

## Schematic of biaxial testing device

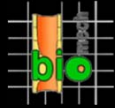
### Consider homogeneous biaxial deformation

The output of the biaxial machine yields following quantities:

- Two stretch ratios  $\lambda_1, \lambda_2$
- Applied forces  $f_1, f_2$

The thickness  $T$  of the tissue has to be measured optically prior testing (reference configuration)

Specimen geometry  $X_1, X_2$  (width and length) is known in reference configuration



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### Consider homogeneous biaxial deformation

The Cauchy stress (actual, current force divided by current area) can be defined as follows:

$$\sigma_{11} = \frac{f_1}{tx_2} \quad \sigma_{22} = \frac{f_2}{tx_1}$$

assuming incompressibility simplifies analysis, as thickness  $t$  is purely dependent on changes in width and height:

$$t = \frac{TX_1X_2}{x_1x_2}$$

Using the definition of the stretches  $\lambda_1 = \frac{x_1}{X_1}$   $\lambda_2 = \frac{x_2}{X_2}$   
The Cauchy stress can be then calculated as follows

$$\sigma_{11} = \frac{f_1\lambda_1}{TX_2} \quad \sigma_{22} = \frac{f_2\lambda_2}{TX_1}$$