



Vanderbilt University
 Mechanical Engineering
 101 Olin Hall
 2400 Highland Ave
my.vanderbilt.edu/batlab

BIOMECHANICS & ASSISTIVE TECHNOLOGY

KARL.ZELIK@VANDERBILT.EDU

EDUCATION

- Ph.D. 2012 **University of Michigan**, Mechanical Engineering, Ann Arbor, Michigan, USA
 Dissertation Title: Passive Energy-Saving Mechanisms in Human Locomotion
 Advisor: Arthur Kuo
- M.S. 2007 **Washington University in St. Louis**, Biomedical Engineering, Missouri, USA
 B.S. 2006 **Washington University in St. Louis**, Biomedical Engineering, Missouri, USA

APPOINTMENTS

- 2014 – Present Assistant Professor of Mechanical Engineering
 Assistant Professor of Biomedical Engineering
 Assistant Professor of Physical Medicine & Rehabilitation
 Co-Director & Co-Founder, Center for Rehabilitation Engineering & Assistive Technology
 Vanderbilt University, Nashville, TN, USA
- 2018 – Present Co-Founder, Chief Scientific Officer & Vice President
 HeroWear, LLC, Nashville, TN, USA
- 2012 – 2014 Post-Doctoral Researcher, Whitaker International Scholar
 Laboratory of Neuromotor Physiology, IRCCS Santa Lucia Foundation, Rome, Italy
- 2008 – 2012 Research Assistant, NSF Graduate Research Fellow
 Human Biomechanics & Control Lab, University of Michigan, Ann Arbor, MI, USA
- 2006 Mechanical Development Engineer
 St. Jude Medical, Cardiac Rhythm Management Division, Sylmar, CA, USA
- 2005 – 2007 Research Assistant
 Cardiac Bioelectricity & Arrhythmia Center, Washington University in St. Louis, MO, USA
- 2004 Research Assistant
 Materials Science & Engineering Dept., Carnegie Mellon University, Pittsburgh, PA, USA

PUBLICATIONS (PEER-REVIEWED)

Underlined author indicates student or post-doc of Prof. Zelik

- In Review Lamers, E. P., Soltys, J. C., Scherpereel, K. L., Yang, A. J. and **Zelik, K. E.** Spring-Powered Exosuit Reduces Low Back Muscle Fatigue. *J Applied Ergonomics*. In Review.
- In Review King, S. T., Eveld, M. E., Martínez, A., **Zelik, K. E.** and Goldfarb, M. A novel system for introducing precisely-controlled, unanticipated gait perturbations for the study of stumble recovery. *J NeuroEngineering & Rehabilitation*. In Review.
- In Review Honert, E. C. and **Zelik, K. E.** Foot and shoe responsible for majority of soft tissue work in early stance of walking. *Human Movement Science*. In Review.

- In Review McDonald, K. A., Honert, E. C., McDonald, K. A. and Zelik, K. E. Unholey shoes: experimental considerations when estimating ankle joint complex power during walking and running. *J Biomechanics*. In Review.
- In Review Lamers, E. P., EVELD, M. E., and Zelik, K. E. Subject-Specific Responses to an Adaptive Ankle Prosthesis during Incline Walking. *Clinical Biomechanics*. In Review.
- In Review Yandell, M. B., Tacca, J. R., and Zelik, K. E. Design of an Ultra-Low Profile, Unpowered Ankle Exoskeleton That Fits Under Clothes: Overcoming Practical Barriers to Widespread Societal Adoption. *IEEE Transactions on NeuroEngineering & Rehabilitation*.
- In Press Matijevich E. S., Branbscombe, L. M., Scott, L. R., and Zelik, K. E. (2019). Ground reaction force metrics are not strongly correlated with tibia bone load during running across speeds and slopes: implications for science, sport and wearable tech. *PLOS ONE*.
- 2018 Honert, E. C., Bastas, G., and Zelik, K. E. (2018). Effect of toe joint stiffness and toe shape on walking biomechanics. *Bioinspiration & Biomimetics*.
- 2018 Bastas, G., Fleck, J. J., Peters, R. A. and **Zelik, K. E.** (2018). IMU-Based Gait Analysis in Lower Limb Prosthesis Users: Comparison of Step Demarcation Algorithms. *Gait & Posture*. 64: 30-37.
- 2018 Dewolf, A. H., Ivanenko Y. P., **Zelik, K. E.**, Lacquaniti, F. and Willems, P. A. (2018). Kinematic patterns while walking on a slope at different speeds. *J Applied Physiology*. <https://doi.org/10.1152/jappphysiol.01020.2017>
- 2018 **Zelik, K. E.** and Honert, E. C. (2018). Ankle and foot power in gait analysis: Implications for science, technology and clinical assessment. *J Biomech*. <https://doi.org/10.1016/j.jbiomech.2018.04.017>
- 2018 Matijevich, E. S., Branscombe, L. M. and Zelik, K. E. (2018). Ultrasound estimates of Achilles tendon exhibit unexpected shortening during ankle plantarflexion. *J Biomech*. 72, 200-206. <https://doi.org/10.1016/j.jbiomech.2018.03.013>
- 2017 Lamers, E. P., Yang., A. J. and Zelik, K. E. (2017). Feasibility of a biomechanically-assistive garment to reduce low back loading during leaning and lifting tasks. *IEEE Transactions on Biomedical Engineering*. <https://doi.org/10.1109/TBME.2017.2761455>
- 2017 **Zelik, K. E.** and Franz, J. R. (2017). It's positive to be negative: Achilles tendon work loops during human locomotion. *PLOS ONE*. 12(7): e0179976. <https://doi.org/10.1371/journal.pone.0179976>
- 2017 Yandell, M. B., Quinlivan, B. T., Popov, D., Walsh, C. J. and Zelik, K. E. (2017). Physical interface dynamics alter how robotic exosuits augment human movement: implications for optimizing wearable assistive devices. *J NeuroEngineering & Rehabilitation*. 14.1: 40.
- 2016 Honert, E. C. and Zelik, K. E. (2016). Inferring muscle-tendon unit kinetics from ankle power estimates during human walking: insights from a multiarticular EMG-driven model. *PLOS ONE*. 11.10: e0163169.
- 2016 **Zelik, K. E.** and Adamczyk, P. G. (2016). Invited Commentary: A unified perspective on ankle push-off in human walking. *J Experimental Biology*. 219.23: 3676-3683.
- 2016 Yandell, M. B. and Zelik, K. E. (2016). Preferred barefoot step frequency is influenced by factors beyond minimizing metabolic rate. *Nature Scientific Reports*, 6, Article number: 23243. doi:10.1038/srep23243

