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MULTISCALE BIOMECHANICS AND MECHANOBIOLOGY OF BONE AND RELATED TISSUES

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ABSTRACT

There has been an increasing interest in multiscale biomechanics and mechanobiology of bone and related tissues such as cartilage, tendon and muscles. These materials are characterized by invariant structural and compositional "universal" patterns of organization, complemented by common underlying mechanobiological structural adaptation mechanisms including cellular and biochemical regulation of tissue properties. In vivo experimentation with bone and related tissue is expensive and a deeper understanding of basic tissue biomechanics and mechanobiology is indispensable to improve treatment methods for disorders such as osteoporosis and osteoarthritis. Bone and other connective tissues are hierarchical in nature, and tissue integrity needs to be maintained by homeostatic feedback processes regulated by cells such as osteocytes, osteoblasts, osteoclasts, and chondrocytes. These processes act across large length and time scales, which are difficult to be identified based on experiments alone. Developing multiscale computational approaches together with new experimental imaging technologies allows for integration of information at different scales. Once such multiscale models are validated they can be used to perform "in-silico" experimentation in order to dissect different interaction mechanisms and cellular feedback processes.

This mini-symposium brings together engineers, biologists, and mathematicians whose common goal is the advancement of current understanding of bone and other connected tissues behavior and function. We are looking for new innovative assessment strategies including multiscale computational modeling and high resolution imaging technologies. Topics will range from musculoskeletal models describing bone-muscle interactions during daily activities such as walking or running, to joint mechanics, to micromechanical models for estimation of tissue mechanical properties, to tissue remodeling and adaptation models, to cellular models describing complex mechanobiological interactions.