Laboratory 3: Viscoelastic Characterization of Bovine Tendon with Harmonic Oscillations
November 8/9, 2006
BIOEN 5201 – Introduction to Biomechanics
Instructor: Jeff Weiss
TA: Heath Henninger

Each student must turn in a separate laboratory report representing his or her own work. The report should be prepared using MSWord or an equivalent word processor. The department has asked me to include grading of the grammar and style of your written report as part of the means of evaluation, so please proof your report, rewrite the initial draft as necessary and check for spelling and other grammatical errors before submission. The report should contain the following sections:

Title/Name:
Your report must include the following information in the upper-left corner of the first page:

BIOEN 5201 - Laboratory 3, Fall 2006: Viscoelastic Characterization of Bovine Tendon with Harmonic Oscillations
<YOUR NAME HERE>
<YOUR GROUP TIME>
<GROUP DATA YOU ARE USING>
<DATE HERE>

Objective: (1 paragraph)
State the purpose of the lab measurements and analysis. Motivate the need for the measurements. State your perception of the intended educational goals of the laboratory in terms of learning new measurement and analysis techniques. This section should be one paragraph.

Methods: (No longer than 2 pages)

a) Describe the methods and step-by step procedure to perform the measurements, i.e.
    -Load Cell Calibration
    -Test Sample Punching, Preparation and Clamping
    -Sample dimension measurements just prior to harmonic oscillation testing
    -Material Test Procedure (all steps prior to and including harmonic oscillation testing)
    -Methodology of separating apart data of interest (If using provided Matlab program or other code, please give a program overview)
    -Methodology used to create plots (i.e. Sigmaplot)

Section a) should be no longer than one page.
Results/Discussion (3 pages including 2 pages for plots):

Plot 1: Equilibrium stress-strain behavior: Determine the stress values that correspond to the applied strain at the end of each stress relaxation experiment. Using these three points and the point (0,0), plot the equilibrium stress-strain curve for the tendon. (1/2 page)

Plot 2: Reduced relaxation curves: Using the data obtained during the relaxation testing, plot the reduced relaxation function corresponding to the relaxation data obtained at each equilibrium strain level. The plot should have log(time) on the x-axis and the value of the reduced relaxation function (linear scale) on the y-axis for all three datasets. There will be as many subplots as there were equilibrium strain levels. (1/2 page)

Plot 3: Dynamic stiffness and phase angle as a function of frequency and equilibrium strain: Make plots of the dynamic stiffness and phase angle as a function of log(frequency) in radians on the x-axis. The y-axis for the dynamic stiffness graph should be log, while the y-axis of the phase angle graph should be linear. You may plot the data for each equilibrium strain level together for the dynamic stiffness and phase shift, yielding 2 plots with three curves per plot (preferred) or you may plot them separately. In either, please put all the plots on one page.

Turn in the 3 plots described above (2 pages max)

Interpret your results. Are they what you expected? Why or why not? What is the physical interpretation of your results for the dynamic stiffness and phase angle data? The verbal description of your results and interpretation section should be <1 page.