MECHANICAL ENGINEERING SEMINAR

Toward an Interdisciplinary Analysis Framework for Cartilage: Formulations, Experiments and Examples

David M. Pierce, Ph.D.
University of Connecticut, Storrs.

In light of the need for advanced computational modeling tools and of the abundance of new forms of medical imaging data, we discuss steps toward the development of an advanced analysis framework for cartilage, combining medical imaging, image analysis, biology, and experimental and computational mechanics. We propose new constitutive models designed to accept sample/patient-specific structural data. The models, and 3-D large strain finite element implementations, focus on the load-bearing morphology. We demonstrate how our approaches, in which the material parameters have direct physical interpretations,facilitate 3-D patient-specific simulations by implementing high-resolution morphological data (e.g., derived from either multiphoton microscopy or ultra-high field diffusion tensor magnetic resonance imaging) in a computational setting. Our analysis framework for cartilage, combining medical imaging, image analysis, experimental and computational mechanics, enables studies of, e.g., fundamental structure-function relationships, surgical interventions,cartilage and joint integrity, disease progression, engineered cartilage replacements, imaging data analysis, and provides insight to microphysical (mechanobiological) cellular stimuli.

Dr. Pierce received the B.S. degree from the University of Minnesota, Minneapolis, and the M.S. and Ph.D. degrees from Stanford University, CA, all in mechanical engineering. Additionally, he received a Ph.D. Minor degree in mathematics from Stanford University and completed his Habilitation (Venia Legendi) in experimental and computational biomechanics at the Graz University of Technology, Austria. With the Inter disciplinary Mechanics Laboratory at UConn he studies the theory, development and application of pragmatic computational methods for physical problems of practical importance using computational and experimental solid (bio) mechanics, finite element methods, applied mathematics, and corollary programming/software. Applications include the mechanics of cartilage in health and disease, the mechanics of arteries, and, in collaboration with A.M. Fitzgerald & Associates, fracture prediction methodologies for microelectromechanical systems. His recent work proposes several new 3-D, large strain constitutive models for articular cartilage, facilitating simulation of sample/patient-specific cartilage deformation, fiber network response and fluid permeation based on medical imaging data.

Friday, September 12th, 2014
11:00 am Seminar in 233 Mudd
Lunch served at 12:00pm
in MECE Lobby