

# Brad Holschuh

## Curriculum Vitae

354 McNeal Hall  
1985 Buford Ave.

St. Paul, MN 55108

☎ (612) 624 3210

✉ [bth@umn.edu](mailto:bth@umn.edu)

📄 [z.umn.edu/holschuh](http://z.umn.edu/holschuh)

📌 [bholschuh](https://www.linkedin.com/in/bholschuh)



### Research Objectives

My research focuses on the novel use of wearable actuation systems to improve human health and performance. I specialize in the use of active (i.e., shape-changing) materials in wearable technology: my team designs and engineers novel actuation technologies that can be worn on the body, and we apply these technologies to solve problems in the medical, aerospace, military, and commercial domains. Details can be found on the [UMN Wearable Technology Website](#).

### Research Interests

Wearable Technology

Active Materials and Soft Robotics

Human Factors Design and Engineering

Medical Device Development

Human-Computer Interaction

Space Suit Design, Bioastronautics and Extravehicular Activity

### Education

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

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

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

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

## Appointments

- 2022–Present **Distinguished University Teaching Professor**,  
*University of Minnesota, Minneapolis, MN.*
- 2021–Present **Associate Professor, Apparel Design**,  
*Department of Design, Housing, and Apparel – College of Design,*  
*University of Minnesota, Minneapolis, MN.*
- 2016–Present **Graduate Faculty**,  
*Aerospace Engineering and Mechanics,*  
*Design (Apparel Studies / Product Development Track),*  
*Human Factors and Ergonomics,*  
*Robotics,*  
*University of Minnesota, Minneapolis, MN.*
- 2016–Present **Faculty Affiliate Researcher**,  
*MnDRIVE Initiative: Robotics, Sensors and Advanced Manufacturing,*  
*MN Robotics Institute (MnRI)*  
*University of Minnesota, Minneapolis, MN.*
- 2016–2021 **Assistant Professor, Apparel Design**,  
*Department of Design, Housing, and Apparel – College of Design,*  
*University of Minnesota, Minneapolis, MN.*
- 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.*
- 2011–2014 **NASA Space Technology Research Fellow (NSTRF)**,  
*Man-Vehicle Laboratory (MVL),*  
*Department of Aeronautics and Astronautics – School of Engineering,*  
*Massachusetts Institute of Technology, Cambridge, MA.*

## Grants / Funding Received

Grants Awarded (total – \$4,146,373; to WTL as PI/Co-I – \$2,221,183)

- 2022 UMN *Award for Outstanding Contributions to Graduate and Professional Education.*  
\$15,000, 2022.
- 2021 Cisco *Research Grants – Tech for Healthcare Call for Proposals:* Co-PI (with Co-PIs L. Dunne, M. Tompkins, and J. Johnson) – “Soft Wearable Systems to Prevent and Rehabilitate Musculoskeletal Injuries”. \$190,528 (\$171,645 to Holschuh/Dunne). 08/30/2021-01/15/2023.

- 2020 Facebook Reality Labs (FRL): Senior Personnel (with PI L. Dunne) – “Mapping Body/Garment Surface Strain Relationships for Functional Apparel Design,”. \$305,869. 09/01/2020-1/31/2023.
- 2020 Australian Space Agency International Space Investment (ISI) – Expand Capability Grant Opportunity): International Collaborator (with PI J. Waldie) – “Spacesuits for Preserving Human Health and Mobility,”. 05/01/2020-4/30/2022.
- 2020 Minnesota Robotics Institute (MnRI) Seed Grant Program: Co-PI (with PI M. Gini and Co-PIs W. Koutstaal, M. Kotlyar, M. Michalowski, and S. Pakhomov) – “Conversational Agents and Interventions in Health Care”. \$22,500. 02/01/2020-01/31/2021.
- 2020 UMN Office of Academic Clinical Affairs (OACA) Faculty Research Development (FRD) Grant Program: Co-PI (with Co-PIs S. Shah and U. Goswami) – “Developing Easy to Don Compression Stockings: Smart Garments to Improve Compliance to Compression Therapy”. \$200,000 (\$125,097 to Holschuh). 04/01/2020-03/31/2022.
- 2019 NSF [Smart and Autonomous Systems \(S & AS\)](#): Senior Personnel (with PI M. Gini, Co-Is S. Pakhomov, W. Koutstaal, M. Kotlyar, and M. Michalowski) – “EAGER: AI-DCL: Addressing sociotechnical challenges of conversational agents”. \$299,998 (\$4,815 to Holschuh). 09/01/2019-08/31/2021.
- 2019 MN Agriculture Experiment Stations (AES) grant: PI – “Supporting the Health and Wellness of Minnesota Farmers through Easy-to-Use, Low-Power Wearable Technology”. 8/26/2019–8/26/2022.
- 2019 2019-20 [UMN Imagine Fund Annual Faculty Award](#): PI – “Investigation of Knittability Parameters for 3D-Printed Multifunctional Filament”. \$5,000. 7/1/2019–6/30/2020.
- 2019 Facebook Reality Labs distinguished faculty award (shared with L. Dunne). \$25,000, 2019.
- 2018 UMN [Grand Challenges Research Initiative – Phase 3](#): Co-PI (with PI M. Gini, Co-PI S. Pakhomov, and Core Faculty W. Koutstaal, M. Kotlyar, L. Dunne, J. Gaugler, and M. Michalowski) – “Improving health and well-being with personalized, pervasive technology”. \$325,000 (\$91,335 to Holschuh/Dunne). 1/01/2019-12/30/2020.
- 2018 IEEE RAS [Technical Committee on Haptics](#) Innovation in Haptics Research Grant: Co-I (with PI E. Foo) – “Investigation of the Objective and Subjective Effects of Computer-Mediated Compression”. \$2,500. 11/30/2018–12/31/2019.
- 2018 Analog Devices, Inc.: Co-I (with Co-I R. Maggay and PI L. Dunne ) – “Smart Ankle Suit (SAS)”. \$111,842. 8/15/2018–8/14/2019.
- 2018 UMN [MnDRIVE RSAM Industrial Partnership Grant](#): Co-I (with PI L. Dunne and W. L. Gore & Associates, Inc.) – “3D-Conformal Sensing of Normal Forces for On-Body Applications”. \$100,000. 8/27/2018–8/26/2019.
- 2018 UMN MnDRIVE Research Equipment RFP: Instron tensile testing system with integrated thermal chamber. \$50,000. 3/13/2018.
- 2018 3M Non-tenured Faculty Award (NTFA): “Active Materials Development for Wearable Systems”. \$15,000, 2018.

- 2017 NSF [Smart and Connected Health \(SCH\) Program Solicitation](#): Co-I (with PIs L. Dunne, T. Martin and M. Lobo) – “SCH: INT: Collaborative Research: Smart Wearable Systems to Support and Measure Movement in Children With and Without Mobility Impairments”. \$1,475,853 (\$540,686 to UMN), 10/1/2017-9/30/2021.
- 2017 UMN [MnDRIVE RSAM Industrial Partnership Grant](#): PI (with Stratasy) – “Novel Manufacturing of Advanced Functional Garments: Textiling with Spatially-Varying Multimaterial Filament”. \$50,000. 1/11/2018–1/09/2019.
- 2017 UMN [Medical School Innovation Grant](#): Co-I (with PI M. Tompkins and Co-I L. Dunne) – “Minimally-Invasive, Wearable, Continuous Monitoring of Knee Flexion Posture for Real-Time Biofeedback”. \$10,000. 5/1/2017-4/30/2018.
- 2017 3M Non-tenured Faculty Award (NTFA): “Active Materials Development for Wearable Systems”. \$15,000, 2017.
- 2016 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. 8/28/2017–1/01/2020.
- 2016 UMN [Grant-in-Aid](#): PI – “Elastomer-Sensor Composite for Dynamic Pressure Measurement and Uniform Pressure Production in Active Compression Garments”. \$42,624. 7/1/2016–6/30/2018.
- 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 3M Non-tenured Faculty Award (NTFA): “Active Materials Development for Wearable Systems”. \$15,000, 2016.
- 2016 Minnesota [Partnership for Biotechnology and Medical Genomics](#): PI – “[Smart Fabric for Cardio-Performance Enhancement Based on Human Spacesuit Design](#).” Co-PI: Bruce Johnson (Mayo); Co-Is: Lucy Dunne (UMN), Michael Joyner (Mayo). \$689,641 (\$344,752 for Holschuh/Dunne group).1/15/2016–6/15/2018.

### Grants Pending Review

- 2022 2021-22 UMN [Imagine Fund Annual Faculty Award](#): PI – “Novel clothing accessibility solutions using garment-based actuation”. \$5,000. 8/31/2022–1/15/2023.
- 2022 AI/Tech + Aging Pilot Awards ([a2 Pilot Awards](#)) Winter 2022 RFP: PI (with Co-PIs S. Pakhomov, M. Kotlyar, and J. Gaugler – “Wearable System for AI-Driven Acute Stress Management in Caregivers”. \$208,576. 9/01/2022–8/31/2023.
- 2022 MN Agriculture Experiment Stations (AES) grant: PI – “Everyday Clothing as Soft Robots: Mechanically Dynamic Garments using Typical Softgoods Assembly Methods”. 8/26/2022–5/26/2025.

