Benjamin Shih

benjshih@gmail.com benshih.github.io
Latest update: April 9, 2019

EDUCATION

University of California, San Diego — San Diego, CA
Ph.D. Mechanical and Aerospace Engineering — August 2015 - present
MicroMBA, Rady School of Management — June 2016 - July 2016

Carnegie Mellon University — Pittsburgh, PA
M.S. Electrical and Computer Engineering — August 2013 - December 2013
B.S. Electrical and Computer Engineering — August 2009 - May 2013

SKILLS

Software: MATLAB, Eagle, SolidWorks, LaTeX, Git, ROS, Cadence, ProTools
Electronics: PCB design, microcontrollers, circuit simulation, soldering, oscilloscope, function generator
Coding: Python, C++, Java, C, HTML
Languages: English (proficient), Mandarin Chinese (speaking), Spanish (basic), French (basic)

WORK EXPERIENCE

Bioinspired Robotics and Design Lab, UC San Diego — San Diego, California
Graduate Research Assistant — August 2015 - present

- Soft actuation and sensing: hands, skin, and touch. Applications in soft sensors and manipulation, human-robot interaction, assistive and wearable robots, and haptic interfaces for virtual/augmented reality.
- Advised by: Prof. Michael T. Tolley.
- Committee: Profs. Henrik Christensen, Andrea Chiba, Shengqiang Cai, Michael Yip, Tania Morimoto.

Momentum Machines — San Francisco, California
Embedded Software Engineering Intern — May 2015 - August 2015

- Food technology startup using robotics and automation to produce gourmet food.
- Lead engineer for PCB fabrication of 6 unique boards with a design firm.
- Statecharts (finite state machine) software architecture for embedded control. Used a web-based graphical user interface to facilitate rapid prototyping and fast system bringup.
- Advised by: Jeff Jensen, Ali Rathore.

Reconfigurable Robotics Lab, EPFL — Lausanne, Switzerland
Research Assistant, École Polytechnique Fédérale de Lausanne — May 2014 - April 2015

- Built untethered, locomotive robot using soft pneumatic actuators (SPAs).
- Experimented with actuator frames to improve actuation consistency.
- Automated SPA testing using computer vision.
- Advised by: Prof. Jamie Paik, Dr. Juan Manuel Florez.

MIT Lincoln Laboratory — Lexington, MA
Graduate Intern — May 2013 - August 2013

- Worked with mechanical engineer to equip plane with visible spectrum vision capabilities.
- Created user interface using Qt for streaming video from camera and toggling individual frame recording.
- Designed software architecture using UML diagrams to describe how camera interacts with system.
- Advised by: Dr. Jon Watson, Dr. Seth Trotz, Dr. Jim Truitt.

NanoJapan, Rice University — Houston, TX
Undergraduate Researcher — May 2011 - August 2011

- Analyzed vibrational and rotational modes of C_{60} nanocars via Raman spectroscopy.
- Presented poster at International Symposium on Terahertz Nanoscience (TeraNano) at Osaka University, Japan in November 2011.
- Worked in cross-cultural research setting alongside ∼40 Japanese graduate students.
- Advised by: Prof. Kevin Kelly.

GRANTS & FUNDING

Office of Naval Research (22k USD)	Jul 2017
Scholar, UC San Diego Frontiers of Innovation Scholars Program (FISP) (25k USD)	Feb 2016
Jacobs Fellow, UC San Diego Irwin Jacobs School of Engineering Fellowship (154k USD)	Feb 2015
Scholarship of Excellence in Research at EPFL (20k CHF)	Feb 2014

