Brad Holschuh

Curriculum Vitae

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bholschuh
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Education

2010–2014 **Ph.D., Aerospace Biomedical Engineering**
(minor in Aerospace Physiology),
Massachusetts Institute of Technology, Cambridge, MA.

2007–2010 **S.M., Aeronautics and Astronautics**,
Massachusetts Institute of Technology, Cambridge, MA.

2007–2010 **S.M., Technology and Policy**,
Massachusetts Institute of Technology, Cambridge, MA.

2003–2007 **S.B., Aerospace Engineering**
(minors in Psychology and Earth, Atmospheric and Planetary Science),
Massachusetts Institute of Technology, Cambridge, MA.

Appointments

2016–Present **Assistant Professor, Wearable Technology and Apparel Design**,
Department of Design, Housing, and Apparel – College of Design,
Co-director, Wearable Technology Laboratory,
Affiliate, MnDRIVE Initiative: Robotics, Sensors and Advanced manufacturing,
Graduate Faculty, Aerospace Engineering and Mechanics,
Graduate Faculty, Design,
Graduate Faculty, Human Factors and Ergonomics,
University of Minnesota, Minneapolis, MN.

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2015 **Lecturer**,
Department of Aeronautics and Astronautics – School of Engineering,
Massachusetts Institute of Technology, Cambridge, MA.

2014-2015 **Postdoctoral Associate**,
Man-Vehicle Laboratory (MVL),
Department of Aeronautics and Astronautics – School of Engineering,
Massachusetts Institute of Technology, Cambridge, MA.

Grants / Funding Received

2016–Pending NSF Computer and Information Science and Engineering (CISE) Research Initiation Initiative (CRII): PI – "Investigation of Computer-Mediated Compression as a New Paradigm for Remote Interaction". $175,000. 8/28/2017–8/27/2019. [Under Review]

2016 UMN Grant-in-Aid: PI – "Elastomer-Sensor Composite for Dynamic Pressure Measurement and Uniform Pressure Production in Active Compression Garments". $42,624. 7/1/2016–6/30/2017.

2016 2016-17 UMN Imagine Fund Annual Faculty Award: PI – "Exploration of morphing clothing and wearable technology applications using active materials". $5,000. 7/1/2016–6/30/2017.

2016-2018 3M Non-tenured Faculty Grant Award: "Active Materials Development for Wearable Systems". $45,000 ($15,000 per year).

2016 Minnesota Partnership for Biotechnology and Medical Genomics: PI – "Smart Fabric for Cardio-Performance Enhancement Based on Human Spacesuit Design." $340,855 ($170,400 for Holschuh/Dunne group). Co-PI: Bruce Johnson (Mayo); Co-Is: Lucy Dunne (UMN), Michael Joyner (Mayo). 1/15/2016–1/15/2017.

Publications

Journal Articles

2016–Pending Goncalves, C., Ferreira da Silva, A., Simoes, R., Gomes, J., Stirling, L., and **Holschuh, B.**"Study of a Cyclic Controlled Pulsatile Compression Wearable Device" submitted to *IEEE Transactions on Mechatronics*, September 2016 (under review).

2016–Pending Duvall, J., Schleif, N., Dunne, L., and **Holschuh, B.** "Dynamic Compression Garments for Sensory Processing Disorder (SPD) Treatment using Integrated Active Materials," submitted to *ACM Transactions on Cyber-Physical Systems – Special Issue on Medical Cyber-Physical Systems*, 15 August 2016 (under review).

2016 **Holschuh, B.**, and Newman, D. "Morphing Compression Garments for Space Medicine and Extravehicular Activity using Active Materials," in *Aerospace Medicine and Human Performance* 87(2), p. 84-92, 01 February 2016.

2015 **Holschuh, B.**, and Newman, D. "Two-Spring Model for Active Compression Textiles with Integrated NiTi Coil Actuators," in *Smart Materials and Structures* 24(3)035011, 06 February 2015.

