December 2021

CURRICULUM VITAE **LUKE E. OSBORN, Ph.D.**

Brain-Computer Interfaces
Intelligent Systems Branch: Neuroscience
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ACADEMIC RECORD

2014 – 2019	Ph.D.	Biomedical Engineering, Johns Hopkins School of Medicine, Baltimore, Maryland
2012 – 2014	M.S.E.	Biomedical Engineering, Johns Hopkins University, Baltimore, Maryland
2008 – 2012	B.S.	Mechanical Engineering, University of Arkansas, Fayetteville, Arkansas Honors: summa cum laude Minor: Physics

EXPERIENCE

2021 – present	Senior Research Staff	Johns Hopkins University Applied Physics Laboratory, Laurel, MD
2019 – 2021	Postdoctoral Researcher	Johns Hopkins University Applied Physics Laboratory, Laurel, MD
2014 – 2019	Graduate Researcher, Ph.D.	Johns Hopkins School of Medicine, Baltimore, MD
2012 – 2019	Teaching Assistant	Johns Hopkins University, Baltimore, MD
2012 – 2014	Graduate Researcher, M.S.E.	Johns Hopkins University, Baltimore, MD Infinite Biomedical Technologies, Baltimore, MD
2011	NSF REU	University of Arkansas, Fayetteville, AR
2009 – 2012	Undergraduate Researcher	University of Arkansas, Fayetteville, AR
2009 – 2013	Academic Tutor	Friendship Academy of Math, Science, and Technology, Baltimore, MD University of Arkansas, Fayetteville, AR Gideon Math and Reading Center, Little Rock, AR
2006 – 2008	Library Technician Intern	Arkansas Supreme Court Library, Little Rock, AR

TEACHING ACTIVITIES

2020-2021	Rehabilitation Engineering (guest lectures)
2019	Systems Bioengineering II Lab: Biointerfacing
2016	Systems Bioengineering II: Neurosciences
2015	Principles of Design of Biomedical Engineering Instrumentation Biomedical Engineering Practice and Innovation
2014	Biomedical Engineering Practice and Innovation
2013	Principles of Design of Biomedical Engineering Instrumentation Biomedical Systems and Controls
2012	Biomedical Engineering Modeling and Design

AWARDS

- Rising Star – Arkansas Academy of Mechanical Engineering (2020)
- Outstanding Scholar in Neuroscience Award Program (OSNAP) – National Institutes of Health (2020)
- Early Career Alumni Award – University of Arkansas (2020) (link)
- Forbes 30 Under 30 – Science (2019) (link)
- Siebel Scholar (2019) (link)
- Best Student Seminar, 2nd place, JHU Biomedical Engineering Seminar Series (Fall 2017)
- Best Live Demonstration, IEEE BioCAS Conference (2017)
- Student Travel Award, IEEE ISCAS Conference (2017)
- Student Travel Award, Johns Hopkins Graduate Student Association (2016)
- TA of the Year Award, Johns Hopkins University (2016)
- Student Travel Award, Johns Hopkins Graduate Student Association (2014)
- 1st Place, Best Technical Content, ASME District E Conference Oral Presentation Competition (2012)
- 2nd Place Overall, ASME District E Conference Oral Presentation Competition (2012)
- Undergraduate Research Fellow, Arkansas Department of Higher Education (2010 – 2012)
- Undergraduate Research Fellow, Honors College, University of Arkansas (2010 – 2012)
- William Charles Robinson Scholarship Recipient, University of Arkansas (2009 – 2012)
- Arkansas Academic Scholarship, Arkansas Department of Higher Education (2009 – 2012)
- Charles & Marjorie Brown Scholarship Recipient, University of Arkansas (2009 – 2011)
- American Society of Mechanical Engineers Scholarship Recipient (2009 – 2010)
- Honors College Leadership Scholarship Recipient, University of Arkansas (2008 – 2012)

RESEARCH FOCUS

Applied research in neuroengineering with a focus on sensorimotor rehabilitation, neural prostheses, cortical and peripheral neural stimulation, tactile sensing, and sensory perception in prosthetic limbs and brain-machine interfaces

- Develop novel techniques for motor rehabilitation through restored and augmented sensory stimulation
- Develop sensing and feedback systems to improve prosthesis and device embodiment and user functionality for motor rehabilitation
- Develop neuromorphic methods to convey complex tactile sensations of touch to individuals with limb amputation or spinal cord injury
- Develop innovative sensing technology for capturing tactile information for medical research and clinical applications
- Develop sensing strategies for improving prosthesis and rehabilitation robot performance and functionality

PUBLICATIONS

Google Scholar Page

Peer-Reviewed Book Chapters

[1] Z. Tayeb, R. Bose, A. Dragomir, **L. E. Osborn**, N. Thakor, G. Cheng, “EEG Decoding of Pain Perception for a Real-Time Reflex System in Prostheses,” in *Brain-Computer Interface Research*, C. Guger, B. Allison, A. Gunduz, Ed. Cham, Springer Nature, 2021, pp. 47-58.