HONORS & AWARDS

San Diego Achievement Rewards for College Scientists (ARCS) Scholarship (7.5k USD)	Aug 1 2018
Jacobs Graduate Student Council Award, UC San Diego (75 USD)	Jul 18 2018
Travel Award, UC San Diego MAE Department (1k USD)	Jun 18 2018
Best Poster Award Finalist (4 of 54), IEEE-RAS International Conference on Soft Robotics 2018	Apr 26 2018
Travel Award, MDPI *Robotics* (800 CHF)	Feb 1 2018
NSF Innovation Corps Program (declined)	Oct 2017
Outstanding Graduate Student, UCSD Mechanical and Aerospace Engineering (300 USD)	Jun 2017
Passed UC San Diego comprehensive qualifying exam for doctoral program	Apr 26 2017
Honorable Mention, UC San Diego Jacobs School of Engineering Research Expo	Apr 2017
Co-finalist, Outstanding Graduate Student Leader Award, UCSD Graduate Student Association	Apr 18 2017
Best Poster Award Finalist, Southern California Robotics Symposium 2017	Mar 2017
Semifinalist, Hackaday Prize 2015	Aug 2015
Winner, Intel Internet of Things Hackathon, Berlin (1.5k EUR)	Apr 2015
Finalist (top 25 out of 101 projects), HackZurich Hackathon	Oct 2014
Honorable Mention, National Science Foundation (NSF) Graduate Research Fellowship Program	Apr 2014
Small Undergraduate Research Grant, Carnegie Mellon University (500 USD)	Nov 2011
NanoJapan NSF International Research Experience for Undergraduates Program	Feb 2011
Intel Science Talent Search, Semifinalist (1k USD)	Jan 2009

INVITED TALKS

"Tactile Sensing for Soft Robots", San Diego Robotics Club, Aug 21 2018.
"Why the Future of Robotics is Soft: Bioinspired Robotics and Design Lab", UC San Diego Global Leadership Institute, Aug 2 2018.
"Tactile Sensing for Soft Robots", guest lecture for W18 MAE207 Soft Robotics, UC San Diego, Feb 23 2018.

PUBLICATIONS

For online links to the following, please see: scholar.google.com/citations?user=lDyNG8oAAAAJ

* denotes equal contribution.

Under Review / In Preparation

1. S. Jadhav, M. R. A. Majit, **B. Shih**, J. Schulze, and M. T. Tolley, "Variable stiffness fiber jamming actuators for haptic feedback in augmented reality," in preparation.
2. M. Ishida, D. Drotman, **B. Shih**, M. Hermes, M. Luhar, and M. T. Tolley, "Morphing structure for changing hydrodynamic characteristics of a soft robot walking underwater," submitted.

Refereed Journal Publications

1. **B. Shih**, C. Christianson, K. Gillespie, S. Lee, J. Mayeda, Z. Huo, and M. T. Tolley, "Design considerations for 3D printed, soft, multimaterial resistive sensors for soft robotics," Frontiers in Robotics and AI, April 2019, in press.
2. T. G. Thuruthel*, **B. Shih***, C. Laschi, and M. T. Tolley, "Soft robot perception using embedded soft sensors and recurrent neural networks,", Science Robotics, 4:26, eaav1488, Jan 2019.
3. Y.-S. Kim, J. Lu, **B. Shih**, A. Gharibans, Z. Zou, K. Matsuno, R. Aguilera, Y. Han, A. Meek, J. Xiao, M. T. Tolley, and T. P. Coleman, "Scalable manufacturing of solderable and stretchable physiologic sensing systems," Advanced Materials, vol. 29, no. 39, Jul 2017.

Refereed Conference Publications

1. **B. Shih**, J. Mayeda, Z. Huo, C. Christianson, and M. T. Tolley, "3D printed resistive soft sensors," in 2018 IEEE-RAS International Conference on Soft Robotics (RoboSoft), pp. 152-157, Apr 2018. Acceptance rate: 74.4% (96 of 129). → *Best Poster Award Finalist (4 of 54), IEEE-RAS International Conference on Soft Robotics 2018.*

2. **B. Shih**, D. Drotman, C. Christianson, Z. Huo, R. White, H. I. Christensen, and M. T. Tolley, "Custom soft robotic gripper sensor skins for haptic object visualization," in 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 494-501, Sept 2017. Acceptance rate: 45% → *Best Poster Award Finalist at Southern California Robotics Symposium 2017, Honorable Mention at UC San Diego Jacobs School of Engineering Research Expo 2017.*
3. T. Kalisky, Y. Wang, **B. Shih**, D. Drotman, S. Jadhav, E. Aronoff-Spencer, and M. T. Tolley, "Differential pressure control of 3D printed soft fluidic actuators," in 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 6207-6213, Sept 2017. Acceptance rate: 45%
4. J. M. Florez, **B. Shih**, Y. Bai, and J. K. Paik, "Soft pneumatic actuators for legged locomotion," in 2014 IEEE International Conference on Robotics and Biomimetics (ROBIO), pp. 27-34, Dec 2014. Acceptance rate: 58.6% (374 of 638).

