LUIS G. VARGAS, Ph.D.
PROFESSIONAL BIOGRAPHICAL OUTLINE

BACKGROUND

Dr. Vargas received his Bachelor of Science in Mechanical Engineering from the University of North Carolina at Charlotte. He went on to obtain a Doctorate of Philosophy in Biomedical Engineering from the Joint Department of Biomedical Engineering at The University of North Carolina at Chapel Hill and North Carolina State University. Dr. Vargas' scientific research focused on the understanding of the biomechanics of human movement and their involved neurological signals via electrical peripheral nerve stimulation, 3-D motion analysis, and computational modelling. During this process, volitional and electrically-evoked motor and/or sensory responses were quantified to assist in improving the rehabilitative outcomes of individuals with physical and neurological disorders. Dr. Vargas' research has also included the development of various novel technologies to measure, assess, and assist individuals with neuromuscular impairments. This research involved human subject testing with individuals across various clinical populations.

In addition to his experience in the field of biomechanics, Dr. Vargas has training in accident reconstruction and continues to study injury biomechanics through various scientific test programs, including automotive sled and crash testing, motor vehicle component testing, human injury prevention analysis via optimization of movement patterns, and studies that implement advanced biomechanical tools such as instrumented anthropomorphic test devices to evaluate the human body's responses to various loading scenarios.

Dr. Vargas' academic and professional experience combines knowledge in biomechanical engineering, human subject kinematic and kinetic testing, human anatomy and physiology, automotive engineering, robotics, and neuromuscular prosthetic control and design. Currently, he specializes in the study of the kinematics and kinetics of the human body as it pertains to quantifying the severity and impact mechanics of vehicular collisions, slip/trip and fall events, and other unique loading paradigms, as well as the injury mechanisms and injury tolerances associated with these adverse events.

SUMMARY OF EXPERIENCE

- Combines his expertise in biomechanics/biomedical engineering, physics, and anatomy to analyze human kinematics, kinetics, and injury causation during various unique loading paradigms.
- Utilizes anthropomorphic test devices (crash test dummies) to quantify the effects of external loading on the human body under blunt impact and automotive testing scenarios.
- Employs peer-reviewed and generally-accepted engineering techniques/principles to assess the severity of an event, and its imposed forces and acceleration in order to determine the presence or absence of various injury mechanisms.
- Evaluates an individual's kinematics during volitional movement and the external loading of various sport-centered safety equipment to improve their performance and mitigate adverse loading conditions.
- Investigated hand and arm kinematics with and without external perturbations to understand the neural responses involved in voluntary and augmented muscle activation using 3-D motion analysis, kinematic and kinetic testing, electromyography, and computational modeling.
- Developed various techniques and technologies to overcome motor and sensory deficiencies in individuals with neuromuscular disorders.

AREAS OF SPECIALTY

- Injury Causation Biomechanics
- Vehicle Dynamics Analysis
- Vehicular Accident Reconstruction
- Scientific Testing Design, Setup, and Execution
- Human Kinematic Analysis and Testing
- Human Injury Tolerance & Failure Analysis
- EDR (Black Box) Imaging and Analysis
- Neuromuscular Disorder Investigations
- Neural Prostheses Design

EDUCATION

- Ph.D. in Biomedical Engineering, The Joint Department of Biomedical Engineering at The University of North Carolina at Chapel Hill and North Carolina State University, December 2021
  - Research Area: Rehabilitation Engineering
  - Dissertation Title: A Closed-Loop Investigation for Dexterous Control of a Prosthetic Hand
- Graduate Certificate in Business Fundamentals, The University of North Carolina at Chapel Hill, December 2020
- Bachelor of Science in Mechanical Engineering, The University of North Carolina at Charlotte, May 2017
  - Concentration in Biomedical Engineering
  - Minors in Mathematics and Psychology

CERTIFICATIONS

- Certified BOSCH Crash Data Retrieval (CDR) Technician, May 2022

PROFESSIONAL EXPERIENCE

January 2022 – Present | ARCCA, LLC | Senior Biomechanist

- Utilizes peer-reviewed and generally accepted techniques to determine the presence or absence of an injury mechanism through investigation of an event's severity, an individual's response, and the direction and magnitude of the forces applied
- Uses biomedical engineering principles to analyze forensic evidence, e.g. via vehicular/site inspections, to reconstruct dynamic events, such as a motor vehicle collision, a sporting injury, or a slip, trip, fall event
- Utilizes anthropomorphic test devices (ATDs) and other test equipment to execute unique test programs, such as impacting testing and component testing, to analyze the forces of an event and/or how the human body responds to various adverse loading conditions
- Applies knowledge of anatomy, physics, and biomechanical principles to perform injury causation analysis based on an event's associated inertial and impact forces and an individual's unique biological attributes and responses

