Nonlinear Mechanics of Soft Fibrous Materials

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Abstract:

Soft fibrous materials are composites with highly flexible filaments embedded in a soft base matrix. The presentation will include overviews of active materials and connective tissue. First, we focus on muscle fibers whose response to loading is dependent on the presence of a stimulus, and consist of a complex hierarchical microstructure, comprised of sarcomeres, the basic motor unit of the muscle, contained within a base matrix. When a stimulus is introduced, the sarcomeres contract, altering the material response. Next, we focus on connective tissue and analyze in-plane extension of goat fascia lata. We review results of a histological analysis that show a well-organized bi-layered arrangement of undulated collagen fibers oriented along two well-defined directions. New data are presented showing the mechanical response in uniaxial and planar biaxial extension. We provide a summary of the main ingredients of the nonlinear theory of elasticity and introduce suitable strain-energy functions to describe the anisotropic response of soft fibrous materials. We validate the models by showing good agreement of the numerical results and the experimental data.

About the Speaker:

Luis Dorfmann is an Associate Professor, Department of Civil and Environmental Engineering, and Adjunct Associate Professor, Department of Biomedical Engineering, of Tufts University. He received his Ph.D. and M.Sc. in structural mechanics from the University of California, Los Angeles, and his Laurea in structural engineering from the University of Padova, Italy.

His research interests include:

- Nonlinear Magneto-and Electroelastic Deformations
- Mechanics of Rubberlike Solids
- Fiber-Reinforced Composites
- Mechanics of Biological Tissues
- Mechanics of Biocompatible Materials

And his teaching interests include:

- Strength of Materials
- Mechanical Behavior of Materials
- Biomechanics of Soft Tissue
- Nonlinear Finite Element Methods