- 2015 Skinner, N. E., **Zelik, K. E.** and Kuo, A. D. (2015). Subjective valuation of cushioning in a human drop landing task as quantified by trade-offs in mechanical work. *J Biomech.* 48(10): 1887-1892. doi: 10.1016/j.jbiomech.2015.04.029
- 2015 **Zelik, K. E.**, Takahashi, K. Z. and Sawicki G. S. (2015). Six degree-of-freedom analysis of hip, knee, ankle and foot provides updated understanding of biomechanical work during human walking. *J Experimental Biology.* 218(6): 876-886. doi:10.1242/jeb.115451
- 2014 **Zelik, K. E.**, La Scaleia, V., Ivanenko, Y. P. and Lacquaniti, F. (2015). Coordination of intrinsic and extrinsic foot muscles during walking. *European J Applied Physiology.* 115(4): 691-701.
- 2014 Fu, X. Y., **Zelik, K. E.**, Board, W. J., Browning, R. C. and Kuo, A.D. (2015). Soft tissue deformations contribute to the mechanics of walking in obese adults. *MSSE.* 47(7): 1435-1443. doi: 10.1249/MSS.0000000000000554
- 2014 La Scaleia, V., Ivanenko, Y. P., **Zelik, K. E.** and Lacquaniti, F. (2014). Spinal motor outputs during step-to-step transitions of diverse human gaits. *Frontiers in Human Neuroscience*, 8: 305.
- 2014 **Zelik, K. E.**, La Scaleia, V., Ivanenko, Y. P. and Lacquaniti, F. (2014). Can modular strategies simplify neural control of multidirectional human locomotion? *J Neurophysiology*, 111(8): 1686-1702. doi: 10.1152/jn.00776.2013
- 2014 **Zelik, K. E.**, Huang, T. P., Adamczyk, P. G. and Kuo, A. D. (2014). The role of series ankle elasticity in bipedal walking. *J Theoretical Biology*, 346: 75-85.
- 2013 Lacquaniti, F., Ivanenko, Y. P., d'Avella, A., **Zelik, K. E.** and Zago M. (2013). Evolutionary and developmental modules. *Frontiers in Computational Neuroscience*, 7: 61. doi:10.3389/fncom.2013.00061
- 2012 **Zelik, K. E.** and Kuo, A. D. (2012). Mechanical work as an indirect measure of subjective costs influencing human movement. *PLOS ONE*, e31143. doi:10.1371/journal.pone.0031143
- 2012 Segal, A. D., **Zelik, K. E.**, Klute, G. K., Morgenroth, D. C., Hahn, M. E., Orendurff, M. S., Adamczyk, P. G., Collins, S. H., Kuo, A. D. and Czerniecki, J. M. (2012). The effects of controlled energy storage and return prototype prosthetic foot on transtibial amputee ambulation. *Human Movement Science*, 31(4): 918–931.
- 2011 **Zelik, K. E.**, Collins, S. H., Adamczyk, P. G., Segal, A. D., Klute, G. K., Morgenroth, D. C., Hahn, M. E., Orendurff, M. S., Czerniecki, J. M. and Kuo, A. D. (2011). Systematic variation of prosthetic foot spring affects center-of-mass mechanics and metabolic cost during walking. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 19(4): 411-419.
- 2011 Morgenroth, D. C., Segal, A. D., **Zelik, K. E.**, Czerniecki, J. M., Klute, G. K., Adamczyk, P. G., Orendurff, M. S., Hahn, M. E., Collins, S. H. and Kuo, A. D. (2011). The effect of prosthetic foot push-off on mechanical loading associated with knee osteoarthritis in lower extremity amputees. *Gait and Posture.* 34(4): 502–507.
- 2010 **Zelik, K. E.** and Kuo, A. D. (2010). Human walking isn't all hard work: evidence of soft tissue contributions to energy dissipation and return. *J Experimental Biology*, 213(Pt 24): 4257–4264.

- 2009 Tereshchenko, L. G., Faddis, M. N., Fetics, B. J., **Zelik, K. E.**, Efimov, I. R. and Berger, R. D. (2009). Transient local injury current in right ventricular electrogram after implantable cardioverter-defibrillator shock predicts heart failure progression. *J American College of Cardiology*, 54(9), 822-828.

CONFERENCE PROCEEDINGS (PEER-REVIEWED)

