of Dynamic Systems, Measurement and Control*, vol. 142, no. 3, 14 pp.
- Zundel, J., Ansari, S.A., Trivedi, H.M., Masters, J.G., and Mascaro, S. 2018, "Characterization of Friction and Moisture of Porcine Lingual Tissue in Vitro in Response to Artificial Saliva and Mouthwash Solutions," *Skin Research and Technology*, vol. 24, pp. 642-649.
- Mascaro, D. and Mascaro S., 2016. "An Integrated Project-Driven Course in Computer Programming for Mechanical Engineering Students," *ASEE Computers in Education Journal*, vol. 7, no. 2, pp. 58-72.
- Grieve, T., Hollerbach, J. and Mascaro, S., 2016. "Optimizing Fingernail Imaging Calibration for 3-D Force Magnitude Prediction," *IEEE Transactions on Haptics*, vol. 9, no. 1, pp. 69-79.
- Yardley, R., Fan. A, Masters, J. and Mascaro. S., 2016. "Haptic Characterization of Human Skin in Vivo in Response to Shower Gels using a Magnetic Levitation Device," *Skin Research and Technology*, vol. 22, no. 1, pp. 115-127.
- Grieve. T, Hollerbach, J. and Mascaro, S., 2015. "3-D Fingertip Touch Force Prediction Using Fingernail Imaging with Automated Calibration," IEEE *Transactions on Robotics*, vol. 31, no. 5, pp. 1116-1129.
- Pierce, M. and Mascaro, S., 2013. "A Biologically Inspired Wet Shape Memory Alloy Actuated Robotic Pump," *IEEE/ASME Transactions on Mechatronics*, vol. 18, no. 2, pp. 536-546.
- Abu-Khalaf, J. and Mascaro, S., 2013. "Effects of Wavelength and Optical Path Length in Design of Fingernail Touch Force Sensing," *IEEE Sensors Journal*, vol. 13, no. 2, pp. 807-815.
- Flemming, L. and Mascaro, S., 2013. "Analysis of Hybrid Electric/Thermofluidic Inputs for Wet Shape Memory Alloy Actuators," *Smart Materials and Structures,* vol. 22, no. 1, 8 pp.
- Ertel, J. and Mascaro, S., 2010. "Dynamic Thermomechanical Modeling of a Wet Shape Memory Alloy Actuator," *ASME Journal of Dynamics Systems, Measurement and Control*, vol. 132, no. 5, 9 pages.
- Sun, Y., Hollerbach, J. and Mascaro, S., 2009. "Estimation of Finger Force Direction with Computer Vision", *IEEE Transactions on Robotics*, vol. 25, no. 6, pp. 1356-1369.

- Sun, Y., Hollerbach, J. and Mascaro, S., 2008. "Predicting Fingertip Forces by Imaging Coloration Changes in the Fingernail and Surrounding Skin," *IEEE Transactions on Biomedical Engineering*, vol. 55, no. 10, pp. 2363-2371.
- Mascaro, S. and Asada, H., 2006. "The Common Patterns Of Blood Perfusion In The Fingernail Bed Subject To Fingertip Touch Force And Finger Posture," *Haptics-e: The Electronic Journal of Haptics Research*, vol. 4, no. 3, pp. 1-6.
- Mascaro, S. and Asada, H., 2004. "Measurement of Finger Posture and Three-Axis Fingertip Touch Force Using Fingernail Sensors," *IEEE Transactions on Robotics and Automation*, vol. 20, no. 1, pp. 26-35.
- Mascaro, S. and Asada, H., 2001. "Photoplethysmograph Fingernail Sensors for Measuring Finger Forces without Haptic Obstruction," *IEEE Transactions on Robotics and Automation*, vol. 17, no. 5, pp. 698-708.