2014 **Holschuh, B.**, Obropta, E., and Newman, D. "Low Spring Index NiTi Coil Actuators for Use in Active Compression Garments," in *IEEE Transactions on Mechatronics* 20(3), p. 1264-1277, 25 June 2014.

Theses

2014 Ph.D. Dissertation: Mechanical Counter-Pressure Space Suit Design using Active Materials, June 2014

2010 Dual Masters Thesis: Space Exploration Challenges: Characterization and Enhancement of Space Suit Mobility and Planetary Protection Policy Analysis, June 2010.

2006 S.B Thesis (joint thesis with T. Gray): Golf Driver / Ball Impact Acoustic Measurement System, June 2006.

Technical Reports

2016 National Academies of Sciences, Engineering, and Medicine. 2016. Review of NASA's evidence report on human health risks: 2015 Letter report. Washington, DC: The National Academies Press.

Invited Papers

2014 **Holschuh, B.**, and Newman, D. "Low Spring Index, Large Displacement Shape Memory Alloy (SMA) Coil Actuators for Use in Macro- and Micro-Systems," in *SPIE MOEMS-MEMS*, 897505, 10.1117-12.2044406, February 2014.

Conference Papers, Posters, and Design Exhibitions

2016 Duvall, J., Schleif, N., Dunne, L., and **Holschuh, B.** "Active "Hugging" Vest for Deep Touch Pressure Therapy", presented at the Juried Design Exhibition at the 20th International Symposium on Wearable Computers, Heidelberg, Germany, September 2016.

2016 Clarke, M., Dunne, L., and **Holschuh, B.** "Self-Adjusting Wearables: Variable Control through a Shape-Memory Latching Mechanism", presented at the Juried Design Exhibition at the 20th International Symposium on Wearable Computers, Heidelberg, Germany, September 2016.

2016 **Holschuh, B.** "Wearable Technology Using Active Materials", poster presented at 3M's 2016 Science and Engineering Faculty Day (SEFD), St. Paul, MN, May 2016.

2016 **Holschuh, B.** "Wearable Technology Using Active Materials", poster presented at 2016 MnDRIVE RSAM Symposium, Minneapolis, MN, April 2016.

2015 **Holschuh, B.**, and Newman, D. "Mechanical Counter-Pressure Space Suit Design using Active Materials," poster presented at *2015 NASA Human Research Program (HRP) Investigators' Workshop*, January 2015.

2015 **Holschuh, B.**, Gatto, G., Levrino, L., Bretl, K., and Newman, D. "Active Material Technology Development for Mechanical Counter-Pressure Space Suits using 3D-Printed Components," poster presented at *2015 NASA Human Research Program (HRP) Investigators' Workshop*, January 2015.

2013 **Holschuh, B.**, Obropta, E., and Newman, D. "Shape Memory Alloy (SMA) Coil Actuators for Use in Controllable Mechanical Counter-Pressure (MCP) Space Suits," poster presented at *2013 NASA Human Research Program (HRP) Investigators' Workshop*, February 2013.

2012 **Holschuh, B.**, Obropta, E., Buechley, L., and Newman, D. "Materials and Textile Architecture Analyses for Mechanical Counter-Pressure Space Suits Using Active Materials," technical manuscript presented at *AIAA Space 2012*, AIAA 2012-5206, September 2012.

2011 Meyen, F., **Holschuh, B.**, Kobrick, R., Jacobs, S., and Newman, D. "Robotic Joint Torque Testing: A Critical Tool in the Development of Pressure Suit Mobility Elements," technical manuscript presented at *41st International Conference on Environmental Systems (ICES)*, AIAA 2011-5105, July 2011.

2011 **Holschuh, B.**, and Newman, D. "Investigation of Compression Technologies using Advanced Materials for Mechanical Counter Pressure Planetary Exploration Suits," poster presented at *41st International Conference on Environmental Systems (ICES)*, July 2011.