[2] **L. Osborn**, M. Iskarous, and N. Thakor, "Sensing and Control for Prosthetic Hands in Clinical and Research Applications," in *Wearable Robotics*, J. Rosen and P. Ferguson, Ed. Cambridge, Academic Press, 2020, pp. 445-468.

[3] **L. Osborn**, J. Betthauser, and N. Thakor, "Neural Prostheses," in *Wiley Encyclopedia of Electrical and Electronics Engineering*, J. Webster, Ed. Hoboken, John Wiley & Sons, 2019, pp. 1-20.

Pre-Prints & Manuscripts Under Review

[1] **L.E. Osborn**, R. Venkatasubramanian, M. Himmtann, C.W. Moran, A. Crego, J.M. Pierce, M.S. Fifer, R.S. Armiger, "Evoking natural thermal perception with a fast high-capacity thin-film thermoelectric device," 2021. *under revisions*

[2] **L.E. Osborn**, C.W. Moran, L.D. Dodd, E.E. Sutton, N. Norena Acosta, J.M. Wormley, C.O. Pyles, K.D. Gordge, M.J. Nordstrom, J.A. Butkus, J.A. Forsberg, P.F. Pasquina, M.S. Fifer, R.S. Armiger, "Monitoring at-home prosthesis control improvements through real-time data logging," 2021. *under review*

[3] T.M. Thomas, R.W. Nickl, M.C. Thompson, D.N. Candrea, M.S. Fifer, D.P. McMullen, **L.E. Osborn**, E.A. Pohlmeyer, M. Anaya, W.S. Anderson, B.A. Wester, F.V. Tenore, G.L. Cantarero, P.A. Celnik, N.A. Crone, "Simultaneous classification of bilateral hand gestures using bilateral microelectrode recordings in a tetraplegic patient," *medRxiv*, 2020. doi: 10.1101/2020.06.02.20116913. *under review*

[4] K. Ohiri, C.O. Pyles, L.H. Hamilton, M.M. Baker, M.T. McGuire, E.Q. Nguyen, **L.E. Osborn**, K.M. Rossick, E.G. McDowell, LM. Strohsnitter, L.J. Currano, "E-textile based modular sEMG suit for large area level of effort analysis," 2021. *under review*

Peer-Reviewed Scientific Journals

[5] M.S. Fifer, D.P. McMullen, **L.E. Osborn**, T.M. Thomas, B.P. Christie, R.W. Nickl, D.N. Candrea, E.A. Pohlmeyer, M.C. Thompson, M. Anaya, W. Schellekens, N.F. Ramsey, S.J. Bensmaia, W.S. Anderson, B.A. Wester, N.E. Crone, P.A. Celnik, G.L. Cantarero, F.V. Tenore, "Intracortical microstimulation elicits human fingertip sensations," *Neurology,* 2021*, accepted.* (preprint: *medRxiv,* doi: 10.1101/2020.05.29.20117374)

[6] S. Chandrasekaran, M. Fifer, S. Bickel, **L. Osborn**, J. Herrero, B. Christie, J. Xu, R. Murphy, S. Singh, M. Glasser, J. Collinger, R. Gaunt, A. Mehta, A. Schwartz, C. Bouton, "Historical perspectives, challenges, and future directions of implantable brain-computer interfaces for sensorimotor applications," *Bioelectronic Med*, vol. 14, pp. 1-11, 2021. doi: 10.1186/s42234-021-00076-6

[7] **L. Osborn**, C. Moran, M. Johannes, E. Sutton, J. Wormley, C. Dohopolski, M. Nordstrom, J. Butkus, A. Chi, P. Pasquina, A. Cohen, B. Wester, M. Fifer, R. Armiger, "Extended home use of an advanced osseointegrated prosthetic arm improves function, performance, and control efficiency," *J Neural Eng*, vol. 18, no. 2, 026020, 2021.
- *Press release:* https://www.jhuapl.edu/PressRelease/210318-home-study-Modular-Prosthetic-Limb-Matheny-piano-Amazing-Grace