Underlined author indicates student or post-doc of Prof. Zelik

- 2018 Matijevich, E. S., Branscombe, L. M., Scott, L., and **Zelik, K. E.** Beyond Ground Reaction Forces: Towards a Wearable Device for Monitoring Bone Stress, Preventing Stress Fractures. American Congress of Rehabilitation Medicine, September 2018, Dallas, TX, USA.
- 2018 Lamers, E. P., Eveld, M. E., and **Zelik, K. E.** Effects of an Adaptive Prosthesis on Level and Sloped Walking for Transtibial Prosthesis Users. American Congress of Rehabilitation Medicine, September 2018, Dallas, TX, USA.
- 2018 Honert, E. C., Bastas, G, and **Zelik, K. E.** Isolating Effects of Toe and Foot Length on Bipedal Walking. American Society of Biomechanics Annual Conference, August 2018, Rochester, MN, USA.
- 2018 Matijevich, E. S., Branscombe, L. M., Scott, L., and **Zelik, K. E.** Beyond Ground Reaction Forces: Towards Wearable Tech to Monitor Bone Loading & Prevent Injury. American Society of Biomechanics Annual Conference, August 2018, Rochester, MN, USA.
- 2018 Lamers, E. P., Eveld, M. E., and **Zelik, K. E.** Effects of an Adaptive Ankle Prosthesis on Level and Sloped Walking. American Society of Biomechanics Annual Conference, August 2018, Rochester, MN, USA.
- 2018 Honert, E. C., and **Zelik, K. E.** Isolating Effects of Toe and Foot Length on Bipedal Walking. Dynamic Walking, May 2018, Pensacola, FL, USA.
- 2018 Yandell M. B., and **Zelik, K. E.** System Identification to Identify Human-Exoskeleton Interface Properties. Dynamic Walking, May 2018, Pensacola, FL, USA.
- 2018 **Zelik, K. E.** For the sake of our biological, prosthetic & robotic feet: why we need to rethink what we know about ankle power. Dynamic Walking, May 2018, Pensacola, FL, USA.
- 2017 Yandell, M. B., Quinlivan B. T., Popov, D., Walsh, C. and **Zelik, K. E.** Human-exosuit interfaces absorb and return energy, reshaping exosuit to human power flow. American Society of Biomechanics, August 2017, Boulder, Colorado, USA.
- 2017 Matijevich, E. S., Branscombe, L. M. and **Zelik, K. E.** Are ultrasound-based estimates of Achilles tendon kinematics consistent with the expected behavior of a passive elastic tissue in series with muscle? American Society of Biomechanics, August 2017, Boulder, Colorado, USA.
- 2017 Lamers, E. P., Yang, A. J. and **Zelik, K. E.** Biomechanically-assistive garment offloads low back during leaning and lifting. American Society of Biomechanics, August 2017, Boulder, Colorado, USA.
- 2017 Honert, E. C., Bastas, Gerasimos and **Zelik, K. E.** Quantifying effects of toe and ankle joint stiffness, and their interplay, on walking biomechanics using an adjustable prosthetic foot. American Society of Biomechanics, August 2017, Boulder, Colorado, USA.

- 2017 Franz, J. R. and **Zelik, K. E.** Too much work: revisiting ultrasound-based estimates of Achilles tendon energy storage and return. American Society of Biomechanics, August 2017, Boulder, Colorado, USA.
- 2017 **Zelik, K. E.** and Adamczyk, P. G. Resolving the debate: ankle push-off during human walking contributes to accelerating both the swing leg and the center-of-mass. American Society of Biomechanics, August 2017, Boulder, Colorado, USA.
- 2017 **Zelik, K. E.** Towards a cohesive, multi-scale understanding of movement biomechanics. International Society of Biomechanics, July 2017, Brisbane, Australia.
- 2017 Yandell, M. B., Quinlivan B. T., Popov, D., Walsh, C. and **Zelik, K. E.** Human-exosuit interfaces absorb and return energy, reshaping exosuit to human power flow. International Society of Biomechanics, July 2017, Brisbane, Australia.
- 2017 Matijevich, E. S., Branscombe, L. M. and **Zelik, K. E.** Are ultrasound-based estimates of Achilles tendon kinematics consistent with the expected behavior of a passive elastic tissue in series with muscle? International Society of Biomechanics, July 2017, Brisbane, Australia.
- 2017 Lamers, E. P., Yang, A. J. and **Zelik, K. E.** Biomechanically-assistive garment offloads low back during leaning and lifting. International Society of Biomechanics, July 2017, Brisbane, Australia.
- 2017 Honert, E. C., Bastas, Gerasimos and **Zelik, K. E.** Quantifying effects of toe and ankle joint stiffness, and their interplay, on walking biomechanics using an adjustable prosthetic foot. International Society of Biomechanics, July 2017, Brisbane, Australia.
- 2017 Franz, J. R. and **Zelik, K. E.** Too much work: revisiting ultrasound-based estimates of Achilles tendon energy storage and return. International Society of Biomechanics, July 2017, Brisbane, Australia.
- 2017 **Zelik, K. E.** and Adamczyk, P. G. Resolving the debate: ankle push-off during human walking contributes to accelerating both the swing leg and the center-of-mass. International Society of Biomechanics, July 2017, Brisbane, Australia.
- 2017 Pint, C., Muralidharan, N., Cohn, A. and **Zelik, K. E.** Highly efficient strain energy harvester through electrochemical cointercalation into few layered graphene. SPIE Conference, August 2017, San Diego, CA, USA.
- 2016 **Zelik, K. E.** Quantifying physical interface dynamics: human-prosthesis and human-exoskeleton power transmission. American Society of Biomechanics, August 2016, Raleigh, NC, USA. *Part of Symposium entitled "Quantifying Human Augmentation: State-of-the-Art & Future Challenges."*
- 2016 **Zelik, K. E.** From muscle-tendon to whole-body dynamics: towards a multi-scale empirical understanding of human biomechanics. American Society of Biomechanics, August 2016, Raleigh, NC, USA.
- 2016 Lamers, E. P. and **Zelik, K. E.** The importance of prosthetic ankle range-of-motion for ascending and descending slopes. American Society of Biomechanics, August 2016, Raleigh, NC, USA.
- 2016 Yandell, M. B. and **Zelik, K. E.** Transforming how we physically integrate exoskeletons with the human body to augment movement. American Society of Biomechanics, August 2016, Raleigh, NC, USA.

