Will Seamless Imaging Across Length Scales Enable Modeling of Multiscale Structure-Function Relationships?

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Cells constitute the living inhabitants of bone, cartilage, and other tissue compartments making up complex organs called joints. Cells are also responsible for generating and remodeling tissues through choreographed secretion and removal of extracellular matrices. Multiscale imaging and modelling may be key to understand bone and joint physiology in health or the clinical restoration of bone and joint function after trauma or disease. Specifically, only multi scale approached will address the current dearth of knowledge regarding how information (chemical, electrical, mechanical) is transferred between the cellular inhabitants of the joint's respective tissues and the tissues' respective inorganic and organic, solid and fluid components. This paper addresses new, disruptive imaging techniques that enable unprecedented understanding of these processes in health and disease. In parallel, recently developed multiscale predictive models use experimentally measured parameters enabled by cutting edge imaging methods to predict emergent structure-function relationships at multiple length and time scales.