Books

1. P. Tandon, S. Lam, **B. Shih**, T. Mehta, A. Mitev, Z. Ong. "Quantum Robotics: A Primer on Current Science and Future Perspectives". Published in Synthesis Lectures on Quantum Computing by Morgan Claypool Publishers, Jan 2017. → *Preprint has over 1.1k views on ResearchGate (as of May 1, 2018).*

Other Conference and Workshop Papers

1. **B. Shih**, D. Drotman, C. Christianson, J. Mayeda, M. T. Tolley, "Towards Rapid Fabrication of Sensors for Haptic Interaction and Perception in Soft Robot Hands", Soft Morphological Design for Haptic Sensation, Interaction and Display workshop, Int. Conf. on Intelligent Robots and Systems (IROS), Vancouver, Sept. 2017.
2. **B. Shih**, D. Drotman, C. Christianson, S. Lee, M. T. Tolley, "Towards Rapid Fabrication of Soft Robot Hands for Haptic Object Visualization", Robotic Materials workshop, Robotics: Science and Systems (RSS), Boston, MA, July 2017.
3. A. Minori, **B. Shih**, C. Christianson, M. T. Tolley. "3D Printed Shape Memory Polymer Composite for Fabric Actuation". Robot Makers Workshop at Robotics: Science and Systems (RSS), Michigan, USA. June 2016.
4. P. Tandon, S. Lam, **B. Shih**, T. Mehta, A. Mitev, Z. Ong. "Quantum Robotics: Primer on Current Science and Future Perspectives". Original working paper on ResearchGate, May 2016. Submitted as book chapter to Morgan Claypool Publishers, Nov 2016.

COLLOQUIA/SEMINAR TALKS, PRESENTATIONS, POSTERS, AND SHOWCASES

"Soft skin for educational robot", Contextual Robotics Forum, UC San Diego, Nov 8 2018.
"Soft skin for educational robot", Grantmakers for Education Annual Conference, Coronado, San Diego, Oct 17 2018.
"Informative Touch for Soft Robots", UC San Diego Thesis Proposal, Oct 9 2018.
"3D Printed Soft Resistive Sensors", IEEE-RAS International Conference on Soft Robotics (RoboSoft) 2018, Livorno, Italy, April 26 2018.
"Custom Soft Robotic Gripper Sensor Skins for Haptic Object Visualization", Frontiers of Innovation Symposium, UC San Diego, October 2017.
Contextual Robotics Forum, UC San Diego, October 2017.
"IROS17 Recap", weekly seminar for Association of Robotics Graduate Students at UCSD, October 5 2017.
"Custom Soft Robotic Gripper Sensor Skins for Haptic Object Visualization", IROS17, Vancouver, September 2017.
"Custom Soft Robotic Gripper Sensor Skins for Haptic Object Visualization", weekly seminar for Association of Robotics Graduate Students at UCSD, September 14 2017.
Robotics Frontiers Showcase, UC San Diego, September 2017.
IROS Soft Morphological Design for Haptic Sensation, Interaction and Display workshop, Vancouver, September 2017.
RSS Robotic Materials workshop, Massachusetts, MA, July 2017.
UC San Diego Jacobs School of Engineering Research Expo, UC San Diego April 2017.
SoCal Robotics Symposium, University of Southern California, March 2017.
"Hydrographic Printing for Circuits", weekly seminar for Association of Robotics Graduate Students at UCSD, March 9 2017.
"Soft Pneumatic Fingers with Twisting Capabilities and Tactile Sensing Skins", Industrial Technology Research Institute, Taiwan, January 2017.
Frontiers of Innovation Symposium, UC San Diego, October 2016.
UC San Diego Jacobs School of Engineering Research Expo, UC San Diego April 2016.

SoCal Robotics Symposium, UC San Diego, March 2016.
Contextual Robotics Forum, UC San Diego, October 2016.
"Tactile Object Modeling with a Soft Pneumatic Gripper Capable of Grasping, Rotating, and Sensing Objects", weekly seminar for Association of Robotics Graduate Students at UCSD, October 6 2016.
Contextual Robotics Forum, UC San Diego, October 2015.
National Centres of Competence in Research (NCCR) Robotics Forum, EPFL, October 2014.

