AEROSPACE & MECHANICAL ENGINEERING

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UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: **Professor Iwona Jasiuk**
Mechanical Science and Engineering
University Illinois
Urbana-Champaign, Illinois

TOPIC: **MULTISCALE CHARACTERIZATION AND MODELING OF BONE**

DATE: Tuesday, August 28, 2012

TIME: 3:30 p.m.

PLACE: Lower Level Auditorium, Geddes Hall

Reception: 2:45 – 3:15 p.m. – Coffee House, Geddes Hall

ABSTRACT

Bone is a structural material with excellent material properties for its application: high stiffness, strength and fracture toughness, and low weight. These superior properties are due to its complex composite, random hierarchical structure. In this presentation we study bone as a hierarchical composite material. We distinguish the following length scales: nanoscale ($1nm$ -$1\mu m$, apatite crystal and collagen fibril level), sub-microscale (1-10μm, single lamella level), microscale (10 -500 μm, single trabecula or osteon level), and mesoscale (1–10 cm, involving a random network of struts in trabecular bone, or a random arrangement of osteons in cortical bone). We model bone at each of these structural levels as a linear elastic composite material. Material properties are determined at each scale either analytically, using micromechanics theories, or numerically, using finite element and beam network approaches. Computational challenges include modeling of complex irregular, random structure at each level and accounting for spatial heterogeneity of bone's properties. Theoretical issues include separation of scales and dependence of properties on specimen size and boundary conditions. This latter topic is of importance in experiments and calculations of a wide range of material systems including composite materials, construction materials such as concrete, wood, and cellular materials. Elastic constants, calculated at each structural level, are compared with those measured experimentally. Results of this study have a wide range of application in orthopedics. Also, this research can serve as a framework for studying other structural materials with hierarchical structures, and can expand our understanding of scale and boundary conditions in materials with microstructures. Finally, lessons can be learned from nature on how to design stiff, strong and light bioinspired synthetic structural materials.

NOTE: ***If you are interested in meeting individually with Prof. Jasiuk, please contact Linda at 631-5431***