## Publications

### Journal Articles - Published (12) (engineering convention lists PI last)

- 2021 Granberry, R., Compton, C., Woelfle, H., Barry, J., and **Holschuh, B.** "Enhancing performance and reducing wearing variability for wearable technology system-body interfaces using shape memory materials", *Flexible and Printed Electronics Special Issue: Focus on e-Textiles*, 6 (2022) 024004, 7 May 2021.
- 2021 Foo, E., Dunne, L., and **Holschuh, B.** "User Expectations and Mental Models for Expressing Emotions through Compressive and Warm Affective Garment Actuation", *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT)*, vol. 5, no. 1, March 2021.
- 2021 Granberry, R., Barry, J., **Holschuh, B.**, and Abel, J. "Kinetically Tunable, Active Auxetic, and Variable Recruitment Smart Textiles from Hierarchical Assemblies", *Advanced Materials Technologies*, 2021, 2000825, 27 January 2021.
- 2020 Eschen, K., Granberry, R., **Holschuh, B.**, and Abel, J. "Amplifying and Leveraging Generated Force Upon Heating and Cooling in SMA Knitted Actuators", *ACS Applied Materials and Interfaces*, 17 November 2020.
- 2020 Granberry, R., Eschen, K., Ross, A., Abel, J., and **Holschuh, B.** "Medical Capability of Dynamic Countermeasure Fabrics for Post-Spaceflight Orthostatic Intolerance", *Aerospace Medicine and Human Performance*, vol. 91, no. 6, pp. 525-531, June 2020.
- 2019 Granberry, R., Eschen, K., **Holschuh, B.**, and Abel, J. "Functionally Graded Knitted Actuators with NiTi-based Shape Memory Alloys for Topographically Self-Fitting Wearables", *Advanced Materials Technologies*, vol. 4, iss. 11, 1900548, November 2019.
- 2019 Goncalves, C., Ferreira da Silva, A., Simoes, R., Gomes, J., Stirling, L., and **Holschuh, B.** "Design and Characterization of an Active Compression Garment for the Upper Extremity" in *IEEE Transactions on Mechatronics*, vol. 24, no. 4, pp. 1464-1472, Aug. 2019.
- 2019 Kelly, K., Johnson, C., Dunne, L., **Holschuh, B.**, Joyner, M., and Johnson, B. "Active Compression Garment Prevents Tilt-Induced Orthostatic Tachycardia in Humans", *Physiological Reports*, vol. 7, iss. 7, e14050, April 2019.
- 2019 Duvall, J., Schleif, N., Dunne, L., and **Holschuh, B.** "Dynamic Compression Garments for Sensory Processing Disorder (SPD) Treatment using Integrated Active Materials," in *ASME Journal of Medical Devices*, vol. 13, iss. 2, 021001, June 2019.
- 2016 **Holschuh, B.**, and Newman, D. "Morphing Compression Garments for Space Medicine and Extravehicular Activity using Active Materials," in *Aerospace Medicine and Human Performance*, vol. 87, no. 2, p. 84-92, 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*, vol. 24, no. 3, 035011, February 2015.

- 2015 **Holschuh, B.**, Obropta, E., and Newman, D. "[Low Spring Index NiTi Coil Actuators for Use in Active Compression Garments](#)," in *IEEE Transactions on Mechatronics*, vol. 20, no. 3, pp. 1264-1277, June 2015.

### Journal Articles - Under Review (1)

- 2022 Granberry, R., Clarke, M., Pettys-Baker, R., Woelfle, H., Compton, C., Ross, A., Johnson, K., Padula II, S., Shah, S., Abel, J., and **Holschuh, B.** "Dynamic, Tunable, and Conformal Wearable Compression using Active Textiles ", technical manuscript submitted to *Advanced Materials Technologies*, 21 March 2022 (under review).

### Conference Papers (29) (engineering convention lists PI last)

- 2021 Datar, S., Ferland, L., Foo, E., Kotlyar, M., **Holschuh, B.**, Gini, M., Michalowski, M., and Pakhomov, S. "Measuring Physiological Markers of Stress During Conversational Agent Interactions", *Studies in Computational Intelligence: Proceedings of the 5th International Workshop on Health Intelligence (W3PHIAI-21)* at the *35th AAAI Conference on Artificial Intelligence (AAAI-21)*, February 2021.
- 2020 Golgouneh, A., **Holschuh, B.** and Dunne, L. "A Controllable Biomimetic SMA-actuated Robotic Arm", technical manuscript presented at the 8th IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics (BIOROB 2020), December 2020.
- 2020 Compton, C., Golgouneh, A., **Holschuh, B.** and Dunne, L. "[Towards Large-area On-body Force Sensing Using Soft, Flexible Materials: Challenges of Textile-Based Array Sensing](#)", technical manuscript published in the 2020 International Conference on Environmental Systems (ICES) online proceedings, July 2020.
- 2020 Granberry, R., Abel, J., and **Holschuh, B.** "[Preliminary Investigation of the Design of a Mechanically Antagonistic, Actuating Countermeasure Garment](#)", technical manuscript published in the 2020 International Conference on Environmental Systems (ICES) online proceedings, July 2020.
- 2020 Foo, E., Baker, J., Compton, C., and **Holschuh, B.** "[Soft Robotic Compression Garment to Assist Novice Meditators](#)", Late-Breaking Work presented at the 2020 ACM CHI Conference on Human Factors in Computing Systems, April 2020.
- 2019 Foo, E., Lee, J.W., Ozbek, S., Compton, C., and **Holschuh, B.** "[User Experiences of Garment-Based Dynamic Compression for Novel Haptic Applications](#)", technical note presented at the 2019 International Symposium on Wearable Computers, September 2019.
- 2019 Granberry, **Holschuh, B.**, and Abel, J. "[Experimental Investigation of the Mechanisms and Performance of Active Auxetic and Shearing Textiles](#)", technical manuscript presented at the 2019 Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS), September 2019.

- 2019 Granberry, R., Padula II, S., Eschen, K., Abel, J., and **Holschuh, B.** “[Design and Control of Reduced Power Actuation for Active-Contracting Orthostatic Intolerance Garments](#)”, technical manuscript presented at the 2019 International Conference on Environmental Systems (ICES), July 2019.
- 2019 Lee, J.W., Foo, E., Ozbek, S., and **Holschuh, B.** “[Investigation of Subjective User Experiences of Applied Passive Compression on Varying Upper Body Locations](#)”, technical manuscript presented at the 2019 UMN Design of Medical Devices Conference, April 2019.
- 2019 Ozbek, S., Foo, E., Lee, J.W., Schleif, N., and **Holschuh, B.** “[Low-Power, Minimal-Heat Exposure Shape Memory Alloy \(SMA\) Actuators for On-Body Soft Robotics](#)”, technical manuscript presented at the 2019 UMN Design of Medical Devices Conference, April 2019.
- 2019 Foo, E., Woelfle, H., and **Holschuh, B.** “[Design Tradeoffs in the Development of a Wearable Soft Exoskeleton for Upper Limb Mobility Disorders](#)”, technical manuscript presented at the 2019 UMN Design of Medical Devices Conference, April 2019.
- 2018 Ozbek, S., Islam Molla, Md. T., Compton, C., and **Holschuh, B.** “[Novel Manufacturing of Advanced Smart Garments: Knitting with Spatially-Varying, Multi-material Monofilament](#)”, technical manuscript presented at 2018 International Symposium on Wearable Computers (ISWC), October 2018.
- 2018 Foo, E., Lee, W., Ozbek, S., and **Holschuh, B.** “[Preliminary Study of Subjective Comfort and Emotional Effects of On-Body Compression](#)”, technical note presented at 2018 International Symposium on Wearable Computers (ISWC), October 2018.
- 2018 Granberry, R., Eschen, K., Abel, J., and **Holschuh, B.** “[Active-Contracting Variable-Stiffness Fabrics for Self-Fitting Wearables](#)”, technical manuscript presented at the 2018 Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS), September 2018.
- 2018 Schleif, N., Berglund, M., Lee, J.W., Utset-Ward, S., Pettys-Baker, R., and **Holschuh, B.** “[Development and Characterization of Modular Elastic Switches for Sensing and Control of Active Compression Garments](#)”, technical manuscript presented at the 2018 International Conference on Environmental Systems (ICES), July 2018.
- 2018 Pettys-Baker, R., Schleif, N., Lee, J.W., Utset-Ward, S., Berglund, M., Johnson, C., Kelly, K., Johnson, B., Joyner, M., Dunne, L., and **Holschuh, B.** “[Tension-Controlled Active Compression Garment for Treatment of Orthostatic Intolerance](#)”, technical manuscript presented at the 2018 UMN Design of Medical Devices Conference, April 2018.
- 2018 R., Granberry, R., Ciarvarella, N., Pettys-Baker, R., Berglund, M., and **Holschuh, B.** “[No-Power-Required, Touch-Activated Compression Garments for the Treatment of POTS](#)”, technical manuscript presented at the 2018 UMN Design of Medical Devices Conference, April 2018.

