Introduction

A sample of soft tissue is extracted from a pig heart muscle in order to characterize its mechanical properties. After treatments the sample is found to behave as an incompressible isotropic nonlinear elastic material characterized by the following stress tensor

where F is a tensor (in this case a 3 ⇥ 3 matrix) that defines the deformation,

p is the pressure in the tissue ,

We want to check how good the mathematical model (1) is with respect to

the experiments. We consider a pure traction experiment, where the sample is

assumed to have a cylindrical shape and it is pulled from one of the flat faces.

In this case, the pressure field can be eliminated and the resulting force balance

for model (1) can be written as

where f is the force (per unit area) applied on the tissue, and   is the amount of

stretch in the direction of the pull (you can think of   as the stretch of a spring:

if the resting length is L0 and the length after pulling is L, then   = L/L0).

• Given the experimental results shown in Tables 1 and 2, how good is the

mathematical model? Discuss your results and the numerical methods

used.

f [kPa] -1.5 -0.5 -0.22 -0.08 0 0.08 0.18 0.37 0.73

Table 1: Forces applied to the tissue sample in the experiment

  0.8 0.85 0.9 0.95 1 1.05 1.1 1.15 1.2

Table 2: Computed values of the stretch in the experiment