Curriculum Vitae

- 2016 Honert, E. C. and **Zelik, K. E.** Whole-body walking biomechanics with vs. without a toe joint: implications for prosthetic foot design. American Society of Biomechanics, August 2016, Raleigh, NC, USA.
- 2016 **Zelik, K. E.** From muscle-tendon to whole-body dynamics: towards a multi-scale empirical understanding of human movement biomechanics. International Society of Electrophysiology and Kinesiology Congress, July 2016, Chicago, IL, USA.
- 2016 **Zelik, K. E.** From muscle-tendon to whole-body dynamics: towards a multi-scale empirical understanding of human movement biomechanics. Biomechanics and Neural Control of Movement, June 2016, Sterling, OH, USA.
- 2016 Lamers, E. P. and Zelik, K. E. The importance of prosthetic ankle range-of-motion for ascending and descending slopes. Dynamic Walking Annual Meeting, June 2016, Holly, MI, USA.
- 2016 Yandell, M. B., Popov, D., Quinlivan, B. T., Walsh, C., O'Donnell, K. and Zelik, K. E. Systematic evaluation of human-exosuit physical interfaces. Dynamic Walking Annual Meeting, June 2016, Holly, MI, USA.
- 2016 Honert, E. C. and Zelik, K. E. Whole-body walking biomechanics with vs. without a toe joint: implications for prosthetic foot design. Dynamic Walking Annual Meeting, June 2016, Holly, MI, USA.
- 2016 Hong, T. S., **Zelik, K. E.** and Bastas, G. Towards objective tools to inform amputee clinical care: pelvic acceleration as a means of quantifying gait asymmetry. Gait & Clinical Movement Analysis Society Annual Conference, May 2016, Memphis, TN, USA.
- 2015 **Zelik, K. E.** Is the foot working with or against the ankle during human walking? American Society of Biomechanics, August 2015, Columbus, OH, USA.
- 2015 Yandell, M. B. and **Zelik, K. E.** Shod vs. barefoot walking: why do humans change their step frequency? American Society of Biomechanics, August 2015, Columbus, OH, USA.
- 2015 Honert, E. C. and **Zelik, K. E.** Foot dissipation during ankle push-off: human walking insights from a multiarticular EMG-driven musculoskeletal model. American Society of Biomechanics, August 2015, Columbus, OH, USA.
- 2015 **Zelik, K. E.** Is the foot working with or against the ankle during human walking? Dynamic Walking Annual Meeting, July 2015, Columbus, OH, USA.
- 2015 Yandell, M. B. and **Zelik, K. E.** Shod vs. barefoot walking: why do humans change their step frequency? Dynamic Walking Annual Meeting, July 2015, Columbus, OH, USA.
- 2015 Honert, E. C. and **Zelik, K. E.** Foot dissipation during ankle push-off: human walking insights from a multiarticular EMG-driven musculoskeletal model. Dynamic Walking Annual Meeting, July 2015, Columbus, OH, USA.
- 2014 **Zelik, K. E.**, Takahashi, K. Z. and Sawicki, G. S. Positively missing: reassessing work production in human gait and the implications for assistive technology. World Congress of Biomechanics, July 2014, Boston, MA, USA.
- 2014 **Zelik, K. E.**, La Scaleia, V., Ivanenko Y. P. and Lacquaniti F. Exploring modular strategies for coordinating muscles during multidirectional human locomotion. World Congress of Biomechanics, July 2014, Boston, MA, USA.

- 2014 **Zelik, K. E.**, Takahashi, K. Z. and Sawicki, G. S. Improved empirical estimates of work production in human walking motivate updated theory of step-to-step transition. Dynamic Walking Annual Meeting, June 2014, Zurich, Switzerland.
- 2014 **Zelik, K. E.**, La Scaleia, V., Ivanenko Y. P., Lacquaniti F. Exploring modular strategies for coordinating muscles during multidirectional human locomotion. Annual Meeting of Neural Control of Movement, April 2014, Amsterdam, The Netherlands.
- 2013 **Zelik, K. E.**, Ivanenko Y. P., Lacquaniti F. Can modular control coordinate different modes of locomotion while maintaining low dimensionality? Motor Control Summer School, July 2013, Ligonier, PA, USA.
- 2012 **Zelik, K. E.**, Huang T. W., Adamczyk, P. G. and Kuo, A. D. All spring, no fall, a simulation study on the benefits of ankle elasticity in walking. Dynamic Walking Annual Meeting, May 2012, Pensacola, FL, USA.
- 2012 Adamczyk, P. G., **Zelik, K. E.**, Huang, T. W. and Kuo, A. D. The agony of walking with long feet. GCMAS Meeting, May 2012, Grand Rapids, MI, USA.
- 2012 Huang, T. W., **Zelik, K. E.**, Adamczyk, P. G. and Kuo, A. D. Effect of foot length on walking with a compliant foot. GCMAS Meeting, May 2012, Grand Rapids, MI, USA.
- 2012 Fu, X. Y., **Zelik, K. E.**, Board, W., Browning, R. C. and Kuo, A. D. Soft tissue work during walking: An energy conserving mechanism for obese adults? Dynamic Walking Annual Meeting, May 2012, Pensacola, FL, USA.
- 2012 Skinner, N. E., **Zelik, K. E.** and Kuo, A. D. Why make more work for yourself? Factors beyond maximizing economy of movement. Dynamic Walking Annual Meeting, May 2012, Pensacola, FL, USA.
- 2011 **Zelik, K. E.** and Kuo, A. D. The distribution of work between active and passive tissues during landing from a jump. XXIII Congress of the International Society of Biomechanics, July 2011, Brussels, Belgium.
- 2011 Huang, T. W., Adamczyk P. G., **Zelik, K. E.** and Kuo, A. D. Influence of a compliant artificial ankle on the mechanics and energetics of human walking. Annual Meeting of the American Society of Biomechanics, August 2011, Long Beach, CA, USA.
- 2010 **Zelik, K. E.** and Kuo, A. D. Moving and Shaking: Soft tissue work in human walking. Annual Meeting of the American Society of Biomechanics, August 2010, Providence, RI, USA.
- 2010 Segal, A., **Zelik, K. E.**, Collins, S. H., Adamczyk, P. G., Klute, G., Hahn, M., Orendurff, M. S., Morgenroth D., Kuo, A. D. and Czerniecki J. Biomechanical effects of controlled energy storage and return prosthetic foot. Joint ESMAC GCMAS Meeting, May 2010, Miami, FL, USA.
- 2010 Morgenroth, D., **Zelik, K. E.**, Adamczyk, P. G., Klute, G., Segal A., Hahn M., Collins, S. H., Orendurff, M. S., Czerniecki, J. and Kuo, A. D. Knee osteoarthritis in lower extremity amputees: the effect of prosthetic foot type on the mechanical loading conditions associated with this common secondary disability. Association of Academic Physiatrists Annual Meeting, April 2010, Bonita Springs, FL, USA. **Awarded Outstanding Scientific Paper Presentation**
- 2010 **Zelik, K. E.** and Kuo, A. D. Non-rigid work in human walking: are hard collisions in fact soft? 2nd Congress of the International Foot and Ankle Biomechanics Community, September 2010, Seattle, WA, USA.