[8] **L. Osborn**, K. Ding, M. Hays, R. Bose, M. Iskarous, A. Dragomir, Z. Tayeb, G. Levay, C. Hunt, G. Cheng, R. Armiger, A. Bezerianos, M. Fifer, N. Thakor, "Sensory stimulation enhances phantom limb perception and movement decoding," *J Neural Eng,* vol. 17, no. 5, 056006, 2020.
- *Press release:* https://www.jhuapl.edu/PressRelease/201204-APL-prosthetics-control-phantom-limb-neural-engineering

[9] D. McMullen, T.M. Thomas, M.S. Fifer, D.N. Candrea, F.V. Tenore, R.W. Nickl, E.A. Pohlmeyer, C. Coogan, **L.E. Osborn**, A. Schivi, T. Wojtasiewicz, C. Gordon, A.B. Cohen, N.F. Ramsey, W. Schellekens, S. Bensmaia, G.L. Cantarero, P.A. Celnik, B.A. Wester, W.S. Anderson, N.E. Crone, "Novel intraoperative online functional mapping of somatosensory finger representations for targeted stimulating electrode placement," *J Neurosurgery,* 2021. doi: 10.3171/2020.9.JNS202675.

[10] K. Ding, A. Dragomir, R. Bose, **L. Osborn**, M. Seet, A. Bezerianos, N. Thakor, "Towards machine to brain interfaces: Sensory stimulation enhances sensorimotor dynamic functional connectivity in upper limb amputees," *J Neural Eng*, vol. 17, no. 3, 035002, 2020.

[11] Z. Tayeb, R. Bose, A. Dragomir, **L. Osborn**, N. Thakor, G. Cheng, "Decoding of pain perception using EEG signals for a real-time reflex system in prostheses: a case study," *Sci Rep*, vol. 10, no. 1, pp. 1-11, 2020.

[12] Y. Gu, D. Yang, **L. Osborn**, D. Candrea, H. Liu, N. Thakor, "An adaptive socket with auto-adjusting air bladders for interfacing transhumeral prosthesis: A pilot study," *Proc Inst Mech Eng H*, vol. 8, pp. 812-822, 2019.

[13] **L. Osborn,** A. Dragomir, J. Betthauser, C. Hunt, H. Nguyen, R. Kaliki, N. Thakor, "Prosthesis with neuromorphic multilayered e-dermis perceives touch and pain," *Science Robotics*, vol. 3, no. 19, eaat3818, 2018.
- *Front cover*: http://robotics.sciencemag.org/content/3/19
- *Press release:* http://releases.jhu.edu/2018/06/20/e-dermis/

[14] J. Betthauser, C. Hunt, **L. Osborn**, M. Masters, G. Levay, R. Kaliki, N. Thakor, "Limb position tolerant pattern recognition for myoelectric prosthesis control with adaptive sparse representations from extreme learning," *IEEE Trans on Biomed Eng*, vol. 65, no. 4, pp. 770-778, 2018.

[15] D.Yang, Y. Gu, L. Jiang, **L. Osborn**, H.Liu, "Dynamic training protocol improves the robustness of PR-based myoelectric control," *Biomed Signal Process Control*, vol. 31, pp. 249-256, 2017.

[16] **L. Osborn**, R. Kaliki, A. Soares, N. Thakor, "Neuromimetic event-based detection for closed-loop tactile feedback control of upper limb prostheses," *IEEE Trans on Haptics*, vol. 9, no. 2, pp. 196-206, 2016.

[17] **L. Osborn,** and M. Zou, "Enhanced Tribological properties of surfaces patterned with SU8/DLC microstructures," *Inquiry*, vol. 15, pp. 69-86, 2013.

Peer-Reviewed Conference Publications

[1] **L.E. Osborn**, B. Christie, D. McMullen, R. Nickl, M. Thompson, Ambarish Pawar, Tessy Thomas, M. Anaya, N. Crone, B. Wester, S. Bensmaia, P. Celnik, G. Cantarero, F. Tenore, M. Fifer, "Intracortical microstimulation of somatosensory cortex enables object identification through perceived sensations," *Conf Proc IEEE Eng Med Biol Conf (EMBC)*, 2021, *accepted*.