- 2017 Yarosh, L., Mejia, K., Unver, B., Wang., X., Yao., Y., Campbell, A., and **Holschuh, B.** “[Squeezebands: Mediated Social Touch Using Shape Memory Alloy Actuation](#)”, technical manuscript published in Proceedings of the ACM on Human-Computer Interaction, Vol. 1 (No. 2), Article 116, November 2017 (doi 10.1145/3134751).
- 2017 Granberry, R., Duvall, J., Dunne, L., and **Holschuh, B.**, “[An Analysis of Anthropometric Geometric Variability for the Fit and Function of Advanced Functional Garments](#)”, technical manuscript presented at 2017 ACM International Symposium on Wearable Computers (ISWC), September 2017.
- 2017 Granberry, R., Dunne, L., and **Holschuh, B.**, “[Effects of Anthropometric Variability and Dimensional Change Due to Posture on Orthostatic Intolerance Garments](#)”, technical manuscript presented at 47th International Conference on Environmental Systems (ICES), July 2017.
- 2017 Berglund, M., Foo, E., Dunne, L. and **Holschuh, B.**, “[Development of Elastomer-Strain Gauge Composite for On-Body Dynamic Pressure Measurement](#)”, technical manuscript presented at 47th International Conference on Environmental Systems (ICES), July 2017.
- 2017 Duvall, J., Granberry, R., Johnson, C., Kelly, K., Johnson, B., Joyner, M., Dunne, L., and **Holschuh, B.** “[The Design and Development of Active Compression Garments for Orthostatic Intolerance](#)”, technical manuscript presented at 2017 UMN Design of Medical Devices Conference, April 2017.
- 2017 Pettys-Baker, R., Compton, C., Utset-Ward, S., Tompkins, M., **Holschuh, B.**, and Dunne, L. “[Design and Development of Valgus-Sensing Leggings](#)”, technical manuscript presented at 2017 UMN Design of Medical Devices Conference, April 2017.
- 2014 **Holschuh, B.**, and Newman, D. “[Low Spring Index, Large Displacement Shape Memory Alloy \(SMA\) Coil Actuators for Use in Macro- and Micro-Systems,](#)” technical manuscript published in SPIE MOEMS-MEMS, 897505, 10.1117-12.2044406, February 2014.
- 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.
- 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.

### Conference Papers – Under Review (2)

- 2022 Golgouneh, A., **Holschuh, B.**, and Dunne, L. “Effects of Repositionable E-Textile Circuit Elements on Signal Quality for Wearable Sensing Applications”, Technical Paper submitted to the 2022 International Conference on Environmental Systems (ICES), February 2022 (under review).
- 2022 Pettys-Baker, R., Subash, N., Mack, I., Woelfle, H. Shah, S., Abel, J., and **Holschuh, B.** “Characterizing the Effects of Annealing Temperature on Knitted Shape Memory Actuators”, Technical Paper submitted to the 2022 ASME Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS), February 2022 (under review).

### Other Conference Contributions (7)

- 2020 Compton, C., Golgouneh, A., **Holschuh, B.**, and Dunne, L. “[Evaluation of Textile-Based Wearable Force Sensors for Functional Clothing Applications](#)”, extended abstract presented at the 2020 International Textile and Apparel Association (ITAA) Annual Conference (virtual format), November 2020.
- 2020 Priebe, M., Foo, E., and **Holschuh, B.** “[Shape Memory Alloy Haptic Compression Garment for Media Augmentation in Virtual Reality Environment](#)”, extended abstract published at the 33rd ACM Symposium on User Interface Software and Technology (UIST) (virtual format), October 2020.
- 2020 Granberry, R., **Holschuh, B.**, and Abel, J. “Design and Experimental Investigation of Mechanical Actuator Fabrics Composed of Torque-Unbalanced SMA Yarns”, abstract/presentation presented at the 2020 Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS), held online, September 2020.
- 2020 Granberry, R., **Holschuh, B.**, and Abel, J. “Preliminary Investigation of the Design of a Mechanically Antagonistic, Actuating Countermeasure Garment for Astronauts Post-Spaceflight”, abstract/presentation presented at the 2020 Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS), held online, September 2020.
- 2019 Pokorny, C., Seifert, E., Griffin, L., **Holschuh, B.**, Juhnke, B., and Savvateev, E. “[Validation of the Artec Eva for Hand Anthropometric Data Collection](#)”, extended abstract published at the 2019 International Textile and Apparel Association (ITAA) Annual Conference, Las Vegas, NV, October 2019.

- 2019 Foo, E., Lee, J.W., Ozbek, S., Compton, C., Schleif, N., and **Holschuh, B.** "[Design and Development of a Garment-based, Dynamic Compression System using Active Materials](#)", work-in-progress manuscript presented at the 2019 IEEE World Haptics Conference, July 2019.
- 2018 Foo, E., and **Holschuh, B.** "[Dynamic Compression in Affective Haptics](#)", submission presented at the 2018 International Symposium on Wearable Computers (ISWC) Doctoral Colloquium Competition (DCC), Singapore, October 2018.

### Design Exhibitions (7)

- 2021 Dahunsi, B., Woelfle, H., Compton, C., Subash, N., Pettys-Baker, R., Priebe., M., and **Holschuh, B.** "Dynamic, Discreet, Robotic Compression Garment for Real-Time Stress Assessment and Intervention", paper and prototype presented at the Juried Design Exhibition at the 2021 ACM International Symposium on Wearable Computers (virtual conference), September 2021.
- 2021 Golgouneh, A., Beaudette, E., Woelfle, H., Li, B., Subash, N., Redhouse, A., Jones, M., Martin, T., Lobo, M., **Holschuh, B.** and Dunne, L. "Design of a Hybrid SMA-Pneumatic based Wearable Upper Limb Exoskeleton", paper and prototype presented at the Juried Design Exhibition at the 2021 ACM International Symposium on Wearable Computers (virtual conference), September 2021.
- 2019 Foo, E., Lee, J.W., Ozbek, S., Compton, C., and **Holschuh, B.** "[Iterative Design and Development of Remotely-Controllable, Dynamic Compression Garment for Novel Haptic Experiences](#)", paper and prototype presented at the Juried Design Exhibition at the 2019 ACM International Symposium on Wearable Computers, London, England, September 2019.
- 2019 Foo, E., Lee, J.W., Ozbek, S., Compton, C., Schleif, N., and **Holschuh, B.** "Garment-based, Computer-Mediated Dynamic Compression System using Shape Memory Alloys", Design Showcase entry presented at the [2019 IEEE World Haptics Conference Design Showcase](#), Tokyo, Japan, July 2019.
- 2017 Granberry, R., Abel, J., and **Holschuh, B.** "[Active Knit Compression Garments for the Treatment of Orthostatic Hypotension](#)", paper and prototype presented at the Juried Design Exhibition at the 2017 ACM International Symposium on Wearable Computers, Maui, Hawaii, September 2017.
- 2016 Duvall, J., Schleif, N., Dunne, L., and **Holschuh, B.** "[Active "Hugging" Vest for Deep Touch Pressure Therapy](#)", paper and prototype presented at the Juried Design Exhibition at the 2016 ACM 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](#)", paper and prototype presented at the Juried Design Exhibition at the 2016 ACM International Symposium on Wearable Computers, Heidelberg, Germany, September 2016.

## Reports (1)

- 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.

## Posters (21) (engineering convention lists PI last)

- 2021 Briggs, E., **Holschuh, B.**, and Griffin L. "[Computer Mediated Compression Technology to Combat Sensory Overload](#)", UMTC Undergraduate Research Presentations and Papers (UROP) collection, 2021.
- 2020 Golgouneh, A., **Holschuh, B.**, and Dunne L. "A Controllable Biomimetic SMA-Actuated Robotic Arm", presented at the [8th IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics \(BioRob 2020\)](#)(virtual format), December 2020.
- 2020 Priebe, M., Foo, E., and **Holschuh, B.** "Shape Memory Alloy Haptic Compression Garment for Media Augmentation in Virtual Reality Environment", presented at the 2020 ACM Symposium on User Interface Software and Technology (UIST) (virtual format), October 2020.
- 2020 Granberry, R., Padula II, S., Ross, A., Abel., J., and **Holschuh, B.** "Design and Operation for Dynamic Countermeasure Garments", presented at 2020 NASA Human Research Program (HRP) Investigators' Workshop, Galveston, T.X., January 2020.
- 2019 Granberry, R., Ross, A., Padula II, S., Abel., J., and **Holschuh, B.** "Shapeshifting Compression Garments for Astronaut Health", poster presented at 2019 NASA STRG Tech Day on the Hill, Washington, D.C., December 2019.
- 2019 Granberry, R., Eschen, K., Abel, J., and **Holschuh, B.** "Medical Compression Capabilities of Contractile SMA Knitted Actuator Fabrics" poster presented at the 2019 Shape Memory and Superelastic Technology (SMST) Conference and Exposition, Konstanz, Germany, May 2019.
- 2018 Eschen, K., Granberry, R., **Holschuh, B.**, and Abel, J. "Active-Contracting Variable-Stiffness Fabrics for Self-Fitting Wearables", poster presented at 2018 Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS), San Antonio, TX, September 2018.
- 2018 Granberry, R., Eschen, K., Ross, A., Abel, J., and **Holschuh, B.** "A Novel Orthostatic Intolerance (OIG) Garment Designed with Active-Contracting Fabrics", poster presented at 2018 International Conference on Environmental Systems (ICES), Albuquerque, N.M., July 2018.
- 2018 **Holschuh, B.** and E. Foo "Active Materials Development for Wearable Systems", poster presented at 3M's 2018 Science and Engineering Faculty Day (SEFD), St. Paul, MN, June 2018.

