



Exponent[®]
Engineering & Scientific Consulting

Nathan Knodel, Ph.D.

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Professional Profile

Dr. Knodel's areas of expertise include advanced biomechanical analyses of human joint complexes, kinematics and kinetics of human motion, development and simulation of musculoskeletal models, advanced anatomical image processing, and mathematical modeling in biomechanical frameworks.

Dr. Knodel's research has focused on the development and validation of a novel skeletal muscle force model which is used to identify surrounding musculoskeletal tissue loading in vivo, providing valuable insight into injury prevention, performance optimization, prosthesis design, and the understanding of occupational risk hazards. Dr. Knodel has experience with motion capture technology, force plates and instrumented treadmills, electromyography (EMG) sensors, inertial measurement units (IMUs), OpenSim, and analyzing advanced biomechanical models within customized graphical user interfaces. Utilizing these technologies allows him to evaluate a wide range of biomechanical applications pertaining to human performance and injury potential.

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 three-dimensional (3D) motion-capture technology, EMG sensors, and force plates. He also worked on a unique segmentation program capable of extracting the 3D geometry of specific musculoskeletal tissues of the knee joint from MRI scans so that subject-specific anatomy may be implemented into higher fidelity musculoskeletal models.

Dr. Knodel is also a former collegiate athlete, which, in conjunction with his research and technical expertise, provides him a unique perspective on human motion, injury potential, and performance optimization.

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

Licenses and Certifications

Professional Engineer, Michigan, #6201314472

Prior Experience

Graduate Student Researcher, Purdue University, 2017-2022

Graduate Teaching Assistant, Purdue University, 2017-2022

Engineer Associate, American Electric Power (AEP), 2016-2017

Professional Affiliations

American Society of Mechanical Engineers (ASME)

Publications

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.

Peer Reviews

Journal of Biomechanical Engineering