[2] **L.E. Osborn**, D. McMullen, B. Christie, P. Kudela, T. Thomas, M. Thompson, R. Nickl, M. Anaya, S. Srihari, N. Crone, B. Wester, P. Celnik, G. Cantarero, F. Tenore, M. Fifer, "Intracortical microstimulation of somatosensory cortex generates evoked responses in motor cortex," *Conf Proc IEEE Neural Eng (NER)*, 2021, pp. 53-56.

[3] C.J. Brown, H.H. Nguyen, M.C. Thompson, J.M. Joyce, E.C. Johnson, M.S. Fifer, **L.E. Osborn**, "Simulation and analysis of neuromorphic tactile data for object interaction speed detection," *Conf Proc IEEE Neural Eng (NER)*, 2021, pp. 136-139.

[4] K. Ding, A. Dragomir, R. Bose, **L. Osborn**, M. Seet, A. Bezerianos, N. Thakor, "Sensory stimulation enhances functional connectivity towards the somatosensory cortex in upper limb amputation," *Conf Proc IEEE Neural Eng (NER)*, 2021, pp. 226-229.

[5] **L. Osborn**, C. Moran, E. Sutton, A. Crego, J. Forsberg, M. Fifer, R. Armiger, "Phantom hand activation during physical touch and targeted transcutaneous electrical nerve stimulation," *MEC20 Symposium*, 2020, pp. 147-149.

[6] E. Sutton, **L. Osborn**, C. Moran, M. Nordstrom, P. Pasquina, R. Armiger, "Long-term functional improvement with dexterous prosthetic limb," *MEC20 Symposium,* 2020, pp. 57-60.

[7] R. Bose, K. Ding, M. Seet, **L. Osborn**, A. Bezerianos, N. Thakor, A. Dragomir, "Sensory feedback in upper limb amputees impacts cortical activity as revealed by multiscale connectivity analysis," *Conf Proc IEEE Eng Med Biol Conf (EMBC)*, 2020, pp. 1-4.

[8] M. Hays, **L. Osborn**, R. Ghosh, M. Iskarous, C. Hunt, N. Thakor, "Neuromorphic vision and tactile fusion for upper limb prosthesis control," *Conf Proc IEEE Neural Eng (NER)*, 2019, pp. 981-984.

[9] C. Hunt, A. Sharma, **L. Osborn**, R. Kaliki, N. Thakor, "Predictive trajectory estimation during rehabilitative tasks in augmented reality using inertial sensors," *Conf Proc IEEE Biomed Circuis Syst (BioCAS)*, 2018, pp.1-4.

[10] M. Iskarous, H. Nguyen, **L. Osborn**, J. Betthauser, N. Thakor, "Unsupervised learning and adaptive classification of neuromorphic tactile encoding of textures," *Conf Proc IEEE Biomed Circuis Syst (BioCAS)*, 2018, pp.1-4.

[11] H. Nguyen, **L. Osborn**, M. Iskarous, C. Shallal, C. Hunt, J. Betthauser, N. Thakor, "Dynamic texture decoding using a neuromorphic multilayer tactile sensor," *Conf Proc IEEE Biomed Circuis Syst (BioCAS)*, 2018, pp. 1-4.

[12] A. Sharma, C. Hunt, J. Betthauser, A. Maheshwari, **L. Osborn**, R. Kaliki, A. Soares, N. Thakor, "A mixed-reality training environment for upper limb prosthesis control," *Conf Proc IEEE Biomed Circuis Syst (BioCAS)*, 2018, pp. 1-4.

[13] J. Costacurta, **L. Osborn**, N. Thakor, S. Sarma, "Designing feedback controllers for human-prosthetic systems using H-infinity model matching," *Conf Proc IEEE Eng Med Biol Conf (EMBC)*, 2018, pp. 1-4.

[14] J. Fu, H. Nguyen, D.W. Kim, C. Shallal, S.M. Cho, **L. Osborn**, N. Thakor, "Dynamically Mapping Socket Loading Conditions During Real Time Operation of an Upper Limb Prosthesis," *Conf Proc IEEE Eng Med Biol Conf (EMBC),* 2018, pp. 1-4.

[15] **L. Osborn**, M. Fifer, C. Moran, J. Betthauser, R. Armiger, R. Kaliki, N. Thakor, "Targeted transcutaneous electrical nerve stimulation for phantom limb sensory feedback," *Conf Proc IEEE Biomed Circuits Syst (BioCAS)*, 2017, pp. 1-4.