- 2018 **Holschuh, B.**, Dunne, L., Woelfle, H., Duvall, J., Foo, E., Granberry, R., Lee, J.W., Ozbek, S., Pettys-Baker, R., Schleif, N., and Utset-Ward, S. "Garment-based Electronics and Actuation for Haptic Displays", poster presented at 2018 IEEE Haptics Symposium, San Francisco, CA, March 2018.
- 2018 Granberry, R., Eschen, K., Ross, A., Abel, J., and **Holschuh, B.** "Contracting Textiles for Orthostatic Intolerance Garments", poster presented at 2018 NASA Human Research Program (HRP) Investigators' Workshop, Galveston, T.X., January 2018.
- 2017 Granberry, R., Abel, J., and **Holschuh, B.** "Active Knit Compression Stockings", poster presented at 2017 Industrial Fabrics Association International (IFAI) Expo, New Orleans, L.A., September 2017.
- 2017 Granberry, R., Duvall, J., Kelly, K., Johnson, C., Joyner, M., Johnson, B., Dunne, L., and **Holschuh, B.** "Evaluating the Effects of Initial Fit of Active Compression Garments on Orthostatic Response during Tilt", poster presented at 2017 International Conference on Environmental Systems (ICES), Charleston, S.C., July 2017.
- 2017 **Holschuh, B.** and R. Granberry "Advancements in Wearable Technology using Active Materials", poster presented at 3M's 2017 Science and Engineering Faculty Day (SEFD), St. Paul, MN, June 2017.
- 2017 Duvall, J., Granberry, R., Johnson, C., Kelly, K., Johnson, B., Joyner, M., Dunne, L. **Holschuh, B.**, "The Design and Development of Active Compression Garments for Orthostatic Intolerance", poster presented at 2017 Design of Medical Devices Conference, Minneapolis, MN, April 2017.
- 2016 **Holschuh, B.** and J. Duvall "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.

- 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.

### Book Chapters (2)

- 2021 **Holschuh, B.**, and Newman, D. "Extravehicular Activity (EVA)", *Handbook of Bioastronautics*, Springer (2021), 978-3-319-10152-1.
- 2021 **Holschuh, B.** "Human Factors: the Hidden Unifier within (and beyond) Design", chapter published in *Collegial Design: Thinking and Making at a Community-Engaged University*, UMN College of Design, September 2021.

### Book Chapters Under Review (1)

- 2016 **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 (publication date TBD).

### Theses (3)

- 2014 Ph.D. Dissertation: [Mechanical Counter-Pressure Space Suit Design using Active Materials](#), June 2014
- 2010 Master's Thesis: [Space Exploration Challenges: Characterization and Enhancement of Space Suit Mobility and Planetary Protection Policy Analysis](#), June 2010.
- 2006 Bachelor's Thesis (jointly authored with T. Gray): Golf Driver / Ball Impact Acoustic Measurement System, June 2006.

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## Patents and Intellectual Property

### Patents Awarded (2)

- 2022 Granberry, R., Eschen, K., Abel, J., and **Holschuh, B.** "[Active Knit Compression Garments, Devices and Related Methods](#)", patent # US 11,280,031 (granted 22 March 2022).
- 2020 **Holschuh, B.**, Gatto, G., Levrino, L., and Newman, D. "[Wearable, Self-Locking Shape Memory Alloy \(SMA\) Actuator Cartridge](#)," patent # US 10,828,221 (granted 10 November 2020).

### Non-Provisional Patent Applications Filed (5)

- 2021 **Holschuh, B.**, Dunne, L., Granberry R., and Abel J. "Dynamic Anchoring using Localized Active Compression", non-provisional patent application (US2017/301285) submitted 30 March 2021.

- 2020 Granberry, R., Barry, J., Weinberg, C., Padula II, S., **Holschuh, B.**, Abel, J. “Multifunctional Active Yarns and Textiles”, non-provisional patent application (PCT/US2020/70841) submitted 2 December 2020 (under review).
- 2020 Eschen, K., Granberry, R., **Holschuh, B.**, Abel, J. “Topographically conforming garments”, non-provisional patent application (docket number PCT/US2020/050495) submitted 11 September 2020 (under review).
- 2018 **Holschuh, B.**, Dunne, L., Granberry, R., Eschen, K., Abel, J., Ciavarella, N., Pettys-Baker, R., Schleif, N., Berglund, M., Lee, J.W., and Utset-Ward, S. “Active Fabrics, Garments, and Materials”, non-provisional patent application (PCT/US2018/63066) submitted 29 November 2018 (under review).
- 2018 **Holschuh, B.**, L. Dunne, R. Pettys-Baker, N. Schleif, J.W. Lee, M. Berglund, S. Utset-Ward, M. Joyner, B. Johnson, K. Kelly, C. Johnson, J. Duvall, and R. Granberry. “Smart Fabric”, non-provisional patent application (US2015/905,372) submitted 26 February 2018 (under review).

### Provisional Patent Applications Filed (1)

- 2021 **Holschuh, B.**, Dunne, L., and Anderson, A. “Reconfigurable, multimodal somatosensory stimulation garment”, provisional patent application (PCT 63/261,380) submitted 20 September 2021 (under review).

### UMN IP Disclosures – Pending Consideration (3)

- 2021 **Holschuh, B.**, Holschuh, N., and Marchetto, P. “Systems and Methods to Remotely Determine Garment Fit using Co-located Multi-Band Scanning”, UMN IP Disclosure (Case # 2022-042) submitted 18 August 2021 (under review).
- 2020 Granberry, R., **Holschuh, B.**, and Abel, J. “Tunable and multi-axial isotropic and anisotropic actuator fabrics”, UMN IP Disclosure (Case # 2021-037) submitted 31 July 2020 (under review).
- 2020 **Holschuh, B.**, Foo, E., Dahunsi, B., Subash, N., Gini, M., Ferland, L., Pakhomov, S., Kotlyar, M., Michalowski, M., and Koutstaal, W. “Voice-assisted smart garment calibration and usage”, UMN IP Disclosure (Case # 2021-002) submitted 24 June 2020 (under review).

## Invited Talks, Lectures, Workshops, and Panels (52)

- 2022 **Holschuh, B.** “Wearable Technology as a Dynamic Interface/Interaction Platform for Aerospace Systems”, invited presentation to be given at the [13th International Conference on Applied Human Factors and Ergonomics \(AHFE 2022\)](#), New York, NY, 24 July 2022.
- 2022 **Holschuh, B.**, “Garment and Textile-Based Robotics for Wearable Medical Applications”, invited talk given at the [Wearable Medical Technology Session](#) at the 2022 Design of Medical Devices (DMD) Conference, 13 April 2022.

