MAE LEADERSHIP SEMINAR SERIES DISTINGUISHED SPEAKER

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Dr. Ellen Arruda

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Department Chair

FULL-FIELD METHODS FOR CHARACTERIZING THE NON-LINEAR ANISOTROPIC RESPONSE OF THE ANTERIOR CRUCIATE LIGAMENT OF THE KNEE

ABSTRACT

The Anterior cruciate ligament, or ACL, of the knee is a soft tissue structure comprised of two main bundles of hierarchical collagenous structures. As with all soft tissue, the ACL is extremely difficult to mechanically test, and determining its non-linear, anisotropic mechanical response has remained elusive. Yet, obtaining the mechanical properties of the ACL is exceedingly clinically relevant to the design of better replacement grafts for torn ACLs or to prevent ACL tears in the first place. This talk will focus on our recent efforts to characterize the ACL response utilizing full-field displacement measurement techniques that offer more accurate, repeatable, and comprehensive experimental data than traditional testing methods. We've pioneered full-volume characterization techniques that provide much needed insight into the inaccuracies associated with many current experimental protocols and also the shortcomings of some popular constitutive models in capturing the full 3D response of the ACL. I will describe how we use these data to develop an ACL constitutive model for implementation into computational models of the knee during regular gait and under impact loading simulations. Accurate computational models of the knee such as ours may one day be used to guide clinical practice to intervene to prevent an ACL injury or to determine the best course of action to repair an injury.

BIO SKETCH

Professor Ellen M Arruda is the Tim Manganello / BorgWarner Department Chair and Maria Comninou Collegiate Professor of Mechanical Engineering at the University of Michigan. She also holds appointments in Biomedical Engineering and in Macromolecular Science and Engineering. She received her BS and MS degrees from Penn State and her PhD from MIT. She joined the UM faculty in 1992. Professor Arruda teaches and conducts research in the areas of theoretical and experimental mechanics of macromolecular materials, including polymers, elastomers, composites, soft tissues and proteins. Her research programs include experimental characterization and analytical and computational modeling of soft materials, including native and engineered tissues. Her polymer mechanics work has focused on the mechanics of these highly strain rate and temperature dependent materials with emphasis on the relationships among the structures at various length scales to the deformation mechanisms of those structures to predict the mechanical responses. More recently she has pioneered efforts to characterize the complex mechanical responses of soft tissues such as ligaments and tendons via full-volumetric-field methods. Professor Arruda has over 100 papers in scientific journals. Her H-index is 36 (ISI).

Honors Received –

- 2021 A.C. Eringen Medal, Society of Engineering Science
- 2019 Nadai Medal, ASME
- 2018 James R. Rice Medal, Society of Engineering Science
- Member, National Academy of Engineering, Class of 2017
- Harold Johnson Diversity Service Award, University of Michigan, 2017
- 2016 Southwest Mechanics Seminar Series Speaker - Nominated to speak at University of Texas, Austin, Texas A&M University, College Station, and the University of Houston, Houston, February 16-18, 2016
- Finalist, Head Health Challenge III, NFL, NIST, GE, Under Armour, 2015
- Outstanding Engineering Alumnus Award, Pennsylvania State University, 2015
- Distinguished Faculty Achievement Award, University of Michigan, 2014

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