2009 Newsome, S., Yamamoto, N., Grindle, A., **Holschuh, B.**, Ono, M., and Weigel, A. "Analysis of US Policy Options for the Future of the International Space Station," technical manuscript presented at *AIAA Space 2009*, AIAA 2009-6498, September 2009.

2009 **Holschuh, B.**, Waldie, J., Hoffman, J., and Newman, D. "Characterization of Structural, Volume and Pressure Components to Space Suit Joint Rigidity" technical manuscript presented at *39th International Conference on Environmental Systems (ICES)*, 2009-01-2535, July 2009.

2009 **Holschuh, B.**, Gray, T., and Blair, K. "Golf Driver/Ball Impact Acoustic Measurement System" technical manuscript presented at *4th Asia Pacific Congress on Sports Technology*, 287-291, September 2009.

Book Chapters

2016 [upcoming] **Holschuh, B.**, and Newman, D. "Extravehicular Activity (EVA)," a chapter to appear in the *Encyclopedia of Bioastronautics*, to be published by Springer, Fall 2016.

2016 [upcoming] **Holschuh, B.**, and Newman, D. "Mechanical Counter-Pressure Space Suits," a chapter to appear in Section VI ("Space Suits and Extravehicular Activity") of the *Handbook of Life Support Systems for Spacecraft and Extraterrestrial Habitats*, to be published by Springer, Fall 2016.

Patents

2015 **Holschuh, B.**, Gatto, G., Levrino, L., and Newman, D. "Wearable, Self-Locking Shape Memory Alloy (SMA) Actuator Cartridge," full patent application (US number 2015/059253), submitted 05 November 2015 (under review).

2014 **Holschuh, B.**, Obropta, E., and Newman, D. "Controllable Compression Textiles using Shape Memory Alloys and Associated Products," full patent application (PCT/US2014/054934) submitted 10 September 2014 (under review).

2014 **Holschuh, B.**, Obropta, E., and Newman, D. "Controllable Compression Garments using Shape Memory Alloys and Associated Techniques and Structures," full patent application (US14482365) submitted 10 September 2014 (under review).

Invited Talks, Lectures, and Panel Discussions

2016 **Holschuh, B.** "Remotely-controllable Compression for EVA Suits and Space Medicine", presentation given at the NASA Extravehicular Activity Technology Workshop, Houston, TX, 13-15 September 2016.

2016 **Holschuh, B.** "Actuation in Wearable Systems", invited given at Technology Collaboration Center of Houston Wearable Technologies Event, Houston, TX, 26 April 2016.

2016 **Holschuh, B.** Invited talk given at 2016 Design in 7: 7 Stories, 7 Minutes., Minneapolis, MN, 13 April 2016.

2016 **Holschuh, B.** "Active Materials Technology for Wearable Systems", invited presentation given at 2016 Design of Medical Devices Conference, Minneapolis, MN, 12 April 2016.

2016 **Holschuh, B.** "Wearable Technology Using Active Materials", invited presentation given at 2016 MnDRIVE RSAM Symposium, Minneapolis, MN, 08 April 2016.

2015 **Holschuh, B.** et al. "The Evolution of Superheroes", panel discussion at The Goldstein Museum of Design, St. Paul, MN, 11 November 2015.

2015 **Holschuh, B.** and Dunne, L. "The Science of Superpowers", National Public Radio (NPR) Science Friday Live, The Fitzgerald Theater, St. Paul, MN, 03 November 2015.

2015 **Holschuh, B.** "Mechanical Counter-Pressure Space Suit Design using Active Materials," invited technology discussion, NASA Ames Research Center, Moffett Field, CA, 12 January 2015.

2014 **Holschuh, B.** "Advancing Space Suit Design," invited 5-minute lightning talk delivered for the MIT Aero/Astro 100th Anniversary Symposium, Cambridge, MA, 24 October 2014.