- 2022 **Holschuh, B.** “Garment-based Wearable Technology: Principles, Applications, and Challenges”, invited presentation given at the University of Minnesota – Duluth Mechanical and Industrial Engineering Department Senior Seminar Series, University of Minnesota, Duluth, MN, 23 March 2022.
- 2022 **Holschuh, B.** “New Frontiers for Wearable Technology”, invited talk given for the Northeast Metro Golden K Kiwanis Club, Roseville, MN, 1 March 2022.
- 2022 **Holschuh, B.** “Anthropometrics and Ergonomics”, invited lecture given for UMN Course PUBH.6120 (Injury Prevention in the Workplace, Community, and Home), University of Minnesota, 28 February 2022.
- 2022 **Holschuh, B.** “Soft Robotics using Shape Memory Materials for Wearable Technology Applications”, invited talk given at the 2021 Minnesota Robotics Institute (MnRI) Spring Webinar (online presentation), Minneapolis, MN, 21 February 2022.
- 2021 **Holschuh, B.**, panel discussion participant as part of the [Kusske Lecture and Dialogue Series: A Conversation with Architect Frank Gehry](#), UMN College of Design, Minneapolis, MN, 16 November 2021.
- 2021 **Holschuh, B.**, “Design Process” panel discussion participant as part of the College of Design 15th Anniversary Compendium Discussion Series, St. Paul, MN, 11 November 2021.
- 2021 **Holschuh, B.**, “[Soft Robotics using Shape Memory Materials for Wearable Technology Applications](#)”, invited talk given at the 2021 Minnesota Robotics Institute (MnRI) Fall Robotics Colloquium (online presentation), Minneapolis, MN, 8 October 2021.
- 2021 **Holschuh, B.** “Garment-based Wearable Technology: Principles, Applications, and Challenges”, invited presentation given at the University of Minnesota – Duluth Mechanical and Industrial Engineering Department Senior Seminar Series, University of Minnesota, Duluth, MN, 13 October 2021.
- 2021 **Holschuh, B.**, “Wearable Technology for Remote Interaction: Opportunities and Challenges in Designing and User Testing Body-Worn Technologies in the Era of Social Distancing”, invited talk given at the [Human Factors and Ergonomics \(HFE\) Symposium](#) at the 2021 Design of Medical Devices (DMD) Conference, 13-14 April 2021.
- 2021 **Holschuh, B.**, “New Frontiers in Wearable Technology”, invited talk given at the [University of Minnesota Retirees Association \(UMRA\) monthly luncheon](#), 26 January 2021.
- 2020 **Holschuh, B.**, “[Textile-integrated Wearable Technologies: Best Practices, Applications, and Open Challenges](#)”, invited talk given at the 2020 Materials Research Society (MRS) Fall Meeting and Exhibit – Symposium F.FLO3: Flexible, Wearable Electronics and textiles, Boston, MA, December 2020.
- 2020 **Holschuh, B.**, “Soft Robotics using Shape Memory Materials for Wearable Technology Applications”, talk given at the 2020 Minnesota Robotics Institute (MnRI) Fall Robotics Colloquium (online presentation), Minneapolis, MN, October 2020.

- 2020 **Holschuh, B.** and Dunne, L., “[Wearable Technology Laboratory Live Demonstrations – Sensing Garments, Actuating Garments, and Designing and Manufacturing E-Textile Garments](#)”, invited talks given at the IPC E-Textiles 2020 Virtual Summit (online presentation), October 2020.
- 2020 **Holschuh, B.**, “[Garment-based Wearable Technology: Principles, Applications, and Challenges](#)”, invited talk given at the International Conference of Clothing and Textiles 2020 (online presentation), Busan City, Republic of Korea, May 2020.
- 2019 **Holschuh, B.**, Hawley, J., Chattaraman, V., Lehew, M., Chi, T., Diddi, S. “Establishing Successful Interdisciplinary Research Collaborations: Implications for Textiles and Apparel Scholars”, special topic session held at 2019 [International Textile and Apparel Association \(ITAA\) Annual Conference](#), Las Vegas, NV, October 2019.
- 2019 **Co-Organizer** with L. Dunne, Wearable Technology Summit – UMN Wearable Technology Laboratory, St. Paul, MN, 31 July 2019.
- 2019 **Invited Participant**, Advanced Materials Workshop for Next-Generation Atmospheric Diving Suit (ADS) – SCALES Workshop, Warfighter Performance Department – Office of Naval Research, Newport, RI, 11-12 July 2019.
- 2019 **Invited Participant**, Workshop on Human-Robot Interface, Facebook Reality Labs, Austin, TX, 4-5 June 2019.
- 2019 **Holschuh, B.**, “Wearable Technology using Active Materials”, invited talk given at the “Wearable Technology, Materials and Applications II” workshop at the 2019 UMN Biomaterials and Pharmaceutical Materials (BPM) [Industrial Partners for Research in Interfacial and Materials Engineering \(IPRIME\) Annual Meeting](#), Minneapolis, MN, 29 May 2019.
- 2019 **Holschuh, B.** “Soft-Robotic Textiles using Integrated Active Materials”, invited talk given at the 2019 [Industrial Fabrics Association International \(IFAI\) Smart Fabrics Virtual Summit](#), 15 May 2019.
- 2019 **Holschuh, B.**, “[Introduction to Engineering for Design](#)”, guest lecture given for UMN Product Design Studio 2 (PDES.2772), Minneapolis, MN, 1 April 2019.
- 2018 **Holschuh, B.** “Garment-based Wearable Technology: Principles, Applications, and Challenges”, invited presentation given at the University of Minnesota [Visual Computing and AI seminar](#), University of Minnesota, Minneapolis, MN, 17 October 2018.
- 2018 **Holschuh, B.** “Garment-based Wearable Technology: Principles, Applications, and Challenges”, invited presentation given at the University of Minnesota – Duluth Mechanical and Industrial Engineering Department Senior Seminar Series, University of Minnesota, Duluth, MN, 19 September 2018.
- 2018 **Holschuh, B.** “Wearable Technology using Active Materials”, presentation given at 3M Technical Forum Seminar, St. Paul, MN, 1 August 2018.



- 2018 **Holschuh, B.** “Garment-integrated sensing and actuation technologies for real-time, remote health monitoring and tele-rehabilitation”, invited talk given at [15th International Conference on Wearable, Micro and Nano technologies for Personalized Health \(pHealth\)](#), Norwegian University of Science and Technology (NTNU), Gjøvik, Norway, 13 June 2018.
- 2018 **Holschuh, B.** “Soft Robotics using Shape Memory Materials for Wearable Technology Applications”, invited presentation given at the [First International Workshop on Martensitic Microstructures \(IWM \$\mu\$ \)](#), University of Minnesota, Minneapolis, MN, 4 June 2018.
- 2018 **Holschuh, B.** “Garment-Integrated Sensing and Actuation: Technology and Systems Development”, presentation given at [Technology Collaboration Center of Houston Wearable Technologies Workshop](#), Houston, TX, 24 April 2018.
- 2018 **Holschuh, B.** “Space Suits: from the Space Race to SpaceX”, invited talk given at the Science Museum of Minnesota [Social Science Cosmos](#), 12 April 2018.
- 2018 **Holschuh, B.** “Garment-based Electronics and Actuation for Haptic Displays”, Cross-cutting Challenges Interactive Discussion leader at the 2018 [IEEE Haptics Symposium](#), 25 March 2018.
- 2018 **Holschuh, B.** “Soft Robotics using Shape Memory Materials for Wearable Technology Applications”, invited presentation given at the UMN [Aerospace Engineering and Mechanics Seminar Series](#), 6 March 2018.
- 2018 **Holschuh, B.** “Wearable Technology to Improve Human Health and Performance: Informing and Influencing Behavior through On-Body Technology”, invited presentation given at the 2018 [American Society of Safety Engineers \(ASSE\) Northwest Chapter Professional Development Conference](#), 13 February 2018.
- 2017 **Holschuh, B.** Invited [Emcee](#), 2017 [Design in 7: 7 Stories, 7 Minutes.](#), Minneapolis, MN, 5 April 2017.
- 2017 **Holschuh, B.** “Active Materials Technology for Wearable Systems”, invited presentation given at the 2017 [Robotics Alley Conference and Expo](#), 28 February 2017.
- 2017 **Holschuh, B.** “Active Materials Technology for Wearable Systems”, invited virtual lecture delivered for Senior Studio II: Wearables (course PD484) at the University of Oregon, 26 January 2017.
- 2017 **Holschuh, B.**, Invited panelist for [MIT Alumni Association’s Faculty Forum Online](#) webcast: “[Manufacturing Smarter Fabrics](#)”, 11 January 2017.
- 2016 **Holschuh, B.** “Active Materials Technology for Dynamic Compression Systems”, presentation given at the Physical Medicine and Rehabilitation Education Conference, Mayo School of Continuous Professional Development, Rochester, MN, 19 December 2016.
- 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 presentation 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.** "Advanced Space Suit Design Using Active Materials", invited presentation given at the UMN [Aerospace Engineering and Mechanics Seminar Series](#), 11 December 2015.
- 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

### Individual Honors, Fellowships, and Awards

- 2022 UMN [2021-22 Award for Outstanding Contributions to Graduate and Professional Education](#) (and induction into the UMN [Academy of Distinguished Teachers \(ADT\)](#)).
- 2019 UMN College of Design 2019 Outstanding Research 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](#)

### Team Honors and Awards

- 2021 First [Place \(Functional Category\)](#)– 2021 International Symposium on Wearable Computers (ISWC) Design Exhibition, 21-26 September 2021 (virtual conference). A. Golgouneh, E. Beaudette, H. Woelfle, B. Li, N. Subash, A. Redhouse [students], M. Jones, T. Martin, M. Lobo, B. Holschuh, and L. Dunne [co-PIs].
- 2020 Ephrahim Garcia Best Paper Award – ASME 2020 Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS), 15 September 2020 (virtual conference). R. Granberry, K. Eschen [students], J. Abel, B. Holschuh [co-PIs].