SELECTED PRESS AND MEDIA COVERAGE

Haptic Object Visualization using Soft Gripper with Sensor Skin

Jacobs School News, "This soft robotic gripper can screw in your light bulbs for you", May 30, 2017. → *Our youtube video has 8.4k views (as of May 1, 2018).*
IEEE Spectrum, "Video Friday: Robotic Creatures, ROS-Industrial, and Machine Knitting", Oct. 13, 2017.
The Economic Times, "New soft robotic gripper can screw in light bulbs", Oct. 11, 2017.
3Ders.org, "UC San Diego engineers developing smart & soft 3D printed gripper that can figure out what it's holding", Oct. 11, 2017.
New Atlas, "Robotic gripper has a feel for the shape of things", Oct. 12, 2017.
Science Daily, "This soft robotic gripper can screw in your light bulbs for you", Oct. 10, 2017.
Communications of the ACM, "This Soft Robotic Gripper Can Screw in Your Light Bulbs for You", Oct. 12, 2017.
NSF, "This soft robotic gripper can screw in your light bulbs for you", Oct. 10, 2017.
NowThis Future on Facebook, "This Robot Hand Can Screw in a Light Bulb", Nov. 21, 2017. → *Video has ∼1.2 million views (as of May 1, 2018).*

PROFESSIONAL ACTIVITIES

Membership

IEEE Robotics and Automation Society (RAS)

Reviewing

Journals

Robotics and Autonomous Systems
Robotics and Automation Letters
Autonomous Robots

Conferences

ACM/IEEE International Conference on Human Robot Interaction
IEEE International Conference on Robotics and Automation
IEEE/RSJ International Conference on Intelligent Robots and Systems
IEEE/RAS International Conference on Soft Robotics

MENTORING

Sebastian Lee. UCSD BS MAE. 3D printed soft gripper, robot skin, starfish. Apr 2017 - Jun 2017 & Jan 2018 - present. *Workshop at RSS17.*
Zhaoyuan Huo. UCSD BS MAE. Sensors for soft gripper, soft manipulation. Sept 2016 - present. *Publications in IROS17, RoboSoft18.* → *Carnegie Mellon RISS.*
Billy Yang. Swarthmore BS MechE. Microfluidic valves for distributed actuation. May 2018 - August 2018.
Aaron Ong. UCSD BS BioE. Hydrographic printing. Sept 2017 - May 2018. → *MS at UC Berkeley Mechanical Engineering.*
Jason Mayeda. UCSD BS MAE. Sensors for soft robots. Jun 2017 - June 2018. *Workshop at IROS17. Publication in RoboSoft18.* → *Cymer.*
Nick Garrett. UCSD BS MAE. Hydrographic printing. Oct 2016 - Dec 2016. → *Brain Corp* → *MS at UC San Diego Mechanical Engineering* → *Planck Aero.*
Bocheng Kang. UCSD MS MAE. Haptic glove. Sept 2016 - Jun 2017. → *Jaten Robot & Automation*
Nathan Adera. UCSD STARS. Soft, torsional sensors. Jun 2016 - Aug 2016.
Tom Kalisky. UCSD MS MAE. Volumetric control system. Feb 2016 - Mar 2017. *First-author publication in IROS17.* → *Kid Print, UC San Diego Design Lab.*
Ricky Wang. UCSD BS MAE. Volumetric control system. Feb 2016 - Mar 2017. *Publication in IROS17.* → *MS at Stanford Mechanical Engineering.*
Eduardo Scheffer. UCSD BS MAE. Hydrographic printing. Feb 2016 - Jun 2016.
Kristen Matsuno. UCSD BS MAE. Epidermal sensor test automation. Sept 2015 - Jun 2016. *Publication in*

Advanced Materials. → PhD at Stanford Mechanical Engineering.
Maris Doherty. UCSD BS MAE. Programming fluidic control board. Sept 2015 - Jun 2016. → *Solar Turbines.*
Kazu Otani. UCSD BS MAE. Fluidic strain sensor. Sept 2015 - Mar 2016. → *MS at Carnegie Mellon Robotics Institute → INRIA → Shield AI.*
Nicolas Besuchet. EPFL BS MechE. Fabrication of soft pneumatic actuator frame. Jan 2015 - Apr 2015.
Basile Audergon. EPFL BS MechE. Fabrication of soft pneumatic actuator frame. Dec 2014 - Apr 2015.

TEACHING EXPERIENCE

Mechanical and Aerospace Engineering Department, UC San Diego La Jolla, CA
MAE207 Soft Robotics Teaching Assistant Jan 2018 - Mar 2018

- Give lectures, teach tutorials, and lead lab sessions.
- Designed homeworks, wrote solutions, held office hours, and graded assignments. Topics include literature review, problem definition, soft pneumatic actuator design and fabrication, microcontroller programming, control theory, electronic bench skills, and waypoint following.
- Work with team of course staff to negotiate and secure support from the California Strawberry Commission (CSC). Coordinate tours at local strawberry farm with members of the CSC and the ranch manager.
- Course by: Prof. Michael Tolley.