[16] J. Betthauser, **L. Osborn**, R. Kaliki, N. Thakor, "Electrode-shift tolerant myoelectric movement-pattern classification using extreme learning for adaptive sparse representations," *Conf Proc IEEE Biomed Circuits Syst (BioCAS)*, 2017, pp. 1-4.

[17] **L. Osborn**, H. Nguyen, R. Kaliki, N. Thakor, "Prosthesis grip force modulation using neuromorphic tactile sensing," *Myoelectric Control Symposium*, 2017, pp. 188-191.

[18] C. Hunt, R. Yerrabelli, C. Clancy, **L. Osborn**, R. Kaliki, N. Thakor, "PHAM: Prosthetic hand assessment method," *Myoelectric Control Symposium*, 2017, pp. 221-224.

[19] D. Candrea, A. Sharma, **L. Osborn**, Y. Gu, N. Thakor, "An adaptable prosthetic socket: regulating independent air bladders through closed-loop control," *Conf Proc IEEE Int Symp Circuits Syst (ISCAS)*, 2017, pp. 1754-1757.

[20] **L. Osborn**, H. Nguyen, J. Betthauser, R. Kaliki, N. Thakor, "Biologically inspired multi-layered synthetic skin for tactile feedback in prosthetic limbs," *Conf Proc IEEE Eng Med Biol Conf (EMBC)*, 2016, pp. 4622-4625.

[21] J. Betthauser, C. Hunt, **L. Osborn**, R. Kaliki, N. Thakor, "Limb-position robust classification of myoelectric signals for prosthesis control using sparse representations," *Conf Proc IEEE EMBC*, 2016, pp. 6373-6376.

[22] M. Masters, **L. Osborn**, A. Soares, N. Thakor, "Real-time arm tracking for HMI applications," *Conf Proc IEEE Body Sens Net,* 2015, pp. 1-4.

[23] **L. Osborn**, W.W. Lee, R. Kaliki, N. Thakor, "Tactile feedback in upper limb prosthetic devices using flexible textile force sensors," *Conf Proc IEEE Biomed Rob Biomechatron (BioRob)*, 2014, pp. 114-119.

[24] **L. Osborn,** R. Kaliki, N.V. Thakor, "Utilizing tactile feedback for biomimetic grasping control in upper limb prostheses," *Conf Proc IEEE Sensors,* 2013, pp. 1266-1269.

[25] S. Beckford, **L. Osborn**, M. Zou, J. Cai, J. Chen, "Tribological study of PTFE/Au nanoparticle composite thin films," *Conf Proc ASME/STLE Int Trib*, 2011, pp.1-3.

Theses

[1] **L. Osborn**, “Enhancing upper limb prostheses through neuromorphic sensory feedback,” P.h.D. thesis, Biomedical Engineering, Johns Hopkins School of Medicine, Baltimore, MD, 2018.

[2] **L. Osborn**, “Closed-loop tactile feedback system for use in upper limb prosthesis grip control,” M.S.E. thesis, Biomedical Engineering, Johns Hopkins University, Baltimore, MD, 2014.

[3] **L. Osborn**, “Enhanced Tribological properties of surfaces patterned with SU8/DLC microstructures,” Honors B.S. thesis, Mechanical Engineering, University of Arkansas, Fayetteville, AR, 2012.

PATENTS

[1] R. Venkatasubramanian, **L. Osborn,** M. Himmtann, J. Pierce, R. Armiger. "Fast-rate thermoelectric device,” *nonprovisional U.S. Patent application*, September 2020.

SEMINAR, INVITED, & CONFERENCE PRESENTATIONS

[1] **L. Osborn**, B. Christie, D. McMullen, A. Pawar, M. Thompson, M. Anaya, S. Bensmaia, P. Celnik, M. Fifer, F. Tenore, “Enhanced tactile sensitivity using intracortical microstimulation,” Society for Neuroscience, November 2021

[2] **L. Osborn**, A. Crego, B. Christie, D. D’almeida, D. McMullen, C. Firestone, F. Tenore, M. Fifer, “Exploring vibrotactile and intracortical microstimulation feedback on sensory embodiment and expectations,” Society for Neuroscience, November 2021

