

Spring 2009 Seminar Series

Department of Biomedical Engineering

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Fabric dependence of poroelastic wave propagation

The current gold standard to assess bone loss is the Bone Mineral Density (BMD) test, which is performed with a Dual X-ray Absorptiometry (DEXA) system. BMD measurements are highly correlated to bone mass when measured in spine, wrist and femoral neck. However, the BMD cannot fully explain the decrease in bone strength and the associated risk of fracture because bone loss is not homogeneous, and does not depend on mass changes only.

Unlike DEXA, ultrasound wave propagation is sensitive to microarchitecture and tissue composition. In this talk, the governing equations for wave motion in the linear theory of anisotropic poroelastic materials are developed and extended to include the dependence of the constitutive relations upon fabric: a quantitative stereological measure of the degree of structural anisotropy in the pore architecture of a porous medium.

While the theory is applicable to any saturated porous material, the two longitudinal waves predicted by this model are measured in cancellous bone and used to derive the corresponding anisotropic elastic constants. Representative examples of bone loss are analyzed as a function of the porosity, tissue density and fabric.