2014 **Holschuh, B.** and Obropta, E. "Compression Garment Design using Active Materials," invited guest lecture delivered for *Textiles + Technology: Transforming Environments* (course 0197) at the Rhode Island School of Design (RISD), Providence, RI, 28 July 2014.

2013 **Holschuh, B.** and Newman, D. "Advanced Space Suit Design at MIT," invited presentation given at the American Textile History Museum (ATHM), Lowell, MA, 26 February 2013.

2012 **Holschuh, B.** and Obropta, E. "Mechanical Counter-Pressure Space Suit Design using Active Materials," invited presentation given at the *Industrial Fabrics Association International (IFAI) Expo*, Boston, MA, 09 November 2012.

2012 **Holschuh, B.** "Mechanical Counter-Pressure Space Suit Design using Active Materials," invited guest lecture delivered for *New Textiles* (course MAS.962) at MIT, Cambridge, MA, 06 March 2012.

Honors, Fellowships and Awards

2016 UMN International Travel Grant Award.

2015 MIT Man-Vehicle Laboratory Sherwood A. Modestino "Sherry" Award.

2015 First Place, Post-Doctoral Poster Competition, given by the National Space Biomedical Research Institute (NSBRI) at the *2015 NASA Human Research Program (HRP) Investigators' Workshop.*

2011–2014 NASA Space Technology Research Fellowship (NSTRF). "Development and Testing of Compression Technologies Using Advanced Materials for Mechanical Counter-Pressure Planetary Exploration Suits".

2013 First Place, Graduate Student Poster Competition, given by the National Space Biomedical Research Institute (NSBRI) at the *2013 NASA Human Research Program (HRP) Investigators' Workshop.*

2011 Third Place, Student Poster Competition, at the 41st *International Conference on Environmental Systems (ICES).*

2011 Nominated to receive the MIT School of Engineering Graduate Student Teaching and Mentoring Award.

2010 Massachusetts Space Grant Consortium Summer Fellowship. "Gas-Pressurized Space Suit Mobility: An Analysis of Industry Measurement Techniques, and a Specific Investigation of the Mobility Characteristics of a Full Body Space Suit Prototype Using Multiple Test Methods".

2009 Massachusetts Space Grant Consortium Summer Fellowship. "Characterization and Mitigation of Space Suit Pressure Effects, and an Investigation of Commercial Space Planetary Protection Policy Issues".

2009 MIT Aero/Astro Teaching Assistantship Award

2007 MIT Aero/Astro Teaching Assistantship Award

2007 MIT Aero/Astro Apollo Award

Teaching and Mentoring Experience

Teaching Positions

2016–Present **Joint Faculty**, Quantitative Research Methods (UMN course DES 8102) - graduate level.

2016–Present **Lead faculty**, Human Factors in Design (UMN course DES 5185) - undergraduate and graduate level.

2015 **Lecturer**, Aerospace Biomedical and Life Support Engineering (MIT course 16.423) - graduate level.

2014-2015 **Instructor**, Bioengineering Journal Article Seminar (MIT course 16.459) - graduate level.

2007-2011 **Graduate Teaching Fellow**, Experimental Projects I-II (MIT courses 16.621-622) - undergraduate level.

2006-2007 **Undergraduate Teaching Assistant**, Experimental Projects I-II (MIT courses 16.621-622) - undergraduate level.

Mentored and Advised Students (23 since 2010)

2016 **Crystal Compton**. "Fit for Space: Leveraging a Novel Skin Contact Measurement Technique Toward a More Efficient Liquid Cooled Garment", Masters Thesis Advisory Committee member.

2016–Present **Mary Ellen Berglund and Esther Foo**. "Elastomer-Sensor Composite for Dynamic Pressure Measurement and Uniform Pressure Production in Active Compression Garments", Project Supervisor / Principal Investigator.

2016–Present **Julia Duvall**. "Shape Memory Alloy Hugging Vest", UMN Master's student project advisor. Project was awarded 1st Place at the Augmented Human 2016 International Conference, Geneva, Switzerland, February 2016; and 3rd Place at the IFAI 2016 Advanced Textile Products Student Design Challenge.