Refereed Conference Proceedings

- Allen, E., Rockwell, B., Foreman, B., and Mascaro, S. 2022. "Impact of Flexor Digitorum Superficialis Opponensplasty and Wrist Angle on Range of Motion and Pinch Force of the Thumb," *Proc. of the Annual Meeting of the American Society for Surgery of the Hand (ASSH)*, Sept 29th-Oct. 2nd, 2022.
- Tigue, J., Rockwell, B., Foreman, B., and Mascaro, S., 2020. "Simulating Tendon Shortening During Flexor Tendon Repair Surgery Using Biomechanical Models and Robotic Testbeds," *Proc. of the 8th IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics* (BIOROB), pp. 193-198.
- Fallahinia, N., and Mascaro, S. 2020. "Comparison of Constrained and Unconstrained Human Grasp Forces Using Fingernail Imaging and Visual Servoing," *Proc. of the IEEE International Conference on Robotics and Automation (ICRA)*, pp. 2668-2674.
- Fallahinia, N. and Mascaro, S. 2020. "The Effect of Contact Surface Curvature on the Accuracy of Fingernail Imaging for Tactile Force Measurement," *Proc. of the IEEE Haptics Symposium*, pp. 760-766.
- Tigue, J., and Mascaro, S., 2019. "Calibration and Validation of Dynamic Model for Simulating Robot Finger Kinematics and Contact Forces," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2019)*, 10 pp.
- Fallahinia, N., and Mascaro, S., 2019. "Feasibility Study of Force Measurement for Multi-Digit Unconstrained Grasping via Fingernail Imaging and Visual Servoing," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2019)*, 10 pp.
- Mascaro, S. 2019. "Educational Force Control using a Modular 2-DOF Serial Robot Manipulator and Low-Cost 2-DOF Force Sensor," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2018)*, 10 pp.
- Padgett, M., and Mascaro S., 2019. "Investigation of Manufacturing Parameters for Copper-Wound Super-Coiled Polymer Actuators," *Proc. of the SPIE 10966, Electroactive Polymer Actuators and Devices (EAPAD) 2019*, 109660R, 12 pp.
- Tyagi, R., and Mascaro, S., 2018. "Omnidirectional Force Feedback for Teleoperation of Omnidirectional Wheeled Robots," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2018)*, 10 pp.
- Fallahinia, N., Harris, S. and Mascaro S., 2018. "Grasp Force Sensing Using Visual Servoing and Fingernail Imaging," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2018)*, 10 pp.

- Tigue, J., Harris. S., Anjewierden, C., and Mascaro, S., 2017. "Validation of Fingertip Force and Finger Pose in the UART Finger and Bond Graph Tendon Model During Surface Contact," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2017)*, 8 pp.
- Mascaro, S., 2016. "A Modular 2-DOF Serial Robot Manipulator for Education in Robot Control," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2016),* 10 pp.
- Mascaro, D. and Mascaro S., 2015. "An Integrated Project-Driven Course in Computer Programming for Mechanical Engineering Students," *ASEE Annual Conference and Exposition 2015,* 18 pp.
- Sarrazin, J. and Mascaro, S., 2015. "Sequential Growth for Lifetime Extension in Biomimetic Polypyrrole Actuator Systems," *Proc. of the SPIE 9430, Electroactive Polymer Actuators and Devices (EAPAD) 2015,* 943018*,* 11 pp.
- King, R. Niehues, T. Rao, P. Deshpande, A. and Mascaro, S., 2015. "Validation of Fingertip Force in the ACT Hand Index Finger and Bond Graph Tendon Model," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2015)*.
- Sarrazin, J. and Mascaro, S., 2014. "Sequential Growth and Monitoring of a Polypyrrole Actuator System," *Proc. of the SPIE 9056, Electroactive Polymer Actuators and Devices (EAPAD) 2014*, 90563L, 11 pp.
- Grieve, T., Doyle, C., Hollerbach, J. and Mascaro, S., 2014. "Calibration of Fingernail Imaging for Multidigit Force Measurement," *Proc. of the IEEE Haptics Symposium 2014*, pp. 623-627.
- Mollaei, M. and Mascaro, S., 2013. "Optimal Control Algorithm for Multi-Input Binary Segmented SMA Actuators Applied to a Multi-DOF Robot Manipulator," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2013)*, 8 pp.
- Grieve, T., Hollerbach, J. and Mascaro, S., 2013. "Fingernail Image Registration Using Active Appearance Models," *Proc. of the IEEE International Conference on Robotics and Automation (ICRA 2013),* pp. 3011-3018.
- Grieve, T., Hollerbach, J. and Mascaro, S., 2013. "Force Prediction by Fingernail Imaging Using Active Appearance Models," *Proc. of the IEEE World Haptics Conference 2013, The 5th Joint Eurohaptics Conference and IEEE Haptics Symposium*, pp. 181-186.
- Mollaei, M. and Mascaro, S., 2012. "Optimal Control of Multi-Input SMA Actuator Arrays on a Trajectory Using Graph Theory: Modified A-Star Search Algorithm," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2012)*, 8 pp.
- King, R. and Mascaro, S., 2012. "Real-Time Control of a Graphical User Interface for Simulating Finger Tendon Kinematics," *Proc. of the ASME Dynamic Systems and Control Conference (DSCC 2012)*, 7 pp.
- Flemming, L., Johnson, D., and Mascaro, S., 2011. "Optimal Control of Multi-Input SMA Actuator Arrays Using Graph Theory: Expanding Wavefront and Simultaneous Operations," *Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2011)*, pp. 780-785.
- Pierce, M. and Mascaro, S., 2011. "Wet Shape Memory Alloy Actuated Robotic Heart with Thermofluidic Feedback," *Proc. of the IEEE International Conference on Intelligent Robots and Systems (IROS 2011)*, pp. 402-407.

