

**Mechanical Properties of Biological Systems: Bones and Bacteria**

**Prof. Christopher J. Hernandez**

**Associate Professor**

**Sibley School of Mechanical and Aerospace Engineering**

**Cornell University**

**Faculty host: Jaime Juarez**

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**Abstract**

My research focuses on the mechanical properties of living tissues and how mechanical forces stimulate biological responses. This talk, for Mechanical Engineers, promises to include Solid Mechanics, Additive Manufacturing, Fluid Dynamics, Nanoscience, Biology and Robotics (sort of).

Cancellous bone is an open cell foam with an anisotropic microstructure made of a heterogeneous polymer-ceramic composite. In the body, cancellous bone is thought to make bones more lightweight and also assist in energy absorption. In a series of experiments examining the accumulation of fatigue damage in high porosity cancellous bone. We show that fatigue failure is influenced by two traits have little effect on uniaxial properties: matrix heterogeneity and microstructural elements oriented transverse to habitual loads. Our findings may not only help prevent osteoporosis-related fractures in the elderly but may also be useful for the design of ultralightweight microarchitected materials used in aircraft.

In addition to studying the mechanical properties of biological materials, my group also studies how mechanical stress and strain influence biological processes. Here I show how mechanical stress influences the physiology of the most ubiquitous type of organism on Earth: bacteria. We use a novel microfluidic platform with nanoscale features to capture and mechanically load individual bacteria and use super-resolution microscopy to measure responses. Our findings demonstrate that bacteria, like mammalian cells, have mechanosensitive systems that influences fundamental processes including those involved in the resistance of toxins and antibiotics.

**Biography**

**Dr. Hernandez** is an Associate Professor in the Sibley School of Mechanical and Aerospace Engineering and the Meinig School of Biomedical Engineering at Cornell University. His work examines bone biomechanics and adaptation, the effects of the microbiome on bone and joint disease and mechanoresponsive properties of bacteria. In addition to his scientific work, Dr. Hernandez's outreach activities include leadership responsibilities with the Society of Hispanic Professional Engineers national meeting and programs to enhance diversity in engineering at Cornell. Dr. Hernandez is a fellow of the American Society of Mechanical Engineers and the American Institute for Medical and Biological Engineer. He is a recipient of the Zellman Warhaft Faculty Award for Commitment to Diversity (Cornell University) and is one of only three engineers to receive the Fuller Albright Award for scientific excellence (American Society for Bone and Mineral Research). Dr. Hernandez received his Ph.D. in Mechanical Engineering at Stanford University and his undergraduate degree from Harvard University.



***This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.***

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