2016–Present **Carlos Goncalves**. "Wearable Technology Impact: study through the development of a soft-orthotic device", MIT visiting student co-advisor.

2016 **Crystal Compton and Robert Pettys-Baker**. "Active Sensing Garment to Detect Valgus During Physical Rehabilitation", UMN summer research advisor.

2016–Present **Julia Duvall, Mary Ellen Berglund, and Rachael Granberry**. "Smart Fabric for Cardio-Performance Enhancement Based on Human Spacesuit Design", Project Supervisor / Principal Investigator.

2015–2016 **Dustin Kendrick**. "The Gravity Loading Countermeasure Skinsuit (GLCS)", MIT Ph.D. advisory committee member.

2015 **Olivia Makepeace**. "Integration of Circuitry and Electronics into Flexible, Wearable Materials for use in Mechanical Counter-Pressure Space Suits" MIT Undergraduate Research Opportunities Program (UROP) supervisor.

2015 **Jamie Voros**. "Active Closure Technologies for the NASA BioSleeve System" MIT Undergraduate Research Opportunities Program (UROP) supervisor.

2015 **Antonis Michael**. "Mechanical Tensioning System for Compression Garments using the Lines of Non-extension (LoNE)" MIT Undergraduate Research Opportunities Program (UROP) supervisor.

2015 **Timothy Nguyen**. "Thermal Insulation for 3D Printed Materials with Integrated SMA Actuators" MIT Undergraduate Research Opportunities Program (UROP) supervisor.

2013-2015 **Katie Bretl**. "Rapid Prototyping of Shape Changing Compression Garments for Mechanical Counter-Pressure Space Suits." MIT Undergraduate Research Opportunities Program (UROP) supervisor.

2014 **Giacomo Gatto, Luca Levrino, and Eric Friedman**. "Large-Scale Manufacturing and Production of Shape Memory Alloy (SMA) Actuator Cartridges." Visiting MIT graduate students' supervisor.

2014 **Nora Carlson-Strom**. "Nickel Titanium Coil Producer." Visiting MIT undergraduate student supervisor.

2012–2013 **Brian Wee**. "Assessment and Preliminary Model Development of Shape Memory Polymers Mechanical Counter Pressure Space Suits." MIT Undergraduate Research Opportunities Program (UROP) supervisor.

2012-2013 **Nora Newie**. "Investigation of Active Materials for Use in Mechanical Counter-Pressure Space Suits." Visiting MIT graduate student supervisor.

2011-2013 **Edward Obropta**. "The BioSuit System - Materials and Textile Development." MIT Undergraduate Research Opportunities Program (UROP) supervisor.

2012 **Andrea Messidoro**. "Dielectric Elastomers: Preliminary Assessment as Building Blocks of a Hybrid MCP Space Suit." Visiting MIT graduate student supervisor.

2011 **Dan Rankin**. "Active Material Development for the BioSuit System, and Real-Time Infrared Body Tracking Technology." MIT Undergraduate Research Opportunities Program (UROP) supervisor.

2010 **Forrest Meyen**. "Mobility Characterization of a S1034 Pilot Protective Assembly and the Development of Motion Capture Robotic Controls." MIT Summer Research Program (MSRP) supervisor.

Service and Outreach

2016–Present **Member**, UMN DHA Product Design Tenure-Track Faculty Search Committee.

2016–Present **Co-Convener**, UMN Institute for Advanced Study (IAS) Physical Computing and the Internet of Things Research and Creative Collaborative.

2016–Present **Member**, Committee on Aerospace Medicine and the Medicine of Extreme Environments (CAMMEE), National Academy of Medicine, Washington, D.C.

2016–Present **Member**, MnDRIVE Robotics, Sensors, and Advanced Manufacturing Research and Outreach Committee.

2016 **Reviewer**, 2016 International Symposium on Wearable Computers.