[3] **L.E. Osborn**, B. Christie, D. McMullen, R. Nickl, M. Thompson, Ambarish Pawar, Tessy Thomas, M. Anaya, N. Crone, B. Wester, S. Bensmaia, P. Celnik, G. Cantarero, F. Tenore, M. Fifer, “Intracortical microstimulation of somatosensory cortex enables object identification through perceived sensations,” *Conf Proc IEEE Eng Med Biol Conf (EMBC)*, November 2021

[4] From Machine-Brain Interfaces (MBI) to Neurorobotics: Challenges and Opportunities – EMBC 2021 Workshop , “Bilateral intracortical microstimulation for sensory feedback”, October 2021

[5] XIII SEB - Simpósio de Engenharia Biomédica, “Neuroengineering and prostheses – advances in sensing, control, and translation”, September 2021

[6] **L.E. Osborn**, D. McMullen, B. Christie, P. Kudela, T. Thomas, M. Thompson, R. Nickl, M. Anaya, S. Srihari, N. Crone, B. Wester, P. Celnik, G. Cantarero, F. Tenore, M. Fifer, “Intracortical microstimulation of somatosensory cortex generates evoked responses in motor cortex,” *Conf Proc IEEE Neural Eng (NER),* May 2021

[7] Johns Hopkins Translational Neuroengineering Technologies Network Showcase, “Translating prosthesis technology to the home”, April 2021

[8] Northeastern University, Electrical Engineering, “Sensory stimulation, encoding, and perception for upper limb prostheses”, February 2021

[9] Boston University, Mechanical Engineering, “Sensory stimulation, encoding, and perception for upper limb prostheses”, January 2021

[10] Neuromatch 3, “Sensory stimulation enhances phantom limb perception and movement decoding”, October 2020. Recording: https://www.youtube.com/watch?v=p2QXZeMxjHo

[11] NIH Outstanding Scholar in Neuroscience Award Program, “Sensory stimulation to enhance perception and rehabilitation”, October 2020

[12] Neuroprosthetics 2020, virtual summer workshop, “Sensory stimulation enhances phantom limb perception and movement decoding”, July 2020.

[13] Analytics for Health and Biological Sciences, JHU Applied Physics Lab. *Invited seminar*, April 2020.

[14] George Mason University. *Invited seminar*, "Enhancing upper limb prostheses using neuromorphic sensory feedback", May 2019.

[15] Northeastern University. *Invited seminar*, "Enhancing upper limb prostheses using neuromorphic sensory feedback", January 2019.

[16] Johns Hopkins University Applied Physics Laboratory. *Invited seminar,* "Enhancing upper limb prostheses using neuromorphic sensory feedback", December 2018.

[17] **L. Osborn**, "Prosthesis with enhanced perception: from e-skin to neuromorphic encoding," *Frontiers Spotlight: Augmentation of Brain Function*, September 2018, École polytechnique fédérale de Lausanne (EPFL).

[18] **L. Osborn**, M. Fifer, C. Moran, J. Betthauser, R. Armiger, R. Kaliki, N. Thakor, "Targeted transcutaneous electrical nerve stimulation for phantom limb sensory feedback," *Conf Proc IEEE BioCAS*, October 2017.

[19] J. Betthauser, **L. Osborn**, R. Kaliki, N. Thakor, "Electrode-shift tolerant myoelectric movement-pattern classification using extreme learning for adaptive sparse representations," *Conf Proc IEEE BioCAS*, October 2017.

[20] **L. Osborn**, "Tactile feedback for improving upper limb prostheses," JHU Biomedical Engineering Department Seminar Series, September 2017

[21] **L. Osborn**, H. Nguyen, R. Kaliki, and N. Thakor, "Prosthesis grip force modulation using neuromorphic tactile sensing," *Myoelectric Control Symposium*, University of New Brunswick, New Brunswick, August 2017

[22] **L. Osborn**, H. Nguyen, R. Kaliki, and N. Thakor, "Live demonstration: prosthesis grip force modulation using neuromorphic tactile sensing," *IEEE ISCAS*, Baltimore, MD, May 2017

[23] **L. Osborn**, H. Nguyen, J. Betthauser, R. Kaliki, and N. Thakor, "Biologically inspired multi-layered synthetic skin for tactile feedback in prosthetic limbs," *IEEE EMBC*, Orlando, FL, August 2016.

[24] M. Masters, **L. Osborn**, A. Soares, and N. Thakor, "Real-time arm tracking for HMI applications," *IEEE Body Sens Net,* Massachusetts Institute of Technology, Boston, MA, August 2015.