- Christensen, Q., and Mascaro, S., 2011. "3-DOF Haptic Feedback for Assisted Driving of an Omnidirectional Wheelchair," *Proc. of the IEEE International Conference on Intelligent Robots and Systems (IROS 2011)*, pp. 2596-2601.
- Flemming, L., Johnson, D., and Mascaro, S., 2011. "Optimal Control of Multi-Input SMA Actuator Arrays Using Graph Theory," *Proc. of the IEEE International Conference on Robotics and Automation (ICRA 2011)*, pp. 6109-6114.
- Abu-Khalaf, J. and Mascaro, S., 2011. "Optimization of Fingernail Sensing Technique based on Optical Experimentation and Modeling," *Proc. of the IEEE Sensors Applications Symposium (SAS 2011)*, pp. 283-288.
- Abu-Khalaf, J. and Mascaro, S., 2010. "Optimization of Fingernail Sensor Design Based on Fingernail Imaging," *Proc. of the SPIE Novel Optical Systems Design and Optimization XIII*, vol. 7787, 8 pages.
- Grieve, T., Lincoln, L., Sun, Y., Hollerbach, J. and Mascaro, S., 2010. "3D Force Prediction Using Fingernail Imaging with Automated Calibration," *Proc. of the 2010 Symp. on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, pp. 113-120.
- Flemming, L. and Mascaro, S., 2009. "Analysis of Hybrid Electric/Thermofluidic Control for Wet Shape Memory Alloy Actuators," *Proc. of the 2009 ASME Dynamic Systems and Control Conference (DSCC2009)*, pp. 1041-1047.
- Ertel, J. and Mascaro, S. 2009. "Wet Shape Memory Alloy Actuated Robotic Heart," *Proc. of the 2009 ASME Dynamics Systems and Control Conference (DSCC2009)*, pp. 1033-1040.
- Abu-Khalaf, J., Park, J.W., Mascaro, D. and Mascaro, S., 2009. "Stretchable Fingernail Sensors for Measurement of Fingertip Force," *Proc. of the 3rd Joint Eurohaptics Conf. and Symp. on Haptic Interfaces for Virtual Environment and Teleoperator Systems (World Haptics Conference'09)*, pp. 625-626.
- Grieve, T., Sun, Y., Hollerbach, J. and Mascaro, S., 2009. "3-D Force Control on the Human Fingerpad Using a Magnetic Levitation Device for Fingernail Imaging Calibration", *Proc. of the 3rd Joint Eurohaptics Conf. and Symp. on Haptic Interfaces for Virtual Environment and Teleoperator Systems (World Haptics Conference'09)*, pp. 411-416.
- Sun, Y., Hollerbach, J. and Mascaro, S., 2007. "Imaging Finger Force Direction," *IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR)*, pp. 1-6.
- Sun, Y., Hollerbach, H. and Mascaro, S., 2007. "Finger Force Direction Recognition by Principal Component Analysis of Fingernail Coloration Pattern," *Proc. of the 2nd Joint EuroHaptics Conf. and Symp. on Haptic Interfaces for Virtual Environment and Teleoperator Systems(WHC'07)*, pp. 90-95.
- Sun, Y., Hollerbach, H. and Mascaro, S., 2007. "EigenNail for Finger Force Direction Recognition," *Proc. of the IEEE International Conference on Robotics and Automation*, pp. 3251-3256.
- Flemming, L., and Mascaro, S., 2007. "Control of a Scalable Matrix Vasoconstriction Device for Wet Actuator Arrays," *Proc. of the IEEE International Conference on Robotics and Automation*, pp. 648-653.