August 2017 – December 2021 | UNC Chapel Hill and NC State | Research Assistant

- Designed and developed a novel neural stimulation platform that non-invasively interfaces with a person's peripheral nervous system to overcome sensory and motor disparities observed in post-stroke and amputee populations
- Evaluated human kinematics and kinetics during volitional and electrically-evoked movement patterns to characterize the responses evoked in individuals with and without neurological disorders

- Conducted human kinematics and kinematic studies to evaluate rehabilitation outcomes in individuals with neurological disorders during continued neural stimulation use
- Designed and developed circuits and devices to record forces and kinematic movements produced by biological and robotic upper extremities
- Performed signal processing on high-density and multi-channel electromyography (EMG) to characterize the motor response evoked by neural stimulation and discriminate intent of voluntarily-activated muscles
- Developed open- and closed-loop control algorithms for intuitively controlling various multi-degrees of freedom prosthetic devices

May 2016 – August 2016 | UNC Charlotte | Undergraduate Research Assistant

- Developed and organized experiments to investigate gait patterns across human participants
- Utilized wearable sensors and motion capture systems in order to classify movement patterns associated with an assortment of activities of daily living
- Investigated how gait patterns are altered and/or differ for individuals with motor deficits in order to develop a wearable means to identify adverse health conditions

August 2017 – December 2021 | UNC Chapel Hill and NC State | Undergraduate Research Mentor

- Supervised various undergraduate and high school students, each with unique projects that involved design, technology development, data processing, or coding
- Provided academic and research support

August 2016 – May 2017 | UNC Charlotte | Teaching Assistant

- Tutored and provided support in several mechanical engineering courses, such as Solids, Heat Transfer, and various design-centered courses
- Lead the coordination of grading and proctoring of exams with a team of 2 fellow assistants

PROFESSIONAL AFFILIATIONS

- Biomedical Engineering Society (BMES)
- Society of Neuroscience (SfN)
- IEEE Robotics and Automation Society (RAS)
- IEEE Engineering in Medicine and Biology Society (EMBS)
- Society of Automotive Engineers (SAE)
- The Latinx in Biomechanix (LiB) organization
- Peer Reviewer for Journal Articles in:
    - IEEE Transactions on Human-Machine Systems
    - IEEE Transactions on Neural Systems & Rehabilitation Engineering
    - IEEE Sensors Journal
    - Journal of NeuroEngineering and Rehabilitation
    - IEEE The Engineering in Medicine and Biology Conference
    - Frontier in Neuroscience

PEER-REVIEWED JOURNAL PUBLICATIONS

Meng, L., **Vargas, L.**, Kamper, D.G., and Hu, X., "Real-Time Myoelectric-Based Neural-Drive Decoding for Concurrent and Continuous Control of Robotic Finger Forces," *IEEE Transactions on Human-Machine Systems*, February 2025.

Coltman, S. K., **Vargas, L.**, and X. Hu, "Spatial-Temporal Dynamics of Evoked Action in Finger Flexors: Implications for Optimizing Transcutaneous Nerve Stimulation," *IEEE Transactions on Biomedical Engineering*, December 2024.

Jiahao, F., **Vargas, L.**, Kamper, D.G., and Hu, X., "Robust Neural Decoding for Dexterous Control of Robotic Hand Kinematics," *Computers in Biology and Medicine*, vol. 162, August 2023.

Vargas, L., Musselman, E.D., Grill, W.M., and Hu, X., "Asynchronous Axonal Firing Patterns Evoked via Continuous Subthreshold Kilohertz Stimulation," *Journal of Neural Engineering*, vol. 20, no. 2, March 2023.

Vargas, L., Huang, H., Zhu, Y., Kamper, D.G., and Hu, X., "Resembled Tactile Feedback for Object Recognition Using a Prosthetic Hand," *IEEE Robotics and Automation Letters*, vol. 7, no. 4, pp. 10977-10984, October 2022.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Evoked Tactile Feedback and Control Scheme on Functional Utility of Prosthetic Hand," *IEEE Robotics and Automation Letters*, vol. 7, no. 2, pp. 1308-1315, April 2022.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Object Recognition via Evoked Sensory Feedback during Control of a Prosthetic Hand," *IEEE Robotics and Automation Letters*, vol. 7, no. 1, pp. 207-214, January 2022.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Closed-Loop Control of a Prosthetic Hand via Evoked Proprioceptive Information," *Journal of Neural Engineering*, vol. 18, no. 6, December 2021.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Static and Dynamic Proprioceptive Recognition through Vibrotactile Stimulation," *Journal of Neural Engineering*, vol. 18, no. 4, July 2021.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Object Shape and Surface Topology Recognition Using Tactile Feedback Evoked through Transcutaneous Nerve Stimulation," *IEEE Transactions on Haptics*, vol. 13, no. 1, pp. 152-158, March 2020.

Pan, L, **Vargas, L**., Fleming, A., Hu, X., Zhu, Y., and Huang, H., "Evoking haptic sensations in the foot through high-density transcutaneous electrical nerve stimulations," *Journal of Neural Engineering*, vol. 17, no. 3, p. 036020, Jun. 2020.