[25] **L. Osborn**, R. Kaliki, and N. Thakor, "Biomimetic touch for force feedback in upper limb prosthetic devices," *IEEE BRAIN Grand Challenges*, Washington DC, September 2014.

[26] **L. Osborn**, W.W. Lee, R. Kaliki, and N. Thakor, "Tactile feedback in upper limb prosthetic devices using flexible textile force sensors," *IEEE BioRob*, Sao Paulo, Brazil, August 2014

[27] **L. Osborn,** R. Kaliki, and N.V. Thakor, "Utilizing tactile feedback for biomimetic grasping control in upper limb prostheses," *IEEE Sensors,* Baltimore, MD, October 2013.

[28] **L. Osborn,** and M. Zou, "Enhanced tribological properties of surfaces patterned with micro-scale core-shell structures," STLE International Conference, St. Louis, MO, April 2012.

[29] **L. Osborn,** and M. Zou, "Enhanced Tribological properties of surfaces patterned with SU8/DLC microstructures," ASME District E SPDC, Louisiana State University, March 2012.

FUNDED RESEARCH

Title: Advancing peripheral sensor and implant technology for human-machine interfaces
Agency: JHU APL – Internal Research Funds
Role: PI
Total: $39k
Duration: 10/21 – 09/22
This project aims to investigate the effect of multilayered tactile sensors on sensory feedback and dexterous control.

Title: Improving upper limb outcomes through advanced prosthetic and rehabilitation technologies
Agency: Uniformed Services University of the Health Sciences (USU) / Henry M. Jackson Foundation (HJF)
Role: Project Manager, Sensory Feedback Lead (PI: Armiger)
Total: $375k

Duration: 12/20 – 08/22
This project aims to investigate the effect of multilayered tactile sensors on sensory feedback and dexterous control.

Title: Sensory modulation for embodiment of complex systems
Agency: JHU APL – Research & Exploratory Development Department
Role: PI
Total: $120k
Duration: 10/20 – 09/21
This internally funded project aims to understand the role of tactile sensory perceptions in the role of embodying an external system to improve human-machine interfaces.

Title: Harnessing Peripheral Nerve Signals from Muscle with a Wireless, Implantable Device for Intuitive Prosthesis Control
Agency: JHU Discover Awards
Role: Co-I (PI: Tuffaha)
Total: $100k
Duration: 01/20 – 12/22
This JHU enterprise funded project aims to validate new surgical techniques and devices for intuitive prosthesis control and human-machine interfacing.

Title: Restoring touch and prothesis control for reducing phantom limb pain
Agency: JHU APL – National Health Mission Area
Role: PI
Total: $10k
Duration: 10/19 – 03/20
This internally funded project investigates the combined effect of noninvasive sensory feedback with advanced prosthesis control training to combat phantom limb pain.

Title: Building a lifelike somatosensory system
Agency: JHU APL – Research & Exploratory Development Department
Role: PI
Total: $100k
Duration: 10/19 – 09/20
This internally funded project aims to develop real-time neuromorphic models on embedded hardware to mimic the somatosensory behavior of healthy humans based on input from the biomimetic e-dermis tactile sensor.

Title: Neural processing and perception of sensory information
Agency: JHU APL – Research & Exploratory Development Department
Role: PI
Total: $147k
Duration: 04/19 – 03/21
This postdoc funded project explored the role of neural stimulation in humans for providing sensory information for upper limb rehabilitation.

Title: Enhanced tribological properties of surfaces patterned with micro-scale core-shell structures
Agencies: Arkansas Department of Higher Education, University of Arkansas Honors College
Total: $10k
Duration: 01/11 – 05/12
This undergraduate research grant was awarded to investigate the tribological effects, specifically friction and wear, of surfaces coated with novel micro core-shell patterns. This research resulted in 2 conference presentations, 1 publication in an undergraduate research journal (*Inquiry*), and 1 undergraduate honor's thesis.