- Ertel, J., and Mascaro, S., 2006. "Thermomechanical Modeling of a Wet Shape Memory Alloy Actuator," *Proc. of ASME IMECE Dynamic Systems and Control Division*, pp. 1-8.
- Sun, Y., Hollerbach, H. and Mascaro, S., 2006. "Dynamic Features and Prediction Model for Imaging Fingernail to Measure Finger Forces," *Proc. of IEEE International Conference on Robotics and Automation*, pp. 2813-2818.
- Sun, Y., Hollerbach, H. and Mascaro, S., 2006. "Measuring Fingertip Forces by Imaging the Fingernail," *Proc. of 14th Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, pp. 125-131.
- Flemming, L. and Mascaro, S., 2005. "Wet SMA Muscle Array with Matrix Vasoconstriction Device," *Proc. of ASME Dynamic Systems and Control Division*, vol. 74, no. 2, pp. 1751-1758.
- Flemming, L. and Mascaro, S., 2005. "Control of Scalable Wet SMA Actuator Arrays," *Proc. of IEEE International Conference on Robotics and Automation*, pp. 1350-1355.
- Cho, K.-J., Roy, B.; Mascaro, S., and Asada, H.H., 2004. "A Vast DOF Robotic Car Seat Using SMA Actuators with a Matrix Drive System," *Proc. IEEE International Conference on Robotics and Automation,* vol. 4, pp. 3647-3652.
- Mascaro, S. and Asada, H., 2003. "Vast DOF Wet Shape Memory Alloy Actuators Using Matrix Manifold and Valve System," *Proc. ASME Dynamic Systems and Control Division*, vol. 72, no. 1, pp. 577-582.
- Mascaro, S., Cho, K., and Asada, H., 2003. "Design and Control of Vast DOF Wet SMA Array Actuators," *Proc. IEEE/RSJ International Conference on Intelligent Robots and Systems*, vol. 2, pp. 1992-1997.
- Mascaro, S. and Asada, H., 2003. "Wet Shape Memory Alloy Actuators for Active Vasculated Robotic Flesh," *Proc. IEEE International Conference on Robotics and Automation,* vol. 1, pp. 282-287. ***Finalist for the Best Conference Paper Award***.
- Mascaro, S. and Asada, H., 2002. "Filter Design and Calibration for Fingernail Sensors to Measure Fingertip Forces and Finger Posture," *Proc. IEEE International Conference on Robotics and Automation*, vol. 2, pp. 1642-1648.
- Mascaro, S. and Asada, H., 2002. "Understanding of Fingernail-Bone Interaction and Fingertip Hemodynamics for Fingernail Sensor Design," *Proc. 10th Int. Symp. on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, pp. 106 -113.
- Mascaro, S. and Asada, H., 2001. "Finger Posture and Shear Force Measurement using Fingernail Sensors: Initial Experimentation," *Proc. IEEE Int. Conf. Robotics and Automation*, vol. 2, pp. 1857-1862.
- Mascaro, S. and Asada, H., 2000. "Fingernail Sensors for Measurement of Fingertip Touch Force and Finger Posture," *Proc. ASME Dynamic Systems and Control Division*, vol. 69-2, pp. 1249-1250.
- Mascaro, S. and Asada, H., 2000. "Fingernail Touch Sensors: Spatially Distributed Measurement and Hemodynamic Modeling," *Proc. IEEE Int. Conf. Robotics and Automation*, vol. 4, pp. 3422-3427.
- Mascaro, S. and Asada, H., 1999. "Distributed Photo-Plethysmograph Fingernail Sensors: Finger Force Measurement Without Haptic Obstruction," *Proc. ASME Dynamic Systems and Control Division*, vol. 67, pp. 73-80.