- 2020 Best Paper Award in Active Material Technology and Integrated Systems – ASME 2020 Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS), 15 September 2020 (virtual conference). R. Granberry, K. Eschen [students], J. Abel, B. Holschuh [co-PIs].
- 2020 CDES 2020 Research Showcase People’s Choice Award. E. Foo and B. Holschuh.
- 2019 First Place – Research Poster Competition at the 2019 Shape Memory and Superelastic Technologies (SMST) Conference, Germany, May 2019. R. Granberry, K. Eschen [students], J. Abel, B. Holschuh [co-PIs].
- 2019 First Place – Student Best Paper Competition at the 2019 Conference on Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS), Louisville, KY, September 2019. R. Granberry [student], J. Abel, B. Holschuh [co-PIs].
- 2019 Best Design Showcase Award – [2019 IEEE World Haptics Conference Design Showcase](#), Tokyo, Japan, July 2019. E. Foo, W. Lee, S. Ozbek, C. Compton, N. Schlieff [students], B. Holschuh [PI].
- 2018 Second Place – Best Student Paper and Best Student Hardware Paper Competitions at the 2018 ASME SMASIS Conference, San Antonio, TX, September 2018. R. Granberry, K. Eschen [students], J. Abel, B. Holschuh [co-PIs].
- 2018 Second place – Student Poster Competition at the [2018 International Conference on Environmental Systems \(ICES\)](#), Albuquerque, MN, July 2018. R. Granberry, K. Eschen [students], A. Ross, J. Abel [Co-Is], B. Holschuh [PI].
- 2018 Selected participant – “[Three in Five](#)” Competition at the [2018 UMN Design of Medical Devices Conference](#), Minneapolis, MN, April 2018. R. Granberry, N. Ciarvarella, R. Pettys-Baker, M. Berglund [students], B. Holschuh [PI].
- 2017 Award of Excellence (Medical & Disaster Relief Sub-Category) – [2017 IFAI International Achievement Awards \(Advanced Textiles Category\)](#) , New Orleans, L.A. September 2017. R. Granberry [student], J. Abel [Co-I], B. Holschuh [PI].
- 2017 Third place – “[Three in Five](#)” Competition at the [2017 UMN Design of Medical Devices Conference](#), Minneapolis, MN, April 2017. J. Duvall, R. Granberry [students], L. Dunne [Co-I], B. Holschuh [PI]
- 2016 Third place – [IFAI 2016 Advanced Textile Products Student Design Challenge](#), Charlotte, N.C, October 2016. J. Duvall, N. Schleif [students], L. Dunne [Co-I], B. Holschuh [PI]
- 2016 First place – [Student Design Competition](#) at the Augmented Human 2016 International Conference, Geneva, Switzerland, February 2016. J. Duvall [student], B. Holschuh [PI]

## Teaching Approach and Experience

My teaching approach blends elements of engineering and design to promote interdisciplinary learning. My background in aerospace engineering and human factors enables me to teach content with heavy emphasis on quantitative research and technology development / product design, while still promoting a user-centric perspective and approach.

## Courses Taught

- 2022–Present Wearable Technology Laboratory Practicum (UMN course DES.5902) - graduate level. **Co-Lead faculty with L. Dunne.**
- 2021–Present Principles of Wearable Technology (UMN course DES.5901) - graduate level. **Co-Lead faculty with L. Dunne.**
- 2020–Present Graduate Seminar in Human Factors and Ergonomics (UMN course HUMF.8901) - graduate level. **Lead faculty.**
- 2016–Present Human Factors in Design (UMN course DES.5185) - undergraduate and graduate level. **Lead faculty.**
- 2016–2021 Quantitative Research Methods (UMN course DES.8102) - graduate level. **Lead faculty from 2017-2021.**
- 2017 Softlines Analysis (UMN course ADES.2214) - undergraduate level. **Lead faculty.**
- 2015 Aerospace Biomedical and Life Support Engineering (MIT course 16.423) - graduate level. Lecturer.
- 2014-2015 Bioengineering Journal Article Seminar (MIT course 16.459) - graduate level. Instructor.
- 2007-2011 Experimental Projects I-II (MIT courses 16.621-622) - undergraduate level. Graduate Teaching Fellow.
- 2006-2007 Experimental Projects I-II (MIT courses 16.621-622) - undergraduate level. Undergraduate Teaching Assistant.

## Curriculum Development

- 2019-2022 Developed new graduate course “Wearable Technology Laboratory Practicum (DES.5902)” with L. Dunne, S22 launch.
- 2019-2020 Developed new graduate course “Principles of Wearable Technology (DES.5901)” with L. Dunne, S21 launch.
- 2019-2020 Developed new graduate course “Graduate Seminar in Human Factors and Ergonomics (HUMF.8901)”, F20 launch.

## Professional Development

- 2019 Selected participant, UMN CDES *Leads* Program.
- 2018–2019 Participant, [UMN Early Career Teaching and Learning Program](#).

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## Mentored and Advised Students

### Advisor – Current Graduate Students (14)

- 2022–Present **Cara Dreifuerst** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).

- 2022–Present **Yung-Hsin Wang** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2022–Present **Aishwarya Siddoju** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2022–Present **Annaika Khoday** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2021–Present **Timothy Dorn** (UMN M.S. student in Robotics). Thesis topic: TBD.
- 2021–Present **Jerry Prindle** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2021–Present **Justin Geeslin** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2021–Present **Jolene Rowan** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2021–Present **Robert Pettys-Baker** (UMN Ph.D. student in Human Factors and Ergonomics). Thesis topic: “More Than a Just a Tug: Characterizing the Relationship Between Artificial Skin Strain and Perception for Novel Haptic Systems.”
- 2021–Present **Olaitan Adeleke** (UMN Ph.D. student in Apparel Studies – Product Development Track). Thesis topic: TBD.
- 2020–Present **Madeleine Roen** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2020–Present **Daniel Korus** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2019–Present **Niharikha Subash** (UMN Ph.D. student in Human Factors and Ergonomics). Thesis topic: “Assessment of perceptual interference in multimodal wearable haptic systems”.
- 2020–2021 **Megan Clarke** (UMN M.S. student in Apparel Studies – Product Development Track). Thesis topic: TBD.

### Committee Member – Current Students (7)

- 2022–Present **Yui An** (UMN Ph.D. student in Apparel Studies – Retail and Consumer Studies Track). Thesis topic: “TBD”.
- 2021–Present **Minji Yu** (UMN Ph.D. student in Apparel Studies – Product Development Track). Thesis topic: “Innovation in medical wearable product development: from design to system application”.
- 2020–Present **Justin Baker** (UMN Ph.D. student in Human Factors and Ergonomics). Thesis topic: “Investigating the practice of autonomy support with parents and teachers in naturalistic, play-based settings”.
- 2020–Present **Zach Schmitt** (UMN Ph.D. student in Human Factors and Ergonomics). Thesis topic: “SponsorLens: Designing a Human-Centered Computational System to Support Peer Mentorship in Substance Use Disorder Recovery”.

- 2020–Present **Courtney Pospick** (UMN Ph.D. student in Computer Science and Engineering). Thesis topic: TBD.
- 2019–Present **Akshay Kothakonda** (MIT Ph.D. student in Aeronautics and Astronautics). Thesis topic: “Enabling Natural Mobility and Active Pressurization of a Mechanical Counter Pressure Spacesuit.”
- 2019–Present **Neil Linscheid** (UMN Ph.D. student in Human Factors and Ergonomics). Thesis topic: “Community Development and Entrepreneurship — A Community Ergonomics Perspective”.

### Advisor – Graduated Students (7)

- 2020–2021 **Mary Korlin-Downs** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C).
- 2018–2021 **Rachael Granberry** (UMN Ph.D. student in Apparel Studies – Product Development Track). Thesis topic: “Advancing the Fit, Performance, and Wearing Stability of Wearable Technologies with Active Textiles”.
- 2016–2020 **Esther Foo** (UMN Ph.D. student in Human Factors and Ergonomics). Thesis topic: “[Dynamic Compression for Novel Haptic Interactions](#)”(defended December 2020). Post-graduation: Merck.
- 2017–2020 **Simon Ozbek** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C). Post-graduation: NASA/KBR.
- 2016–2018 **Rachael Granberry** (UMN M.S. student in Apparel Studies – Product Development Track). Thesis topic: “[Active-Contracting Fabrics for Wearable Compression Applications](#)”(defended August 2018). Post-graduation: Ph.D. student at UMN.
- 2016–2018 **Esther Foo** (UMN M.S. student in Human Factors and Ergonomics). Thesis topic: N/A (Plan C). Post-graduation: Ph.D. student at UMN.
- 2016–2017 **Julia Duvall** (UMN M.S. student in Apparel Studies – Product Development Track). Thesis topic: “[Bear Hug: The Design and Development of an Active Deep Touch Pressure Garment for Sensory Processing Disorder](#)”(defended August 2017). Post-graduation: Microsoft Applied Sciences Group.

### Committee Member – Graduated Students (15)

- 2020–2022 **Matt Overby** (UMN Ph.D. student in Computer Science). Thesis topic: “Versatile Geometry Optimization with Hard Constraints”.
- 2019–2021 **Bo Ra Joo** (UMN Ph.D. student in Apparel Studies – Retail and Consumer Studies Track). Thesis topic: “Co-Branding of Luxury Fashion Brands and Technology Brands and Retail Channels: Focusing on Consumer Perceptions of Status-Signaling”.
- 2018–2021 **Crystal Compton** (UMN Ph.D. student in Apparel Studies – Product Development Track). Thesis topic: “[Wearable Textile-Based Contact Sensing for Functional Fit Assessment](#)”.

