seminario

NANOINDENTATION OF BIOLOGICAL TISSUES: EXPERIMENTS AND MODELING FOR ARTICULAR CARTILAGE

Prof. Pasquale Vena
Politecnico di Milano

Articular cartilage is a soft hydrated tissue that facilitates proper load transfer in diarthroidal joints. The mechanical properties of articular cartilage derive from its structural and hierarchical organization that, at the micrometric length scale, encompasses three main components: a network of insoluble collagen fibrils, negatively charged macromolecules and a porous extracellular matrix. In this talk, a constituent-based constitutive model for the simulation of nanoindentation tests on articular cartilage is presented: it accounts for the multi-constituent, non-linear, porous, and viscous aspects of articular cartilage mechanics. In order to reproduce the articular cartilage response under different loading conditions, the model considers a continuous distribution of collagen fibril orientation, swelling, and depth-dependent mechanical properties.

The validated constitutive model has been used to simulate multiload spherical nanoindentation creep tests. Upon accounting for strain-dependent tissue permeability and intrinsic viscoelastic properties of the collagen network, the model accurately fits the drained and undrained curves and time-dependent creep response. The results show that depth-dependent tissue properties and glycosaminoglycan-induced tissue swelling should be accounted for when simulating indentation experiments.

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