DEPARTMENT OF MECHANICAL ENGINEERING COLLOQUIUM

UNIVERSITY OF CALIFORNIA
UC RIVERSIDE

The Department of Mechanical Engineering

PRESENTS

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Friday, June 7, 2019
Winston Chung Hall 205/206
11:10-12:00PM

Virtual Cartilage: Toward Translational Applications

Abstract:
Osteoarthritis (OA) is a debilitating disease that afflicts nearly 20% of people in the US, costing more than $185.5 billion a year (in 2007 dollars), and its prevalence is projected to increase by about 40% in the next 25 years. We understand neither the cause nor progression of the disease, and treatment remains primarily symptomatic, as no cure yet exists. Furthermore, despite an enormous body of literature on cartilage mechanics, a great need remains to understand the in vivo mechanobiology of human cartilage, particularly regarding how mechanical stimuli influence chondrocyte (cell) function and regulate matrix synthesis. We discuss experimental, computational, and translational advances toward the development of a multidisciplinary analysis framework for cartilage—a virtual cartilage—combining medical imaging, image analysis, experimental and computational mechanics. Patient-specific computational analysis of virtual human joints and cartilage enables a unique opportunity to couple the in vivo solid and fluid biomechanics of cartilage at the joint and tissue levels with cell-mediated changes in cartilage structure, properties, and geometry. In the future, evolving virtual cartilage will help clarify relationships between the biology and physics of cartilage function in health and disease. Virtual cartilage could also advance understanding of patient-specific pathological changes due to biomechanical factors, improve clinical diagnostics and therapies, and enable new methods for non-invasive diagnosis and pre-/post-operative decision making.

About the Speaker:
Dr. Pierce received the B.S. degree from the University of Minnesota, Minneapolis, and the M.S. and Ph.D. degrees (with S.D. Sheppard) 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 (with G.A. Holzapfel) at the Graz University of Technology in Austria. The driving interest of Dr. Pierce's research is to understand and predict the mechanics of soft tissues and engineering materials. His current work employs theoretical, computational, and experimental tools to explore the interplay of form and function in cartilage, specifically the multiscale and multi-phase mechanics and how these evolve in health, damage, and disease. To this end, Dr. Pierce's Interdisciplinary Mechanics Laboratory (imLab, im.engr.uconn.edu) establishes novel experimental protocols and builds validated simulation tools that inform our understanding of the mechanics of cartilage, the complex progression of osteoarthritis, and clinical perspectives on causes, treatments, and possible preventions. His other work encompasses characterization and modeling of arteries and intraluminal thrombi and, in collaboration with A.M. Fitzgerald & Associates, failure prediction and design tools for Si-based MEMS devices.