- Mascaro, S., Chang, K.-W. and Asada, H., 1999. "Photo-Plethysmograph Nail Sensors for Measuring Finger Forces Without Haptic Obstruction," *Proc. IEEE Int. Conf. Robotics and Automation*, vol. 2, pp. 962-967. ***Winner of the Best Conference Paper Award.***
- Mascaro, S. and Asada, H., 1999. "Virtual Switch Human-Machine Interface Using Fingernail Touch Sensors," *Proc. IEEE Int. Conf. Robotics and Automation*, vol. 4, pp. 2533-2538.
- Mascaro, S., Chang, K.-W., and Asada, H., 1998. "Finger Touch Sensors Using Instrumented Nails and Their Application To Human-Robot Interactive Control," *Proc. ASME Dynamic Systems and Control Division*, vol. 64, pp. 91-96.
- Mascaro, S., Chang, K.-W., and Asada, H., 1998. "Instrumented Fingernails: a Haptically Unobstructive Method for Touch Force Input," *Proc. SPIE Telemanipulator and Telepresence Technologies V*, vol. 3524, pp. 170-178.
- Mascaro, S. and Asada, H., 1998. "Hand-in-Glove Human-Machine Interface and Interactive Control: Task Process Modeling Using Dual Petri Nets," *Proc. IEEE Int. Conf. Robotics and Automation*, vol. 2, pp. 1289-1295.
- Mascaro, S. and Asada, H., 1998. "Docking Control of Holonomic Omnidirectional Vehicles with Applications to a Hybrid Wheelchair/Bed System," *Proc. IEEE Int. Conf. Robotics and Automation*, vol. 1, pp. 399-405.
- Mascaro, S., and Asada, H., 1997. "A Hybrid Bed/Chair System for Bedridden Patients - Elimination of Transfer Between a Bed and Wheelchair," *Proc. ASME Dynamic Systems and Control Division*, vol. 61, pp. 393-400.
- Mascaro, S., Spano, J. and Asada, H., 1997. "A Reconfigurable Holonomic Omnidirectional Mobile Bed with Unified Seating (RHOMBUS) for Bedridden Patients," *Proc. IEEE Int. Conf. Robotics and Automation*, vol. 2, pp. 1277-1282.

Patents

- Mascaro, S., Mascaro, D., Abu-Khalaf, J., Park, J. "Stretchable Electronic Circuit," US Patent 8,907,376, Issued December 9, 2014.
- Mascaro, S., Mascaro, D., Abu-Khalaf, J., Park, J. "Stretchable Circuit Configuration," US Patent 8,329,493, Issued December 11, 2012.
- Asada, H.H. and Mascaro, S., 2002. "Fingernail Sensors for Measuring Finger Forces and Finger Posture," US Patent 6,388,247, Issued May 14, 2002.
- Asada, H.H., Mascaro, S., and Chang, K.-W., 2001. "Finger Touch Sensors and Virtual Switch Panels," US Patent 6,236,037, Issued May 22, 2001.
- Asada, H.H., Mascaro, S., and Spano, J., 2000. "Human Transport System with Dead Reckoning Facilitating Docking," US Patent 6,135,228, Issued October 24, 2000.

Invited Talks

- "Wet Robotics," presented at the International Symposium on Neo-Robotics, Nagoya Institute of Technology, Nagoya, Japan, January 13th, 2007.
- "Fingernail Imaging for Touch Force Measurement," presented at Arizona State University, May 2nd, 2014.

Stephen A. Mascaro

Media Exposure

- *American Ninja Warrior*, "Minneapolis Qualifiers," NBC, 7/10/2018.
- "Univ. of Utah Professor Competes in 'American Ninja Warrior,'" Ashley Kewish, *KSL TV*, 7/10/2018.
- "A Utah Professor Said He'd Train for 'American Ninja Warrior' if His Student's Robots Could Conquer his Obstacle Course. Now He's Competing on TV," Sean P. Means, *Salt Lake Tribune*, 7/8/2018.

Society Memberships

- American Society of Mechanical Engineers
- Institute of Electrical and Electronics Engineers
- IEEE Robotics and Automation Society
- *Pi Tau Sigma* National Mechanical Engineering Honor Society