- 2020–2021 **Sabrill Holcomb** (UMN MFA student in Graphic Design). Thesis topic: “The Human FACTors of Life: Code-Switching as an Inspiration for Design”.
- 2020 **Emily Seifert** (UMN M.S. student in Apparel Studies – Product Development Track). Thesis topic: “A Comparison and Validation of Traditional and Three-Dimensional Anthropometric Methods for Measuring the Hand through Reliability, Precision, and Visual Analysis” (defended December 2020).
- 2017–2020 **Kevin Eschen** (UMN Ph.D. student in Mechanical Engineering). Thesis topic: “Multiscale Mechanics of Shape Memory Alloy Knitted Actuators”(defended July 2020).
- 2017–2020 **Md. Tahmidul Islam Molla** (UMN Ph.D. student in Apparel Studies – Product Development Track). Thesis topic: “Manufacturing Cut-And-Sew Garment-Integrated Technologies: An Investigation of Surface-Mount Fabrication for Electronic Textiles”(defended July 2020).
- 2018–2020 **Do Yuon Kim** (UMN Ph.D. student in Apparel Studies – Retail and Consumer Studies Track). Thesis topic: “Examining the Underlying Mechanism of Influencer-Follower Relationships on Social Media: An Integrated Application of The Source Credibility and Attractiveness Models” (defended May 2020).
- 2017–2020 **Noorh Albadi** (UMN Ph.D. student in Interior Design). Thesis topic: “Preferred Learning Styles Among Interior Design Students of Generation Z: How Do They Learn?” (defended May 2020).
- 2016–2018 **Claire Whang** (UMN Ph.D. student in Apparel Studies – Retail and Consumer Studies Track). Thesis topic: “Voice Shopping – the Effect of the Consumer-Voice Assistant Parasocial Relationship on the Consumer’s Perception and Decision Making”(defended August 2018).
- 2018 **Fan Feng** (UMN Ph.D. student in Aerospace Engineering and Mechanics). Thesis topic: “Phase Transformation in Helical Structures: Theory and Application”(defended July 2018).
- 2016–2018 **MinJung Park** (UMN Ph.D. student in Apparel Studies – Retail and Consumer Studies Track). Thesis topic: “When Social Media Backfires: The Impact of Psychological Distance on Perceived Values and Desirability of Luxury Brands”(defended July 2018).
- 2016 **Mary Ellen Berglund** (UMN M.S. student in Apparel Studies – Product Development Track). Thesis topic: “Development of Form-Fitted Body-Worn Pressure Sensors for Space and Terrestrial Applications”(defended October 2016).
- 2016 **Crystal Compton** (UMN M.S. student in Apparel Studies – Product Development Track). Thesis topic: “Fit for Space: Leveraging a Novel Skin Contact Measurement Technique Toward a More Efficient Liquid Cooled Garment”(defended August 2016).
- 2015–2016 **Dustin Kendrick** (MIT Ph.D. student in Bioastronautics). Thesis topic: “The Gravity Loading Countermeasure Skinsuit: A Passive Countermeasure Garment for Preventing Musculoskeletal Deconditioning During Long-duration Spaceflight”(defended April 2016).



## Undergraduate Supervisor (5)

- 2020–Present **Miles Priebe** (UMN undergraduate researcher). Related projects: “UROP: Computer Mediated Haptics in a Virtual Reality Environment”.
- 2020–2021 **Erin Briggs** (UMN undergraduate researcher). Related projects: “UROP: Computer-Mediated Compression Technology to Combat Sensory Overload.”
- 2020 **Noah Garon** (UMN undergraduate honors thesis supervisor). Related projects: What are the information needs for developing stable manufacturing process for wearable technology?
- 2019 **Justin Barry** (UMN undergraduate researcher). Related projects: “Characterization and testing of body-temperature SMA actuators for exoskeleton and compression garment applications”.
- 2017-2018 **Nicole Ciavarella** (UMN undergraduate researcher). Related projects: “Investigation of SMA Shape Setting Parameters on Spring Actuator Performance”.

## Advisee Fellowships and Awards

- 2020 Rachael Granberry [advisee] – 2020 UMN CDES Outstanding Graduate Student award (Ph.D. level).
- 2019-2020 Esther Foo [advisee] – UMN Doctoral Dissertation Fellowship (DDF).
- 2019 Esther Foo [advisee] – 2019 UMN CDES Outstanding Graduate Student award.
- 2018 Esther Foo [advisee] – First place, [Doctoral Colloquium](#) Competition at the [2018 International Symposium on Wearable Computers \(ISWC\)](#), Singapore, October 2018.
- 2018-2021 Rachael Granberry [advisee] – NASA [Space Technology Research Fellowship \(NSTRF\)](#) (Ph.D. level) – “Active Knit Textiles for Orthostatic Intolerance Garments”.
- 2017-2018 Rachael Granberry [advisee] – NASA [Space Technology Research Fellowship \(NSTRF\)](#) (Masters level) – “Leveraging Active Knit Technologies for Aerospace Pressure Suit Applications”.

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## Service and Outreach

### University Service – Leadership

- 2016–Present Co-Director, UMN [Wearable Technology Laboratory \(WTL\)](#).
- 2019–Present Director of Graduate Studies (DGS), UMN Human Factors and Ergonomics (HFE) Graduate Program.
- 2019–Present Member, Design Academic Leaders (DAL) Graduate Learning Community Working Group.
- 2018–2019 UMN CDES Academic Technology Committee (Chair).
- 2017 Acting Co-Director of Graduate Studies (DGS), UMN Human Factors and Ergonomics (HFE) Graduate Program (August-November 2017).

## University Service – Other

- 2016–Present MnDRIVE Robotics, Sensors, and Advanced Manufacturing Research and Outreach Committee member.
- 2021–Present UMN CDES Mentor Committee member for C. Lauff.
- 2022–Present UMN CDES Grant Development Coordinator Search Committee member.
  - 2022 UMN CDES Kusske Design Initiative (KDI) Scholarships and Fellowships reviewer (12 proposals).
  - 2022 UMN MAES proposal reviewer (2 proposals).
- 2020–2021 UMN CDES Collegiate Structures Working Group member.
  - 2021 UMN User Experience in Design (DES.3131) course guest reviewer (6 May 2021).
  - 2021 UMN MAES proposal reviewer.
  - 2020 UMN Mechanical Engineering Robot Show judge.
  - 2019 UMN Mechanical Engineering ME 4054W Project Co-Advisor (with E. Nickel).
- 2016–2019 UMN Human Factors Program Graduate Advisory Committee member.
  - 2018 UMN Mechanical Engineering Robot Show judge.
  - 2017 UMN President Postdoctoral Fellowship Program (PPFP) reviewer.
  - 2017 UMN Imagine Fund Annual Award reviewer.
- 2017–2018 UMN CDES Academic Technology Committee member.
- 2016–2017 UMN DHA Product Design Tenure-Track Faculty Search Committee member.
- 2016–2017 UMN Institute for Advanced Study (IAS) [Physical Computing and the Internet of Things](#) Research and Creative Collaborative. Co-convener.
  - 2016 UMN Mechanical Engineering Robot Show judge.

## Professional Service

- 2021–Present **Member**, Research Impact Fund (RIF) Committee (Engineering Sub-Group), Research Grants Council, Hong Kong.
- 2022–Present **Co-Chair**, Session 407 (Extravehicular Activity: Emerging Space Suit Technologies), International Conference on Environmental Systems (ICES).
- 2016–Present **Member**, [Standing Committee on Aerospace Medicine and the Medicine of Extreme Environments \(CAMMEE\)](#), National Academy of Medicine, Washington, D.C.
  - 2022 **Reviewer**, 2022 NASA Space Technology Graduate Research Opportunities (NSTGRO) program.
  - 2022 **External Reviewer**, Hong Kong Research Grants Council (RGC) – General Research Fund (GRF), Faculty Development Scheme (FDS), Research Impact Fund (RIF), and Early Career Scheme (ECS) – 28 proposals.
  - 2022 **Reviewer**, Fashion Practice: The Journal of Design, Creative Process and the Fashion Industry.