- 2010 **Zelik, K. E.** and Kuo, A. D. There is no W in walking, but there is in soft tissue. Dynamic Walking Annual Meeting, July 2010, Boston, MA, USA.
- 2010 Huang, T. W., **Zelik, K. E.** and Kuo, A. D. Influence of prosthetic stiffness on walking mechanics. Dynamic Walking Annual Meeting, July 2010, Boston, MA, USA.
- 2009 **Zelik, K. E.** and Kuo, A. D. Passive dynamic simulation of ankle elasticity during walking: Implications for prosthetic feet. Dynamic Walking Annual Meeting, June 2009, Vancouver, British Columbia, Canada.
- 2008 **Zelik, K. E.**, Collins, S. H. and Kuo, A. D. Effect of elastic preload on energy expenditure during walking: Implications for prosthetic feet. Dynamic Walking Annual Meeting, May 2008, Delft, The Netherlands.

PATENTS

- 2018 **Zelik, K. E.**, Scott, L., Matijevich, E. S. Wearable device to monitor musculoskeletal loading & provide biofeedback to prevent injuries. U.S. Provisional Patent 62/664,479, filed 2018.
- 2017 **Zelik, K. E.**, Yandell, M. B., Lamers, E. P. and Howser, D. Wearable assistance devices and methods of operations. Patent Application No. PCT/US18/14393, filed 2018.
- 2017 Yandell, M. B., **Zelik, K. E.**, et al. Friction clutch for ankle exoskeleton and other applications. U.S. Provisional Patent 62/489,268, filed 2017.
- 2015 **Zelik, K. E.** and Yandell, M. B. Exo-interface and application for lower-limb prostheses. US Provisional Patent 62/254,849, filed 2015.

GRANTS & SPONSORED RESEARCH FUNDING

- 2018 – 2021 **Principal Investigator.** NIH R01 Grant. CPS: Cyber-physically assistive clothing to reduce societal incidence of low back pain. Co-Investigators: Michael Goldfarb, Peter Volgyesi. \$930,000
- 2019 Sub-Contract Co-Investigator. NSF SBIR – Phase I. Multifunctional semi-powered ankle prosthesis. Principal Investigator: Brian Lawson. Co-Investigators: Michael Goldfarb. \$150,000
- 2018 Sub-Contract Co-Investigator. NIH SBIR – Phase I. Swing-Assist Knee Prosthesis for Increasing Mobility in Transfemoral Amputees. Principal Investigator: Brian Lawson. Co-Investigators: Michael Goldfarb, Harrison Bartlett. \$225,000
- 2017 – 2020 **Principal Investigator.** NIDILRR Field-Initiated Project. Toe joint articulation in passive and powered prostheses for enhancement of walking and long-term health. Co-Investigators: Michael Goldfarb, Gerasimos Bastas. \$600,000
- 2017 - 2022 Co-Investigator. NIH R01 Grant. Mitigating the effects of stumble perturbations in transfemoral amputees. Principal Investigator: Michael Goldfarb. \$1,600,000
- 2017 – 2020 **Principal Investigator.** NSF Disability & Rehabilitation Engineering Grant. Bio-Inspired ankle-knee coupling to enhance walking for individuals with transtibial amputation. Co-Investigators: Michael Goldfarb, Gerasimos Bastas, Steve Collins, Josh Caputo. \$330,000

Curriculum Vitae

- 2017 – 2018 Sub-Contract Principal Investigator. US Hypophosphatasia Foundation. Characterizing Functional Performance in Adolescents & Adults with Hypophosphatasia. PI: Kathryn Dahir, VUMC. \$25,000
- 2017 **Principal Investigator.** Ossur, Industry Sponsored Research.
- 2016 – 2017 **Principal Investigator.** SEC Visiting Faculty Travel Grant. \$900
- 2016 – 2019 **Principal Investigator.** NSF General & Age-Related Disabilities Engineering Grant. Leveraging Toe Dynamics to Improve Prosthetic Feet and Amputee Mobility. Co-Investigator: Gerasimos Bastas, Vanderbilt PM&R. \$295,500
- 2016 **Principal Investigator.** New Balance Footwear Research Award. Personalizing shoe properties to optimize running economy for each individual.
- 2016 – 2018 **Principal Investigator.** Vanderbilt University Discovery Grant. No Holding Back: A Novel, Wearable Exoskeleton to Reduce Low Back Pain and Injury Risk. Co-Investigator: Aaron Yang, Vanderbilt PM&R. \$100,000
- 2016 – 2017 **Principal Investigator.** NIH Interdisciplinary Rehabilitation Engineering K12 Career Development Award. Translating Biomechanical Insights into Mobility-Enhancing Assistive Technology. \$270,000
- 2015 **Principal Investigator.** Fillauer LLC, Industry Sponsored Research. Effect of prosthetic ankle range-of-motion on amputee gait.
- 2012 – 2014 **Principal Investigator.** Whitaker International Post-Doctoral Fellowship. EMG-controlled orthosis for walk empowering and entraining locomotor circuits of spinal cord injury patients. Collaborators: Yuri Ivanenko & Francesco Lacquaniti, Santa Lucia Foundation, Rome, Italy. \$100,000
- 2012 – 2014 **Principal Investigator.** National Science Foundation International Post-Doctoral Research Fellowship. Central pattern generator control of powered prosthetic feet. Collaborator: Auke Ijspeert, Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland. \$150,000 [declined]
- 2008 – 2011 National Science Foundation Graduate Research Fellowship. Development of advanced motor control prostheses using implantable myoelectric sensors. Collaborators: Arthur Kuo & Daniel Ferris, University of Michigan, Ann Arbor, MI, USA. \$120,000 [stipend/tuition]

HONORS, AWARDS & SCHOLARSHIPS

- 2018 Nashville Emerging Leader Award (Category: Architecture, Engineering & Construction)
- 2017 International Society of Biomechanics Promising Scientist Award
- 2017 American Society of Biomechanics Young Scientist Award (Post-Doctoral)
- 2017 Littlejohn Faculty Fellow, Vanderbilt University
- 2008 – 2012 Rackham Merit Fellowship/Rackham Engineering Award. University of Michigan, Ann Arbor, MI, USA.