Professional Service

- Organizer of Workshop titled "A Short Course on Robot Control," at the ASME Dynamic Systems and Control Conference, 2019.
- Industrial Liaisons Chair and Local Arrangements Chair, ASME Dynamic Systems and Control Conference, 2019.
- Associate Editor: IEEE Int. Conf. on Intelligent Robots and Systems, 2007 & 2012
- Session Chair/Co-Chair: IEEE International Conference on Robotics and Automation; ASME International Mechanical Engineering Congress and Exposition, Robotics Track, Dynamic Systems and Control Division; ASME Dynamic Systems and Control Conference, IEEE/RSJ Int. Conf. on Intelligent Robots and Systems
- Technical Committee Participant: ASME Dynamic Systems and Control, Robotics Panel.
- Reviewer: IEEE Transactions on Robotics and Automation (TRO), IEEE Robotics and Automation Letters (RAL), IEEE/ASME Transactions on Mechatronics (TMECH), IEEE Robotics and Automation Magazine, ASME Journal of Dynamic Systems and Control, ASME Journal of Biomechanical Engineering, IEEE Transactions on Circuits and Systems II (TCAS-II), ASME Journal of Mechanisms and Robotics, ASME Journal of Computing and Information Science in Engineering (JCISE), International Journal of Robotics Research (IJRR), Optical Engineering (SPIE), International Journal of Robotics and Automation (IASTED), Sensors and Actuators: A. Physical, IEEE Systems Journal, Computer Methods in Biomechanics and Biomedical Engineering, Expert Systems with Applications, IEEE International Conference on Robotics and Automation (ICRA), IEEE International Conference on Intelligent Robots and Systems (IROS), IEEE Haptics Symposium, Eurohaptics Conference, ASME International Mechanical Engineering Congress and Exposition (IMECE), ASME Dynamic Systems and Control Conference (DSCC), Robotics Science and Systems Conference (RSS), International Conference on Applied Bionics and Biomechanics (ICABB), International Conference on Biological Information and Biomedical Engineering (BIBE), International Conference on Biomedical Robotics and Biomechatronics (BIOROB).

- NSF Panel Service: Computing Research Infrastructure Program (CRI); Control Systems Program (CS), National Robotics Initiative (NRI), NSF Research Traineeship (NRT)

Institutional Service

- Curriculum Committee, *Fall 2015 – Present.*
- Academic Standards Committee, *Fall 2010 – Present.*
- Chair of Robotics Search Committee, *Fall 2020-Spring 2021*.
- ECE Robotics Search Committee, *Fall 2019-Fall 2020*.
- Machine Shop Committee, *Fall 2009 – Spring 2018.*
- Ad Hoc Kennicott Renovation Committee, *Fall 2007 – Spring 2018.*
- Robotics Search Committee, *Fall 2017 – Spring 2018.*
- Chair of Robotics Search Committee, *Fall 2015 – Spring 2016.*
- Freshman/Sophomore Curriculum Review Committee, *Summer 2013*.
- Systems Engineering Search Committee, *Fall 2009 – Spring 2010.*
- College Council Representative, *Fall 2008 – Spring 2010.*
- Seminar Committee, *Fall 2007 – Spring 2008.*

Outreach Activities

- Lead Robot Inspector, Utah Regional FIRST Robotics Competition, 2011-2022.
- Robot Inspector, Utah Regional FIRST Robotics Competition, 2010.
- Mentor, FIRST Robotics Team #3243, AMES, 2021-present.
- Mentor, FIRST Lego League Team #1610, Wasatch Junior High, 2019-present.

Consulting

- Bunnell, Inc, Salt Lake City, UT.
- Utah Attorney General's Office, Salt Lake City, UT.
- DCI Corporation, Bountiful, UT.
- Hexatron Engineering, Salt Lake City, UT.
- JTech Medical, Salt Lake City, UT.

Grants Awarded

- "Simulating Tendon Reconstructive Surgeries using a Virtual Hand Model and Robotic Testbed," National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIH R21). PI: Stephen Mascaro, Co-PI: Kenneth Foreman, 07/02/2019-05/31/2023, $347,798.
- "Anatomically Correct Hand Kinematics." University of Utah Funding Incentive Seed Grant Program. PI: Stephen Mascaro, Co-PI: Kenneth Foreman, 01/01/14-5/30/15, $33,000.
- "Haptic Characterization of Oral Hydration," Colgate-Palmolive. PI: Stephen Mascaro, 08/19/2013-08/14/-2015, $121,018.
- "NRI-Small: Measuring Unconstrained Grasp Forces Using Fingernail Imaging." National Science Foundation, National Robotics Initiative. PI: Stephen Mascaro, Co-PI: John Hollerbach, 07/01/12-09/30/18, $917,999.

