ME Seminar

Modeling Biological Tissues Across Length Scales

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ABSTRACT

Biomechanical phenomena in our bodies happen across multiple length scales, with each scale having their own geometry, material properties and physics. For example, the brain during gestation experiences drastic changes in volume and develops wrinkling patterns (cortical folding). These result from the proliferation and migration of cells leading to growth of the tissue. On the other hand, the force production and deformation characteristics of the skeletal muscle are determined by the orientation of fibers and stiffness differences with their surrounding tissue. While capturing these multi-scale dynamics in-vivo and in-vitro presents significant non-trivial challenges, in-silico approaches provide complimentary tools for robust hypothesis testing. In this talk, computational frameworks for capturing the growth of the brain tissue, and understanding the mechanisms by which muscles transmit force will be discussed. Using theories of finite growth and multi-scale material homogenization, this talk aims to address hypotheses such as the role of glial cells (astrocytes) in cortical folding, and how skeletal muscles transmit forces laterally through shearing.

ABOUT THE SPEAKER

Karan Taneja is a postdoctoral researcher at the University of Notre Dame (Notre Dame, IN, USA). He earned his bachelor's degree in civil engineering from Delhi Technological University (New Delhi, India), M.Sc. in structural engineering from TU Delft (Delft, The Netherlands) and Ph.D. in structural engineering from University of California San Diego (San Diego, CA, USA). His research is in computational biomechanics, using solid mechanics and computational tools to develop multi-scale models for biological materials. Collaborating with clinicians and experimentalists, he aims to understand how lower level phenomena affect higher level behaviors in soft tissues in the human body, providing insights that can help comprehend their role in related pathologies.

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