

Abstract Submitted  
for the MAR13 Meeting of  
The American Physical Society

**A micromechanical viscoelastic model for soft biological tissue**

BAPTISTE COUDRILLIER, THAO D. NGUYEN, Johns Hopkins University,  
PROF. NGUYEN LAB TEAM — Understanding the viscoelastic behavior of soft  
collageneous tissue from micromechanical considerations is critical to the character-  
ization of their physiological and pathological response. In this study, we propose to  
model biological tissue as an aggregate of unit cells (UC). Each UC represents two  
wavy parallel collagen fibrils cross-linked by intrafibrillar bridges. A fibril consists of  
two linear springs deforming axially, and interconnected by a linear torsional spring  
modeling the fibril bending rigidity. When an axial displacement is applied to the  
unit cell, the uncrimping and stretching of the fibrils cause the ground substance  
to shear and the intrafibrillar bridges to rotate. This model assumes that the time-  
dependent behavior of the UC is due to the viscous rotation of the bridges, which  
are modeled as Maxwell solids. The constitutive equation of the tissue is calculated  
from the orientation average of the constitutive equation of the unit cell weighted  
by the probability density function for unit cell distribution. The performance of  
the model to predict the creep response will be illustrated using the results of an  
inflation test performed on the human sclera.

Baptiste Coudrillier  
Johns Hopkins University

Date submitted: 27 Nov 2012

Electronic form version 1.4