- "Reconfigurable Servo-Motor Stations for Mechatronics, Robotics, and Control Laboratories." University of Utah, College of Engineering, Base Engineering Equipment Fund (BEEF). 06/30/2010, $117,175 ($66,000 BEEF funds + $51,175 matching funds from Quanser, Inc.).
- "Optimal Control of Actuator Arrays with Electric and Thermofluidic Inputs." National Science Foundation, Control Systems/CMMI. PI: Stephen Mascaro, 08/15/2010-7/31/2013, $279,996.
- "Haptic Characterization of Shower Gels." Colgate-Palmolive. PI: Stephen Mascaro, 08/16/10-8/15/12, $100,000.
- "Self-Healing ElectroActive Polymer Actuator Systems." University of Utah Funding Incentive Seed Grant Program. PI: Stephen Mascaro, Co-PI: Debra Mascaro, 07/01/10-6/30/11, $32,000.
- "IGERT: Interdisciplinary Training in Biocentric Robotics." National Science Foundation. PI: John Hollerbach, Co-PIs: Stacy Bamberg, Stephen Mascaro, Mark Minor, William Provancher, 09/01/07-8/31/12, $2,969,597.
- "Measuring Finger Forces by Imaging the Fingernail." NIH Exploratory/ Developmental (R21) Bioengineering Research Grants (EBRG), PA-03-058. PI: John Hollerbach, Co-PI: Stephen Mascaro, 07/12/06 - 06/30/10, $392,677.

Current Graduate Students

- Elena Pradhan (M.S. Candidate in Mechanical Engineering) Project: Holonomic Haptic Force Feedback for Assisted Navigation of Omnidirectional Ground Robots.

Students Graduated

- Evan Allen (M.S. in Mechanical Engineering, 2022) Thesis: Simulation and Evaluation of a Tendon Transfer Surgery using Cadaveric Hands and a Biomimetic Robot.
- Navid Fallahinia (Ph.D. in Mechanical Engineering, 2022) Dissertation: Grasp Force Measurement via Fingernail Imaging with Multiple Robotic Arms.
- James Tigue (Ph.D. in Mechanical Engineering, 2021) Dissertation: Finger Flexor Tendon Repair Surgery: Simulation and Analysis Using a Biomimetic Robot, A Cadaver Testbed, and a Computational Model.
- Matt Padgett (M.S. in Mechanical Engineering, 2019) Thesis: Manufacturing and Experimental Characterization of Copper-Wound Supercoiled Polymer Actuators.
- Rajat Tyagi (M.S. in Mechanical Engineering, 2017) Thesis: Omnidirectional Force Feedback for Assisted Navigation of Omnidirectional Robots.
- Jared Zundel (M.S. in Mechanical Engineering, 2015) Thesis: Characterization of Friction and Moisture of Porcine Lingual Tissue in Vitro in Response to Artificial Saliva and Mouthwash Solutions.
- Raymond King (Ph.D. in Mechanical Engineering, 2015) Dissertation: Development and Validation of a Bond Graph Tendon Model of the Human Finger with the Anatomically Correct Testbed (ACT) Hand.
- John Sarrazin (Ph.D. in Mechanical Engineering, 2015) Dissertation: Sequential Growth, Regrowth, and Control of Polypyrrole-Metal Coil Composite Artificial Muscles.

- Thomas Grieve (Ph.D. in Mechanical Engineering, 2013) Thesis: Automated Calibration and Registration using Active Appearance Models for a Fingernail Imaging System.
- Ryan Yardley (M.S. in Mechanical Engineering, 2012) Thesis: Haptic Characterization of Human Skin in Vivo in Response to Shower Gel Treatments Using a Magnetic Levitation Device.
- Leslie Flemming (Ph.D. in Mechanical Engineering, 2012) Dissertation: Intelligent Control of SMA Actuator Arrays with Electric and Thermofluidic Inputs.
- Jumana Abu-Khalaf (Ph.D. in Mechanical Engineering, 2012) Dissertation: Optimization of Stretchable Fingernail Sensor Design for Fingertip Force Direction Estimation.
- Quinton Christensen (M.S. in Mechanical Engineering, 2011) Thesis: Three Degree of Freedom Haptic Feedback for Assisted Driving of Holonomic Omnidirectional Wheelchairs.
- Matt Pierce (M.S. in Mechanical Engineering, 2011) Thesis: Design and Optimization of a Shape Memory Actuated Pump with Thermofluidic Feedback.
- Joel Ertel (M.S. in Mechanical Engineering, 2007) Thesis: Design and Modeling of a Shape Memory Alloy Actuated Robotic Heart.
- Yu Sun (Ph.D. in Computer Science, 2007) Dissertation: Measure Fingertip Force by Imaging the Fingernail and the Surrounding Skin.
- Leslie Flemming (M.S. in Mechanical Engineering, NDSU, 2006) Thesis: Vast Arrays of Actuators using a Matrix Vasoconstrictor Device.

