AbstractID: 7845 Title: Direct and Indirect Magnetic Resonance Visualization of Tissue Architecture and Function: from Micro to Nanostructure

“Form follows function” is one of the most fundamental principles underlying evolution of all organisms. Thus the desire to visualize tissue architecture has been a key driver behind all forms of microscopy starting with the magnifying lens, and leading to optical and, eventually, electron microscopy. During the past two decades methods have emerged that allow nondestructive imaging of the internal 3D structure of tissues by micro magnetic resonance (μ-MRI) and computed tomography (μ-CT) at resolutions of 5-50μm. MRI’s unique sensitivity to biologic processes such as the interaction of water with biomolecules makes it particularly attractive as an investigational tool in biomedicine. However, the practically achievable resolution is determined by signal-to-noise and ultimately, diffusion, and in vivo by our ability to correct for physiologic motion. Though below the resolution limit of k-space μ-MRI, indirect detection techniques such as q-space imaging, which exploit restricted diffusion, can be shown to provide quantitative information at sub-μm resolution in some instances. This lecture intends to provide an overview of the methodology and to discuss various applications ranging from quantifying the architectural and mechanical changes of trabecular bone architecture in response to intervention in humans, to measurement of axon diameters in the mouse spinal cord by q-space MRI using 50T/m home-built gradients.