Vargas, L., Shin, H., Huang, H., Zhu, Y., and Hu, X., "Object stiffness recognition using haptic feedback delivered through transcutaneous proximal nerve stimulation," *Journal of Neural Engineering,* vol. 17, no. 1, p. 016002, Dec. 2019.

Vargas, L., Whitehouse, G., Huang, H., Zhu, Y. and Hu, X., "Evoked Haptic Sensation in the Hand with Concurrent Non-Invasive Nerve Stimulation," *IEEE Transactions on Biomedical Engineering*, vol. 66, no. 10, pp. 2761-2767, Oct. 2019.

Yao, S., **Vargas, L.**, Hu, X. and Zhu Y., "A Novel Finger Kinematic Tracking Method Based on Skin-Like Wearable Strain Sensors," *IEEE Sensors Journal*, vol. 18, no. 7, pp. 3010-3015, April 2018. [Co-First Author]

CONFERENCE PROCEEDINGS (PEER REVIEWED)

Prabhu, N., **Vargas, L.**, and Hu, X., "Quantitative Characterization of Haptic Sensory Adaptation Evoked through Transcutaneous Nerve Stimulation," *Proceedings of the 2022 IEEE 3rd International Conference on Human-Machine Systems (ICHMS)*, Nov. 17-19, 2022.

Vargas, L., Baratta, J., and Hu, X., "Distribution of M-Wave and H-Reflex in Hand Muscles Evoked via Transcutaneous Nerve Stimulation: A Preliminary Report," *Proceedings of the 2021 43rd Annual*

International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC), Oct. 31- Nov. 4, 2021.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Perception of Static Position and Kinesthesia of the Finger using Vibratory Stimulation," *Proceedings of the 2021 10th International IEEE/EMBS Conference on Neural Engineering*, May 4-6, 2021.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Stiffness Perception using Transcutaneous Electrical Stimulation during Active and Passive Prosthetic Control," *Proceedings of the 2020 42nd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*, July 20-24, 2020.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Object Shape and Surface Topology Recognition Using Tactile Feedback Evoked through Transcutaneous Nerve Stimulation," *Proceedings of the 2020 IEEE Haptics Symposium*, March 28-31, 2020.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Merged Haptic Sensation in the Hand during Concurrent Non-Invasive Proximal Nerve Stimulation," *Proceedings of the 2018 40th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*, July 17-21, 2018.

REFEREED CONFERENCE ABSTRACTS WITHOUT PROCEEDINGS

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Functional Interaction of Objects During Myoelectric Control of a Prosthetic Hand with Non-Invasive Somatotopic Tactile Feedback," *Proceedings of the 2021 IEEE International Conference on Rehabilitation Robotics*, Sept. 23-25, 2021.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Object Property Recognition during Closed-loop Control of a Prosthetic Hand with Elicited Tactile Feedback through Transcutaneous Nerve Stimulation," *Proceedings of the 2021 Society of Neuroscience*, Nov. 13-16, 2021.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Eliciting Haptic Sensation in Lower-Limb Amputees Using Transcutaneous Electrical Nerve Stimulation," *Proceedings of the 2021 10th International IEEE/EMBS Conference on Neural Engineering*, May 4-6, 2021.

Vargas, L., Huang, H., Zhu, Y., and Hu, X., "Shape and Texture Detection using Haptic Sensation Delivered through Transcutaneous Nerve Stimulation," *Proceedings of the 2019 Society of Neuroscience*, Oct. 19-23, 2019.

INVITED LECTURES AND PRESENTATIONS

Mini-Symposium Presentation, "Eliciting Haptic Sensation in Lower-Limb Amputees Using Transcutaneous Electrical Nerve Stimulation," *2021 10th International IEEE/EMBS Conference on Neural Engineering (NER)*, Virtual, May 4-6, 2021.

RESEARCH SUPPORT/AWARDS & HONORS

- **NIH F31 Fellowship (PI: Vargas)** Feb. 2019-Feb. 2022
  - Grant Number: 5F31NS110364-02
  - Title: Evaluation of Haptic Sensation and Object Recognition using Transcutaneous Nerve Stimulation
- **Doctoral Student of the Year Award Finalist** April 2021
- **Provost Fellowship** Aug. 2017-May 2018
- **Charlotte Summer Research Fellowship** May 2016

LEADERSHIP & MENTORSHIP EXPERIENCE

- **Lead Initiative to Develop Community to Support Hispanic Students in the BME Department**
  - Aug. 2020 – May 2021
- **President of Biomedical Engineering Chapter of Graduate Student Association**
  - July 2019 – August 2021
- **Vice President of Biomedical Engineering Chapter of Graduate Student Association**
  - Aug. 2018 - June 2019
- **Undergraduate Research Mentor for Neuromechanics Laboratory**
  - Nov. 2017 – Dec. 2021
- **Undergraduate Teaching Assistant, Peer Tutor, and Peer Mentor**
  - Aug. 2014 – May 2016