LEADERSHIP ACTIVITIES

- Vice President, Academic Affairs, JHU Biomedical Engineering PhD Student Council (2015 – 2016)
- Visiting Student Research Mentor: Asheesh Maheshwari (VIT, Vellore), Prasanna Venkatesan (IIT, Palakkad), Dan Candrea (Duke), Avinash Sharma (IIT, Delhi), Max Cetta (Washington & Lee Univ), Kshitij Agarwal (IIT, Kanpur), Juliana Perl (Stanford) (2014 – present, 7 total)
- Undergraduate / Intern Research Mentor: Harrison Nguyen, Jonathon Fu, Will Kim, Chris Shallal, Wally Niu, Shain Bannonwsky, Anna Frazier, Adam Polevoy, Rohith Bhethanabotla, Nicole Cheng, Adam Polevoy, Shipra Khatri, Mario Choi, William Shyr, Olivia Puleo, Anton Alyakin, Ben Miller, Christophe Brown (graduate), Dayann D'almeida (2014 – present, 19 total)
    - Undergraduate Research Mentor Outcomes: 9 poster presentations, 1 conference abstract, and 3 conference papers
- High School Research Mentor: Dayann D'almeida (Eleanor Roosevelt HS), Myles Lipscomb (Anne Arundel), Chanel Grant (Anne Arundel), Iven Chen-Van Dyk (Baltimore Polytechnic Institute) (2014 – present, 4 total)
    - High School Research Mentor Outcomes: 5 research presentations, 4 poster presentations, and 4 project reports
- President, JHU Biomedical Engineering MSE Student Council (2013 – 2014)
- President (2013 – 2015), Vice President (2015 – 2016), Race Director (2016 – 2018), Johns Hopkins Cycling Team

PROFESSIONAL ACTIVITIES

- Member, Society for Neuroscience (SfN); Institute of Electrical and Electronics Engineers (IEEE); IEEE Engineering in Medicine and Biology Society (EMBS); IEEE Young Professionals; IEEE Circuits and Systems Society (CAS); American Society of Mechanical Engineers (ASME)
- Honor Societies: Pi Tau Sigma, Tau Beta Pi, Phi Kappa Phi
- Service Societies: Gamma Beta Phi

IN THE MEDIA

- Good Morning America: Man who lost arm to cancer learns to play the piano with prosthetic limb
- MIT Technology Review: Eight ways scientists are unwrapping the mysteries of the human brain
- Muy Interesante: Sentidos de última generación
- JHU Hub: Amputee makes music with modular prosthetic limb
- JHU APL: Enhanced Phantom Limb Perception Improves Prosthesis Function
- Freethink: Electronic Skin Gives Sensation Back to Amputees
- Forbes: 30 Under 30 in Science
- JHU Engineering: Sweet Sensation
- JHU Hub: Five engineering graduate students named Siebel Scholars
- The Baltimore Sun: 'Electronic skin' developed at Johns Hopkins allows amputees to feel sensations in prosthetic hands
- JHU Hub: Bringing a Human Touch to Modern Prosthetics
- WYPR: Creating a Sense of Touch
- Wired: Pain is Weird. Making Bionic Arms Feel Pain is Even Weirder.
- Reuters: Scientists create 'electronic skin' to restore sense of pain
- La Monde: Des chercheurs créent une peau électronique capable de ressentir la douleur
- The Times: Prosthetic that can feel pain helps amputees avoid injury
- IEEE Spectrum: A Prosthetic That Feels Pain
- Gizmodo: 'Electronic Skin' Allows User of Prosthetic Hand to Feel Pain
- The Atlantic: Why Would You Want a Prosthetic Hand That Feels Pain?
- Axios: New electronic skin gives prosthetics a sense of pain

- Science Daily: New ‘e-dermis’ brings sense of touch, pain to prosthetic hands
- Tech Xplore: New ‘e-dermis’ brings sense of touch, pain to prosthetic hands
- The Engineering: E-dermis gives sense of touch to fingertips of prosthetic hands

SERVICES

Journal and Conference Review

Applied Sciences
Electronics
Frontiers in Neuroscience
Frontiers in Cell and Developmental Biology
IEEE Access
IEEE Biomedical Circuits and Systems (BioCAS)
IEEE Engineering in Medicine and Biology Society (EMBC)
IEEE International Symposium on Circuits and Systems (ISCAS)
IEEE EMBS Conference on Neural Engineering (associate editor)
IEEE Signal Processing
Journal of Clinical Medicine
Journal of Neural Engineering
Journal of NeuroEngineering and Rehabilitation
Materials & Design
Medical & Biological Engineering & Computing
Myoelectric Controls Symposium
Nature Electronics
Nature Machine Intelligence
Neurosci
Neuroscience (Elsevier)
Science
Science Translational Medicine
Sensors
Symmetry