

Exponent®
Engineering & Scientific Consulting

Nathan Knodel, Ph.D.

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Professional Profile

Dr. Knodel's area of expertise is in the kinematics and kinetics of human motion, with an emphasis on gait and whole-body dynamics. He investigates how consumer products, wearables, and environmental conditions influence a person's biomechanical responses. He also identifies the kinematics of events to understand potential injury mechanisms, particularly in slip, trip, and fall incidents.

Dr. Knodel leverages skills in optical-based motion capture technology, instrumented force plates, inertial measurement units (IMUs), electromyography (EMG), and metabolic measurement systems to address a wide range of biomechanical questions and challenges for his clients. His work is focused on evaluating the effects of consumer products on key biomechanical measures and thereby assessing injury potential, validating the efficacy of wearable technologies in naturalistic environments, understanding potential injury mechanisms based on kinematic analyses of events, and determining whether those mechanisms can be causally related to specific pathologies.

Prior to joining Exponent, Dr. Knodel was a graduate researcher in the Human Injury Research and Regenerative Technologies (HIRRT) Laboratory at Purdue University where he focused on the development and validation of a skeletal muscle force model derived from dimensional analysis. He designed, operated, and managed the experimental setting in which the model was validated using data collected from optical-based motion capture technology, EMG sensors, and an instrumented treadmill. He also worked on a unique segmentation program capable of extracting the 3D geometry of musculoskeletal tissues of the knee joint from MRI scans such that subject-specific anatomy could be implemented into higher fidelity musculoskeletal models.

Academic Credentials & Professional Honors

Ph.D., Mechanical Engineering, Purdue University, 2022

M.S., Mechanical Engineering, Purdue University, 2020

B.S., Mechanical Engineering, Ohio Northern University, 2016

2019 National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) Honorable Mention

Prior Experience

Graduate Student Researcher, Purdue University, 2017-2022

Graduate Teaching Assistant, Purdue University, 2017-2022

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Professional Affiliations

American Society of Biomechanics (member)

International Society of Biomechanics (member)

Publications

Knodel, Nathan B, et al. “Laboratory-based wearable heart rate data efficacies for informing real-world department of defense wearables decisions.” Military Medicine, vol. 190, no. Supplement_2, 1 Sept. 2025, pp. 558–566, https://doi.org/10.1093/milmed/usaf267.

Knodel, Nathan, et al. “Investigation of the loading at the knee joint complex using an EMG-based constitutive law for Skeletal Muscle Force.” Journal of Mechanics in Medicine and Biology, vol. 23, no. 07, 11 Aug. 2023, https://doi.org/10.1142/s0219519423500823.

Knodel, Nathan B., et al. An Electromyography-Based Constitutive Law for Force Generation in Skeletal Muscle — Part I: Model Development. Journal of Biomechanical Engineering 2022; 144(10). https://doi.org/10.1115/1.4053568.

Knodel, Nathan B., et al. An Electromyography-Based Constitutive Law for Force Generation in Skeletal Muscle — Part II: Model Validation on the Ankle Joint Complex. Journal of Biomechanical Engineering 2022; 144(10). https://doi.org/10.1115/1.4054275.

Presentations

Nathan Knodel (Presenter), Brie Lawson, and Eric Nauman. Evaluation of a Dimensional Analysis Derived, EMG-Based Constitutive Law for Quantifying Muscle Forces: A Pilot Study. Annual Summer Biomechanics, Bioengineering, and Biotransport Conference (SB3C), Virtual Conference, June 2020.

Project Experience

Significant experience running and managing large-scale human subjects research studies. Projects range in scope from various wearable validation and evaluation efforts using indirect calorimetry, optical-based motion capture, and IMUs, to risk assessment of consumer products by evaluating key biomechanical metrics, to designing various obstacle avoidance environments for evaluating effects of various head-mounted device technologies.

Peer Reviews

Journal of Biomechanical Engineering