Undergraduate Research Training

- Braden Foard, UROP, *Fall 2020*.
- Spencer Brewster, UROP, *Fall 2018*.
- Christopher Anjewierden, UROP, *Fall 2016*.
- Piyush Bubna, Summer Research Intern, *Summer 2006*
- Jared Wood, URT, *Fall 2005-Spring 2006*

Senior Capstone Projects

- Adaptive Chairlift: Connor Gromko, Alex Forsberg, Taylor Kalensky, Ashleigh Bicknell, Will Tesseyman, *Fall 2022 – Spring 2023*
- Robotic Ply-Handling: Caleb Bost, Darrick Minshall, Chase Lee, Victor David-Leao, *Spring 2022 – Fall 2022*
- Robot Rec Room: Alex Best, Matthew James, Jack Montgomery, Derek Mouser, Robert Nievar, *Spring 2021 – Fall 2021*
- Robot Arm Controlled by Super-Coiled Polymer Muscle Fibers: Braden Foard, Jacob Kuoha, Tyler Starr, Claire Ticknor, *Spring 2021 – Fall 2021*
- Pedestal-Mounted Camera Control System for Aircraft Tracking using ADS-B Data: Freeman Allred, Anthony Russo, Zach Lauritzen, Alex Rooney, *Spring 2020-Fall 2020*
- Super-Coiled Polymer Muscles: Nathan Bennett, Radit Nopcharoenwong, Zachary St Clair, Justin Szymanski, Matthew Brown, Corban Bothell, *Fall 2019-Spring 2020*

- Super-Coiled Polymer Muscles: Taylor Liljenquist, David Castaneda, Ruben Soriano, Yisarai Valbuena, McKay Chamberlain, Charles Nelson, *Fall 2018-Spring 2019*
- Omni Board: David Geddes, Connor Bevins, Cameron Cox, Adam Magneson, *Fall 2016-Spring 2017*
- Wet SMA Outreach Kit: Werner Hoeffler, Michael Howe, Stephen Naylor, *Fall 2012-Spring 2013*
- Hand Exoskeleton II: Jared Muirhead, Thomas Rissky, Eric Smith, Dave Bytheway, Mark Howell, Eric Mcclain, *Fall 2010-Spring 2011*
- Hand Exoskeleton: Troy Arbuckle, Shane Jensen, Sean Osborn, Erick Vega, Steven Pittson, *Fall 2009-Spring 2010*
- Robot Hand IV: Patrick Maudsley, James Clark, Price Lefler, David Schafer, Chiew Cheong, *Fall 2008-Spring 2009*
- Robot Hand III: Tim Anderson, Marshall Floyd, Rob Green, Alan Romney, Chris Root, *Fall 2007-Spring 2008*
- Robot Hand II-Design: Tyson Skinner, Bryan Adams, Robert Poulsen, Evan Coombs, *Fall 2006-Spring 2007*
- Robot Hand II-Control: Andrew Ige, Jason Lindstrom, Clifton Christensen, *Fall 2006-Spring 2007*
- Robot Hand I: Jared Wood, Cameron Sulllivan, Aaron Lassig, *Fall 2005-Spring 2006*

Independent Studies

- Joshua Neeley, *Summer - Fall 2022*
- Braden Foard, Independent Design Project, *Summer 2020*.
- Andrew Pamp, IGERT Lab Rotation, *Fall 2012*
- Courtney Doyle, IGERT Lab Rotation, *Summer 2011*
- Daman Bareiss, IGERT Lab Rotation, *Summer 2011*
- Dara Scher, IGERT Lab Rotation, *Summer 2011*
- David Hepworth, Independent Design Project, *Fall 2011-Spring 2012*
- Scott Almquist, IGERT Lab Rotation, *Fall 2010*
- Nathan Nelson, IGERT Lab Rotation, *Summer 2010*
- Raymond King, IGERT Lab Rotation, *Summer 2010*
- Lucas Lincoln, IGERT Lab Rotation, *Fall 2009*
- Cody Sarrazin, IGERT Lab Rotation, *Fall 2009*
- Brittney Baker, IGERT Lab Rotation, *Fall 2008*
- Thomas Fountain, IGERT Lab Rotation, *Fall 2008*