- 2018–2021 **Co-Chair**, Session 400 (Extravehicular Activity: Space Suits), International Conference on Environmental Systems (ICES).
- 2021 **Member**, International Symposium on Wearable Computers (ISWC) 2021 Program Committee.
- 2021 **External Reviewer**, Hong Kong Research Grants Council (RGC) – General Research Fund (GRF), Research Impact Fund (RIF), RGC Joint Research Scheme (JRS) and Faculty Development Scheme (FDS) – 27 proposals.
- 2021 **Reviewer**, Fashion Practice: The Journal of Design, Creative Process and the Fashion Industry.
- 2020 **Member**, International Symposium on Wearable Computers (ISWC) 2020 Program Committee.
- 2020 **Member**, IPC E-Textiles 2020 Technical Conference Program Committee.
- 2020 **External Reviewer**, Hong Kong Research Grants Council (RGC) – General Research Fund (GRF), Early Career Scheme (ECS), and Inter-Institutional Development Scheme (IIDS) – 13 proposals.
- 2020 **Reviewer**, 2020 NASA Human Exploration Research Opportunities (HERO) Program – Research and Technology Development to Support Crew Health and Performance in Space Exploration Missions call for proposals.
- 2019 **Member**, International Symposium on Wearable Computers (ISWC) 2019 Program Committee.
- 2019 **External Reviewer**, Hong Kong Research Grants Council (RGC) – General Research Fund (GRF), Early Career Scheme (ECS), Faculty Development Scheme (FDS), Inter-Institutional Development Scheme (IIDS), Collaborative Research Fund (CRF), and Joint Laboratory Funding Scheme (JLFS) – 8 proposals.
- 2019 **Abstract Reviewer**, 2019 Fashion and Active Aging Symposium.
- 2019 **Reviewer**, 2019 NASA Space Technology Research Fellowship (NSTRF) program.
- 2018 **Participant**, 2018 NSF review panel.
- 2018 **Reviewer**, 31st ACM User Interface Software and Technology Symposium (UIST).
- 2018 **Reviewer**, ASME Journal of Medical Devices.
- 2018 **External Reviewer**, Hong Kong Research Grants Council (RGC) – General Research Fund (GRF) and Early Career Scheme (ECS) – 7 proposals.
- 2018 **Reviewer**, 48th International Conference on Environmental Systems (ICES) Conference Proceedings.
- 2017 **External Reviewer**, Hong Kong Research Grants Council (RGC) – General Research Fund (GRF) and Early Career Scheme (ECS) – 2 proposals.
- 2017 **Reviewer**, ASME Journal of Medical Devices.
- 2017 **Reviewer**, 47th International Conference on Environmental Systems (ICES) Conference Proceedings.

- 2016 **Reviewer**, Fashion Practice: The Journal of Design, Creative Process and the Fashion Industry.
- 2016 **Reviewer**, 2016 International Symposium on Wearable Computers (ISWC).
- 2016 **Reviewer**, Acta Astronautica.
- 2015 **Committee to Review NASA's Evidence Reports on Human Health Risks**, Decompression sickness report lead, [Institute of Medicine](#), Washington, D.C.
- 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.

### Outreach

- 2020–Present **Science Advisor**, UMN Bell Museum – NASA TEAM II Grant: “A Charge Forward: Activating the Nation’s Planetariums to Excite the Public about Human Space Exploration of the Moon and Beyond”. 8/1/2020–7/31/2023.
- 2022 **Guest speaker**, virtual career discussion with students at Farnsworth Aerospace PreK-4 (Saint Paul). 24 March 2022.
- 2021 **Featured Faculty Researcher (with L. Dunne)**, evening with UMN President Gabel at Eastcliff and local business leaders. 11 November 2021.
- 2021 **Guest Expert and Contributor**, Science Museum of Minnesota / The Scientific Center of Kuwait: “Robosapiens”. 23 August 2021 (exhibit opens 2022).
- 2020 **Guest Speaker**, UMN Rocket Team general meeting (“Space Suits and Bioastronautics”), 7 December 2020.
- 2020 **Guest Speaker**, “Research at the UMN Wearable Technology Lab”, UMN Bell Museum Skynet Scholars Program, 18 April 2020.
- 2018 **Guest Speaker**, “Space Suits: Past, Present, Future”, LEGO League Workshop at the UMN Bell Museum, 11 November 2018.
- 2018 **Public Lecturer and Workshop Facilitator**, “Living and Working in Outer Space”, FIRST Lego League (FLL) INTO ORBIT Research Workshop (broader Minnesota chapters), 1 October 2018.
- 2018 **Guest Lecturer**, “Space Exploration and Human Factors”, FIRST Lego League (FLL) Robotics teams (Minneapolis chapters), 27 July 2018.
- 2018 **Participant**, Start-up Capital of the North Showcase, Greater MSP, 30 January 2018.
- 2017 **Invited Expert (with L. Dunne)**, Evenings@TheBakken – “Space is the Place”, The Bakken Museum, 5 October 2017.
- 2017 **Team Mentor and Judge**, Minneapolis South High School Engineering Design and Development Course Final Project, Minneapolis, MN.

- 2015 **Consultant**, Two-week studio on Space Suit Technologies, [NuVu Innovation Studio](#), Cambridge, MA.
- 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](#).

## — Affiliations

- 2020–Present American Institute of Aeronautics and Astronautics (AIAA), Member
  - 2016–Present Association for Computing Machinery (ACM), Member
  - 2006–2014 American Institute of Aeronautics and Astronautics (AIAA), Student Member
  - 2013–2014 International Society for Optics and Photonics (SPIE), Member
- ResearcherID:** [G-9553-2014](#), **ORCID:** [0000-0002-2054-3534](#),  
**ResearchGate:** [Profile](#), **Google Scholar:** [Profile](#), **Mendeley:** [Profile](#)

## — Media Coverage

- 2022 Feature: [“Wearable Technology Laboratory”](#), Minnesota Robotics Institute (MnRI) Newsletter, April 2022.
- 2021 Feature: [“NASA faces new criticism, possible congressional hearing over spacesuit delays”](#), United Press International (UPI), 23 August 2021.
- 2021 Feature: [“My, That’s a Snug-Fitting Spacesuit Jeff Bezos is Wearing”](#), The Daily Beast, 19 July 2021.
- 2021 Feature: [“Getting smarter about wearables”](#), IFAI Specialty Fabrics Review, 17 February 2021.
- 2020 Feature: [“Can clothing change the world?”](#), University of Minnesota News and Events, 28 September 2020.
- 2020 Feature: [“Smart Clothes: Developing the Next Generation of Wearable Technologies to Keep Us Healthy”](#), University of Minnesota Office of Academic and Clinical Affairs, 10 February 2020.
- 2019 Feature: [“We can now create textiles, garments that change shape over time”](#), Fibre2Fashion.com Feature, December 2019 (pages 98-99).
- 2019 Feature: [“Research Brief: Invention of Shape Changing Textiles Powered only by Body Heat”](#), University of Minnesota Research Brief, 29 October 2019.
- 2019 Feature: [“Sonar Gloves and the Incredible Future of Wearable Tech”](#), What’s Next in Tech presented by Best Buy and Studio @ Gizmodo, August 2019.

- 2019 Feature: [“A Wearable-Tech Vest that Hugs You Back”](#), What’s Next in Tech presented by Best Buy and Studio @ Gizmodo, August 2019.
- 2019 Feature: [“U of M students work on new space suit”](#), Kare 11 NBC Affiliate, 19 July 2019.
- 2019 Feature: [“Spacesuits face challenge of creating livable habitat – as clothing”](#), Isanti-Chisago County Star, 19 July 2019.
- 2019 Feature: [“Talking Spacesuits with U of M”](#), UMN News and Events, 9 July 2019.
- 2019 Feature: [“The Right Squeeze: A University of Minnesota team is using space technology to develop compression clothing for earthlings”](#), Minnesota Alumni Magazine, Summer 2019 Issue.
- 2019 Feature: [“Soft robotics pair with textile technologies”](#), Advanced Textiles Source (IFAI Publication), 20 May 2019
- 2019 Feature: [“UMN researchers outline wearable tech for managing stress”](#), Minnesota Daily, 28 April 2019
- 2018 Feature: [“Fellow Journeys – Students to NASA and Beyond”](#), NASA Technology Innovation, August 2018
- 2018 Feature: [“Profile: University of Minnesota Wearable Technology Lab”](#), Greater MSP, 18 January 2018
- 2017 Feature: [“In Pursuit of the Perfect Spacesuit”](#), Air and Space Magazine, September 2017
- 2017 Feature: [“Skintight space suits for Mars: what kind of suits do astronauts need to survive on the red planet?”](#) , Newsweek, 08 July 2017
- 2017 Feature: [“U of M develops wearable technology to help autism”](#) , Kare 11 News, 20 April 2017. Picked up by [9 News \(Denver\)](#), [News 4 \(Tucson\)](#), [WLBZ 2 \(Bangor\)](#), [WCSH 6 \(Portland\)](#), [WTHR 13 \(Indianapolis\)](#), [News 4 KTIV \(Sioux City\)](#), [KGNS \(Laredo\)](#)
- 2017 Feature: [“Three in Five Research Competition – Student News”](#) , White Bear Press, 26 April 2017
- 2016 Feature: [“Mission to Mars – What Do I Wear”](#) , National Geographic Kids, November 2016
- 2016 Miniseries: [“Xploration Outer Space”](#) , Season 3, FOX. Episode 2 (“Surviving Space”), 17 September 2016
- 2016 Feature: [“How space suit technology is going into what you wear here on Earth”](#), Circa.com, 16 September 2016
- 2016 Feature: [“SpaceX Just Hired a Superhero Design Team for Its Spacesuits”](#), HowStuff-Works.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 Podcast: [“Wearable Superpowers for Earth and Beyond”](#), National Public Radio’s Science Friday, 06 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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