2016 **Reviewer**, *Acta Astronautica.*

2015 **Member**, Committee to Review NASA's Evidence Reports on Human Health Risks, Decompression sickness report lead, Institute of Medicine, Washington, D.C.

2015 **Consultant**, Two-week studio on Space Suit Technologies, NuVu Innovation Studio, Cambridge, MA.

2015 **Reviewer**, *Journal of Mechanical Engineering Science (Proceedings of the Institution of Mechanical Engineers - Part C).*

2015 **Reviewer**, *45th International Conference on Environmental Systems (ICES) Conference Proceedings.*

2014 **Reviewer**, *44th International Conference on Environmental Systems (ICES) Conference Proceedings.*

2011-2014 **Contributor**, MIT K-12+ Educational Videos Program, MIT School of Engineering (8 videos).

2011-2014 **Graduate Resident Tutor**, MIT Baker House.

2009 **Discovery workshop co-organizer**, Sally Ride Science Festival / Cambridge Science Festival.

Research and Work Experience

2006 **Research Associate**, NASA Academy, Goddard Space Flight Center (GSFC), Greenbelt MD.

2006 **Undergraduate Research Opportunities Program (UROP)**, MIT Space Systems Laboratory (SSL).

2005 **Summer Intern**, Engine Operability Division, General Electric (GE) Transportation - Aircraft Engines, Lynn, MA.

Activities and Affiliations

2016–Present **Member**, ACM

2006–2014 **Member**, AIAA

2013–2014 **Member**, SPIE

2009–2014 **Assistant Coach**, MIT Club Ice Hockey Team

2004–2009 **Player**, MIT Varsity Ice Hockey Team

2003–2007 **Member**, Delta Tau Delta Fraternity

ResearcherID: G-9553-2014, **ORCID:** 0000-0002-2054-3534,
ResearchGate: Profile, **Google Scholar:** Profile, **Mendeley:** Profile

Press Coverage

2016 Feature: "SpaceX Just Hired a Superhero Design Team for Its Spacesuits", HowStuffWorks.com, 16 May 2016

2016 Feature: "U to develop auto-compression clothes", Minnesota Daily, 19 April 2016

2016 Feature: "The Future of Clothing", UMN News, 18 April 2016

2016 Feature: "National initiative will weave technology into smart fabrics", Minnesota Daily, 11 April 2016

2016 Feature: "Why Nike's self-lacing shoes could herald sports' cyborg future", The Week, 7 April 2016

2016 Feature: "Designing a Smarter Compression Garment", Design at MN Blog, 2 March 2016

2016 Miniseries: "NASA's Unexplained Files", Season 3, The Science Channel. Episodes 2 ("Return of the Moon Bugs"), 4 ("Ghosts on a Comet"), 5 ("The Moon that Disappeared"), 7 ("Red Storm Rising")

2015 Feature: "The Future of Wearable Tech", Design at MN Blog, 11 November 2015

2015 Feature: "University creates fashion of the future", Minnesota Daily, 03 November 2015

2015 Feature: "How to Build the Next Generation of Spacesuits", Popular Mechanics, 03 June 2015

2015 Feature: "Why Can't We Design the Perfect Spacesuit?", Universe Today, 18 February 2015

2014 Feature: "Shrink-wrapping spacesuits", MIT News, Gizmodo, The Washington Post, Discovery News, Boston Globe, FOX News, National Academy of Engineering,Top Stories @ MIT 2014

2014 Feature: "Next: Suited for Space", National Geographic Magazine (September 2014 Issue)

2014 Miniseries: "Man vs. the Universe",The Science Channel. Episode 3 ("Mars is Ours")

2012 Feature: "The Deep-Space Suit", Popular Science, 19 November 2012

2011 Guest Editorial: "A Sunrise for Space Program", Fargo Forum, NASA, 31 July 2011

2010 Feature: "Skintight 'superhero' space suit aims to fight bone loss", CNN, Popular Science

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