Jordan P., Kerdok A.E., Socrate S., Howe R.D., “Breast Tissue Parameter Identification for a Nonlinear Constitutive Model”, in Proceedings of the BMES conference in Baltimore, MD, 2005.

Breast Tissue Parameter Identification for a Nonlinear Constitutive Model

Petr Jordan, Amy E. Kerdok, Simona Socrate, Robert D. Howe

Constitutive models of the nonlinear, viscoelastic response of soft tissue under large strains typical of medical manipulations is required for accurate diagnostic and simulation purposes. We have modified a constitutive model used to describe cartilage and cervix to characterize the large strain mechanical behavior of breast tissue across pathologies [1,2]. The model’s response combines individual tissue constituent contributions in the form of two parallel networks. A hyperelastic 8-chain network captures the elastic response from collagen and a porous-viscous network establishes the time-dependent fluid response. To identify the material parameters of the model (initial shear modulus, bulk modulus, prestretch, locking stretch, and relative permeability), we solve the inverse problem using large strain (>25% nominal strain) *ex vivo* indentation data from various breast tissue pathologies: normal glandular, papilloma, and infiltrating ductal carcinoma. The model’s parameters are identified using an iterative finite-element (FE) approach that minimizes the least-squares error between the model’s response and the data. Initial parameter estimation results show that initial shear modulus, locking stretch, and bulk modulus increase while the relative permeability decreases with pathological state. Complete parameter estimation will be validated against uniaxial compression data.

References:

1. Buschmann MD, Grodzinsky AJ 1995, J Biomech Eng 117, 179-191.
2. Febvay S, Socrate S, 2003, Proc ASME IMECE '03.