Mechanical and Aerospace Engineering Department, UC San Diego La Jolla, CA
MAE150 Computer Aided Design Head Teaching Assistant March 2017 - June 2017

- Designed homeworks, wrote solutions, held office hours, and graded assignments. Topics include theory for mechanical design, finite element analysis, MATLAB, and SolidWorks.
- Gave two 1 hour classroom lectures on MATLAB and error analysis.
- Designed a final project(/homework/competition) along with course staff, that consisted of giving students three uneven pillars and a location for a mass, and having them design and 3D print a structure of their choice to support the mass (using topology optimization in SolidWorks to minimize the mass of the structure).
- Of the 27 out of 67 students who completed the course evaluation, 96% recommend the class.
- Course by: Prof. Michael Tolley.

Mechanical and Aerospace Engineering Department, UC San Diego La Jolla, CA
MAE140 Linear Circuits Grader September 2016 - December 2016

- Graded and provided feedback on homeworks and exams. Topics include RLC circuit analysis, operational amplifiers.
- Course by: Prof. Mauricio De Oliveira.

Electrical and Computer Engineering Department, Carnegie Mellon University Pittsburgh, PA
18-202 Mathematical Foundations of Electrical Engineering Teaching Assistant August 2013 - December 2013

- Held weekly office hours to review math topics spanning linear algebra, calculus, and differential equations.
- Course by: Prof. Tom Sullivan.

Electrical and Computer Engineering Department, Carnegie Mellon University Pittsburgh, PA
18-320 Microelectronic Circuits Teaching Assistant August 2012 - December 2012

- Guided ∼30 students through amplifier design (analog) and transistor layouts in Cadence (digital). Lead two 3 hour/week lab sections.
- Course by: Prof. Jeyanandh Paramesh.

Electrical and Computer Engineering Department, Carnegie Mellon University Pittsburgh, PA
18-290 Signals and Systems Teaching Assistant August 2011 - December 2011

- Guided ∼30 students through various MATLAB activities related to introductory signal processing, including audio/speech processing and specgram analysis. Managed one 3 hour/week lab section.
- Course by: Prof. Bruce Krogh.

Service, Outreach, and Contributions to Promoting Diversity

RoboGrads at UC San Diego

Co-Founder and Co-President September 2016 - June 2018

Vice President and Advisor June 2018 - present

- Build multi-disciplinary community for graduate students to connect and learn about each others' work.
- Organize weekly seminar series consisting of both graduate students and industry guests.
- Obtain funding from UCSD's Contextual Robotics Institute and Graduate Student Association.

OpenWorm

Community Manager October 2015 - October 2016

- Volunteer coordinator for open source neuroscience project creating virtual simulation of C. elegans. Wrote Javascript-based form to improve subproject introductions for volunteers.
- Organized online series of OpenWorm Journal Clubs. Five archived YouTube videos with ∼1300 views (as of January 31, 2017).
- Advised by: Dr. Stephen Larson

Commitment to science communication:

- ComSciCon San Diego 2017 (Communicating Science workshop for graduate students) organizing committee. Helped with fundraising and event photography.
- Co-founded the Association of Robotics Graduate Students at UC San Diego as a venue for students to practice communicating their work and foster the robotics community, 2016.
- ComSciCon San Diego 2016 (Communicating Science workshop for graduate students) participant.
- Inspiring Research: Creative Strategies for Communication 2016, UC San Diego.
- Organized inter-program lab tours for the EPFL research internship, 2014, EPFL.

Mentor for under-represented and educationally/economically disadvantaged students through campus programs including:

- Summer Training Academy for Research Success (STARS) 2016, UC San Diego.

Encourage K-12 students to pursue careers in engineering through participation in lab/campus visits, festivals, panels, and outreach events including:

- Hedemkamp Robotics Team (FIRST Lego League) from Chula Vista, Feb 2018, UC San Diego
- Johns Hopkins Center for Talented Youth Family Academic Programs, 2017, UC San Diego.
- UrbanLife Robotics Program, 2016, UC San Diego.
- San Diego Maker Faire 2015 & 2016, San Diego.