Numerical treatments of strong discontinuities within soft tissue biomechanics: state of the art and challenges ahead

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Several soft biological tissues such as arteries in health and disease typically show highly nonlinear and volume-preserving mechanical responses requiring sophisticated numerical approaches [1]. Multi-field variational principles are frequently used to solve related boundary-value problems leading to mixed or hybrid methods for finite elements. In addition, collagen is the ubiquitous load-bearing and reinforcing protein in many soft and hard biological tissues, which forms an important structural basis. The structural arrangement of collagen leads to the characteristic anisotropic behavior of the material which challenges the related constitutive formulation [2].

Tissue dissection is one form of trauma involving laceration and/or cleavage of the tissue. For capturing the jump in the displacement field for a dissection a traditional kinematic concept is not sufficient; we need to involve the kinematics of strong discontinuities [3]. This talk presents the latest experimental findings of soft tissue dissections, and associated material and finite element modeling. Future multi-disciplinary challenges that we will face the next decade will be discussed.

References:

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