Curriculum Vitae

- 2008 – 2012 Mechanical Engineering Departmental Fellowship. University of Michigan, Ann Arbor, MI, USA.
- 2002 – 2006 John B. Ervin Scholarship. Washington University in St. Louis, MO, USA.
- 2002 – 2006 Enterprise Rent-A-Car Scholarship. Washington University in St. Louis, MO, USA.

INVITED SEMINARS

- 2018 Design of Medical Devices Conference. From biomechanics to bionics: how scientific insights unleash our imagination and inspire new design solutions for assistive technologies. April 2018.
- 2018 Wearable Robotics Association Conference. From biomechanics to bionics: how scientific insights can unleash our imagination, inspire new tech & broaden the use of wearable robots in society. March 2018.
- 2017 Shirley Ryan AbilityLab. Exoskeletons, prostheses & smart clothing: Biomechanical challenges to maximizing human health & performance. November 2017.
- 2017 University of Tennessee. The rise of wearable exoskeletons & prostheses: biomechanical challenges to maximizing human health & performance. May 2017.
- 2016 Northwestern University Movement & Rehabilitation Sciences Training Day. Maximizing Human Performance via Wearable Exoskeletons and Prostheses. August 2016.
- 2016 Northwestern University Prosthetics-Orthotics Center. Translating biomechanical insights into mobility-enhancing assistive technology. July 2016.
- 2016 U.S. Army Research Laboratory, Aberdeen Proving Ground, MD, USA. Translating biomechanical insights into mobility-enhancing assistive technology. May 2016.
- 2016 University of Virginia, Charlottesville, VA, USA. Translating biomechanical insights into mobility-enhancing assistive technology. May 2016.
- 2016 University of Texas, Austin, TX, USA. Translating biomechanical insights into mobility-enhancing assistive technology. April 2016.
- 2016 Vanderbilt University Biomedical Engineering Seminar, Nashville, TN, USA. Translating biomechanical insights into mobility-enhancing assistive technology. April 2016.
- 2016 Harvard University, Cambridge, MA, USA. Translating biomechanical insights into mobility-enhancing assistive technology. March 2016.
- 2016 Vanderbilt Physical Medicine & Rehabilitation Grand Rounds, Nashville, TN, USA. Translating biomechanical insights into mobility-enhancing technology. February 2016.
- 2015 Vanderbilt Initiative in Surgery and Engineering, Nashville, TN, USA. Using human motion analysis to improve surgical outcomes: recent progress and future opportunities. March 2015.
- 2014 Annual Whitaker Enrichment Seminar, Rome, Italy. Biomechanical work production in human gait and the implications for assistive technology. March 2014.
- 2014 University of Delaware, Newark, DE, USA. Ankle-foot function: from neuromechanical principles to prosthetic technology. February 2014.

Curriculum Vitae

- 2014 University of Maryland, College Park, MD, USA. Ankle-foot function: from neuromechanical principles to prosthetic technology. February 2014.
- 2014 Carnegie Mellon University, Pittsburgh, PA, USA. Ankle-foot function: from neuromechanical principles to prosthetic technology. February 2014.
- 2014 Vanderbilt University, Nashville, TN, USA. Ankle-foot function: from neuromechanical principles to prosthetic technology. January 2014.
- 2013 Foro Italico University of Rome, Italy. The energy-saving benefits of the Achilles tendon during walking, how humans seem to screw it up, and what it means for improving prosthetic technology. December 2013.
- 2013 Catholic University of Louvain, Louvain-La-Neuve, Belgium. The energy-saving benefits of the Achilles tendon during walking, and how humans seem to screw it up. September 2013.
- 2012 Santa Lucia Foundation, Rome, Italy. Energy-saving mechanisms in human locomotion. January 2012.
- 2011 The Biorobotics Institute, Scuola Superiore Santa'Anna, Pisa, Italy. The economy of human movement: prosthetic feet and the distribution of work. July 2011.
- 2011 Department of Engineering, University of Cambridge, England. The cost of comfort: what's it worth to avoid pain? July 2011.
- 2011 Royal Veterinary College, University of London, England. The cost of comfort: what's it worth to avoid pain? July 2011.
- 2011 Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland. The economy of human movement: prosthetic feet and the distribution of work. June 2011.
- 2010 University of Michigan Tau Beta Pi Martin Luther King Jr. Symposium, Ann Arbor, MI, USA. Accessibility: Opening technology to all. February 2010.
- 2009 University of Michigan Engineering Graduate Symposium, Ann Arbor, MI, USA. Designing a prosthetic foot to restore ankle function. November 2009. **Awarded Best Oral Presentation on Biomedical Technology**

TEACHING & MENTORING

GRADUATE

- 2018 – Instructor, Advanced Dynamics (ME4280/ME5280, Vanderbilt University)
- 2016 – Instructor, Biomechanics of Human Movement (ME8391, Vanderbilt University)

PhD Students Mentored

- 2018 – Rachel Teater (Vanderbilt University) – robotic ankle-toe prosthesis
- 2018 – David Ziemnicki (Vanderbilt University) – artificial gastrocnemius
- 2017 – Maura Eveld (Vanderbilt University) – mitigating stumbles by prosthetic users
- 2017 – Shane King (Vanderbilt University) – mitigating stumbles by prosthetic users
- 2016 – Emily Matijevich (Vanderbilt University) – muscle-tendon dynamics
- 2015 – Erik Lamers (Vanderbilt University) – lower-limb prosthetics & orthotics
- 2014 – Eric Honert (Vanderbilt University) – foot and ankle biomechanics
- 2014 – Matthew Yandell (Vanderbilt University) – human-device physical interface dynamics
- 2012 – 2014 Giovanna Catavittello (Univ. of Rome Tor Vergata) – animal coordination of locomotion
- 2012 – 2014 Valentina La Scaleia (Univ. of Rome Tor Vergata) – spinal motor outputs during gait

Curriculum Vitae

2011 – 2014 Xiao-Yu Fu (University of Michigan) – soft tissue contributions to obese gait
2010 – 2014 Tzu-Wei Huang (University of Michigan) – ankle/foot elasticity during walking
2009 – 2013 Nathaniel Skinner (University of Michigan) – jump landing kinetics

Mentored PhD Students Who Won Grants/Fellowships

2016 Erik Lamers (NSF GRF) – human-prosthesis interface dynamics
2009 Jessica Deneweth (NSF GRF) - impact of ACL graft stiffness on knee stress
2009 Jeremy Brown (NSF GRF) - neuroprosthetic interface with haptic feedback

Member of PhD Committee

2018 Matthew Yandell (Chair: Goldfarb)
2018 Eric Honert (Chair: Zelik)
2018 Harrison Bartlett (Chair: Goldfarb)
2017 Andrew Ekelem (Chair: Goldfarb)
2017 Ben Gasser (Chair: Goldfarb)
2017 Nima Sarli (Chair: Simaan)
2016 Amanda Huff Shultz (Chair: Goldfarb)
2016 Rich Hendrick (Chair: Webster)
2015 Marco Beccani (Chair: Valdastri)
2015 Christian Di Natali (Chair: Valdastri)
2015 Haoran Yu (Chair: Simaan)

MS or ME Students Mentored

2017-2018 Lauren Branscombe (Vanderbilt University) – wearable tech to reduce bone stress injury
2016 – 2017 Taylor Larsen (Vanderbilt University) – powered prosthetic ankle control
2015 – 2016 Zach Korman (Vanderbilt University) – effect of shoe properties on locomotion

Member of MS or ME Committee

2017 Taylor Larsen (Chair: Zelik)
2016 Elissa Ledoux (Chair: Goldfarb)
2016 Zhangshi Liu (Chair: Simaan)
2016 Zach Korman (Chair: Zelik)

MD Students Mentored

2015 Tracey Hong (Vanderbilt University) – clinical assessment tools to improve amputee care

UNDERGRADUATE

2014 – 2017 Instructor, Introduction to Mechanical Engineering Design (ME2160, Vanderbilt University)

2009 – 2011 Academic Tutor for Multicultural Engineering Programs Office (University of Michigan)

Undergraduate Students Mentored

2018 – Sara Tsai (Vanderbilt) – artificial gastrocnemius
2018 – Olivia Cook (Vanderbilt) – effects of toe and ankle joint stiffness on prosthetic feet
2018 – Kendall Derry (Vanderbilt) – quantifying and optimizing running shoe performance
2018 – Jacob Rogatinsky (Vanderbilt) – effects of toe and ankle joint stiffness on prosthetic feet
2017 Justin Huang (Ohio State) – adaptive human-exoskeleton interface
2017 – 2018 Juliana Soltys (Vanderbilt) – biomechanics of wearable assistive devices
2017 Steven Sherk (Vanderbilt) – effects of toe and ankle joint stiffness on prosthetic feet
2017 Ethan Jones (Vanderbilt) – ultrasound imaging of muscle-tendon dynamics
2017 Mason Hall (Vanderbilt) – instrumented stairs and prosthetic feet
2017 – Keaton Scherpereel (Vanderbilt) – biomechanically-assistive clothing to offload low back
2017 – 2018 Josh Tacca (Vanderbilt) – human-exoskeleton interface dynamics
2016 – 2018 Tristan Gilbert (Vanderbilt) – portable electromyography system for sensing and control
2016 Ellen Turner (Grove City College) – ultrasound imaging of muscle-tendon dynamics
2016 Eric Speer (Vanderbilt University) – human-exoskeleton integration

Curriculum Vitae

2016 – 2018 Lauren Branscombe (Vanderbilt University) – pet prosthetics; muscle-tendon dynamics
2016 – 2017 Taylor Larsen (Vanderbilt University) – human-exoskeleton integration
2016 – 2018 Joshua Fleck (Vanderbilt University) – clinical tools for quantifying amputee gait
2016 Brendan Wilder (Vanderbilt University) – ultrasound imaging of muscle-tendon dynamics
2015 – 2016 Jacqueline Cabello (Vanderbilt University) – real-time biofeedback for gait studies
2015 – 2016 Dustin Howser (Vanderbilt University) – wearable sit-to-stand exoskeleton
2015 Eric Diaz (Iowa State University) – canine prosthetic limb design
2015 – 2016 Nicole Steiner (Vanderbilt University) – ultrasound imaging of muscle-tendon dynamics
2015 – 2016 Zach Korman (Vanderbilt University) – shoe cushioning biomechanics
2008 – 2012 Adrian Choy, Henry Xu, Justin Sung, Wisit Jirattigalachote, Yiqi Gao, Megan Moore, Emmanuel Gansallo, Stephen Thompson, Steven Upplegger (University of Michigan)

Mentored Undergraduate Students Who Won Research Scholarships/Fellowships

2017 Lauren Branscombe (Goldwater Scholar) – muscle-tendon dynamics, wearable tech.
2017 Joshua Fleck (Goldwater Scholar, Vanderbilt Littlejohn Scholar) – robotic prostheses
2015 Nicole Steiner (VU Summer Research Fellowship) – muscle ultrasound

Member of BS Honors Thesis Committee

2016 Luke Moretti (Chair: Goldfarb)

SECONDARY

2016 – National Biomechanics Day Outreach Event for Local High School Students
2015 – Lab Tours for Local High & Middle School Students (Antioch High School, School for Science & Math at Vanderbilt High School, Art2STEM program for Middle School Girls)
2012 Invited Speaker for Upper St. Clair High School International Education Week
2008 – 2012 Laboratory Guide for Office of Outreach Education & Ypsilanti High School
Undergraduate Students Mentored
2018 – Leila Capozzi (SSMV HS) – ankle-toe biomechanics & prosthetics
2017 Eli Renuka (Franklin HS) – bionic boots
2017 Frank Chytil (Father Ryan HS) – bionic boots

PRIMARY

2009 Instructor for “A World in Motion”: introducing elementary students to engineering

INTERNAL SERVICE

2018 Liaison for University Committee to Enhance Faculty Voices in Public Sphere
2018 Vanderbilt Board of Trustees Strategic Planning Session on Technology Transfer
2017 VUSE Strategic Planning Working Group: Rehabilitation Engineering
2017 Vanderbilt Board of Trustees Strategic Planning Session on STEM
2017 Department Coordinator for Academic Pathways Postdoctoral Fellows Program
2017 Family Weekend Faculty Lecture
2017 – Discovery Grant Review Committee, University-Wide Faculty Funding/Resource Fair Rep

Curriculum Vitae

- 2017 – Departmental Representative for Academic Pathways Initiative for Diversity
- 2016 – 2017 Graduate Faculty Delegate Assembly
- 2016 – Mechanical Engineering Graduate Committee
- 2015 – Mechanical Engineering Faculty Search Committee
- 2014 – VU-EDGE (Vanderbilt Diversity Recruitment Event) Departmental Representative

EXTERNAL SERVICE & OUTREACH

- 2018 Session Co-Chair on Assistive Technology, International Society of Biomechanics Conf.
- 2018 Session Co-Chair on Ankle Rehab Tools/Methods, World Congress of Biomechanics
- 2018 Session Co-Chair on Braces & Engineering, Mid-South Biomechanics Conference
- 2017 Session Co-Chair on Exoskeletons, American Society of Biomechanics Conference
- 2017 NIDILRR Grant Review Panel
- 2017 National Biomechanics Day, Member of National Organizing Committee
- 2016 Session Co-Chair on Prosthetics, American Society of Biomechanics Annual Conference
- 2016 Symposium Organizer, "Quantifying Human Augmentation: State-of-the-Art and Future Challenges," American Society of Biomechanics Annual Conference
- 2016 Session Co-Chair on Neuromechanics, International Society of Electrophysiology & Kinesiology Congress
- 2016 National Biomechanics Day, Organized Vanderbilt Lab Tours & Research Open House
- 2015 Session Co-Chair on Prosthetics, American Society of Biomechanics Annual Conference
- 2015 Session Co-Chair on Modeling, American Society of Biomechanics Annual Conference
- 2015 – 2016 Scientific Advisory Board, International Society of Electrophysiol. & Kinesiology Congress
- 2015 – 2016 NIH Grant Review Panel
- 2015 NSF Grant Review Panel
- 2015 Scientific Committee, International Conference on Rehabilitation Robotics
- 2011 – 2014 da Vinci Awards® Committee Member & Creator of the *Student of da Vinci Award*
- 2011 – 2012 Interdisciplinary Liaison, Laboratory Guide for School of Art & Design (Univ. of Michigan)
- 2010 – 2011 Member of Project Gettis Committee on Diversity, Recruitment and Retention
- 2009 – 2011 Planning Committee Member for Prospective Student Visits (Univ. of Michigan)

Curriculum Vitae

- 2009 – 2010 Outreach Recruiter & College of Engineering Representative at National Society of Black Engineers (NSBE) Convention, Arizona State University (Society of Women Engineers) and Washington University in St. Louis (NSBE)
- 2008 University of Michigan “Tech Day” Volunteer

POPULAR PRESS

- 2017 USA Today, CNN, US News & World Report, Smithsonian, Men’s Health, Daily Mail, WebMD, Now This, Futurity, Good, Digital Trends
- 2015 ABC, CBS, FOX news in Nashville, Chicago, Kansas City, Los Angeles, etc. (dog prosthetics)
- 2014 – 2015 Vanderbilt myVU Magazine, Vanderbilt School of Engineering Annual Solutions Publication, Inside JEB feature article (new biomechanical analysis)
- 2010 Popular Science, New Scientist, Engadget, CNET, Gizmag, COSMOS, The O&P Edge, Out of the Blue television show (energy-recycling prosthetic foot)

OTHER PROFESSIONAL EXPERIENCE

- 2016 Expert Witness – Biomechanical Engineering

JOURNAL REFEREE

ASME Journal of Medical Devices, Bioinspiration & Biomimetics, Frontiers in Computational Neuroscience, Gait & Posture, IEEE Transactions on Haptics, IEEE Neural Systems and Rehabilitation Engineering, IEEE Transactions on Robotics and Automation, Journal of Biomechanics, Journal of Experimental Biology, Journal of NeuroEngineering and Rehabilitation, Nature Scientific Reports

CURRENT/RECENT AFFILIATIONS

American Society of Biomechanics
Footwear Biomechanics Group
International Ankle and Foot Biomechanics Community
International Consortium on Rehabilitation Robotics
International Society of Biomechanics
International Society of Electrophysiology and Kinesiology
International Society of Posture and Gait Research
Wearable Robotics Association
ASTM International

CURRENT/RECENT COLLABORATORS

Peter G. Adamczyk, Asst. Professor, Department of Mechanical Engineering, University of Wisconsin
Gerasimos Bastas, Asst. Professor, Department of Physical Medicine & Rehabilitation, Vanderbilt University
Steven H. Collins, Assoc. Professor, Department of Mechanical Engineering, Carnegie Mellon University
Jason Franz, Asst. Prof., Department of Biomedical Engineering, UNC Chapel Hill & NC State
Michael Goldfarb, Professor, Department of Mechanical Engineering, Vanderbilt University
Yuri P. Ivanenko, Senior Research Scientist, Santa Lucia Foundation, Rome, Italy
Francesco Lacquaniti, Professor, University of Rome Tor Vergata and Santa Lucia Foundation, Rome, Italy
Gregory S. Sawicki, Assoc. Professor, Dept. of Biomedical Engineering, NC State & UNC Chapel Hill
Kota Z. Takahashi, Asst. Professor, Dept. of Health Physical Education & Recreation, Univ. of Nebraska
Conor Walsh, Assoc. Professor, School of Engineering & Applied Sciences, Harvard University
Patrick A. Willems, Professor, Institute of Neuroscience, Catholic University of Louvain, Belgium
Aaron Yang, Asst. Professor, Department of Physical Medicine & Rehabilitation, Vanderbilt University