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1st SIRAMM Winter School
PhD Presentations

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Mechanical Behavior of Soft Matters and Biological Tissues

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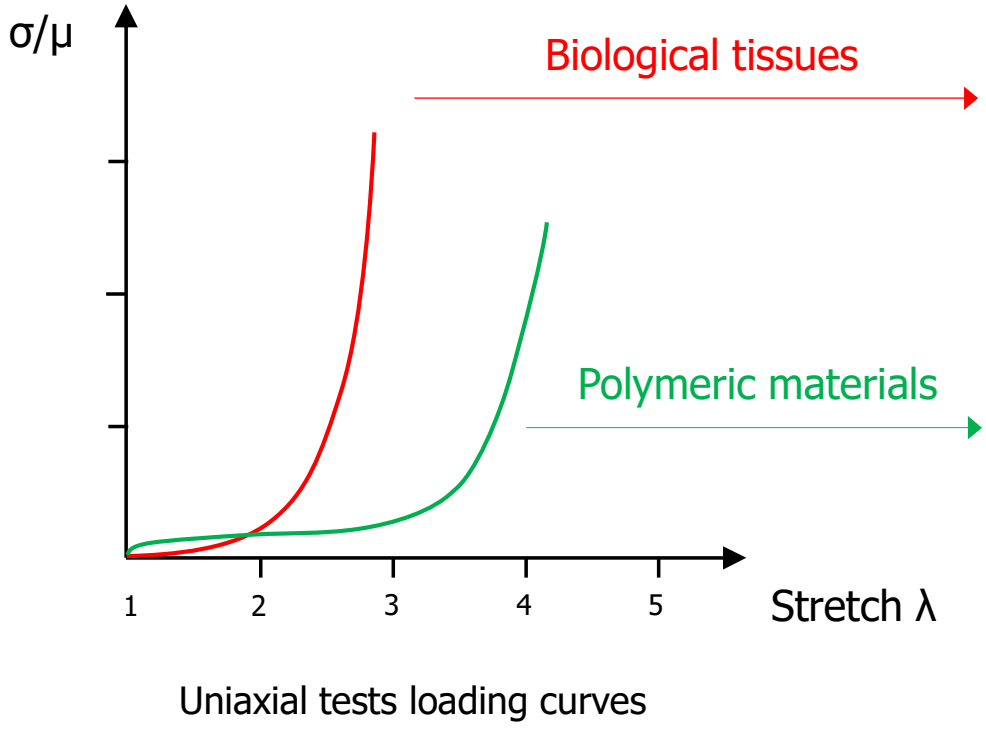
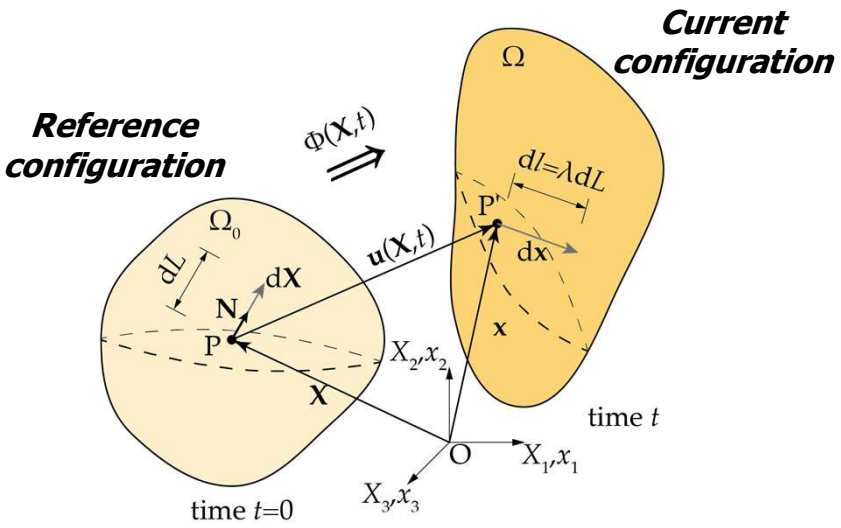
Soft materials – Hyperelastic behavior



Uniaxial tests loading curves

Finite strain mechanics



Current coordinates	$\mathbf{x} = \Phi(\mathbf{X}, t)$
Current coordinates variation	$\mathrm{d}\mathbf{x} = \mathbf{F}\mathrm{d}\mathbf{X}$
Deformation gradient	$\mathbf{F} = \dfrac{\partial \Phi(\mathbf{X}, t)}{\partial \mathbf{X}}$
Volume	$J = \det\mathbf{F} = \lambda_1\lambda_2\lambda_3$
Ogden potential function	$\Psi(\lambda_1, \lambda_2, \lambda_3) = \sum_{i=1}^{N} \dfrac{\mu_i}{\alpha_i}\left(\lambda_1^{\alpha_i} + \lambda_2^{\alpha_i} + \lambda_3^{\alpha_i} - 3\right)$
Cauchy stress tensor	$\boldsymbol{\sigma} = \sum_{a=1}^{3} J^{-1}\lambda_a \dfrac{\partial \Psi}{\partial \lambda_a} \hat{\boldsymbol{n}}_a \otimes \hat{\boldsymbol{n}}_a$

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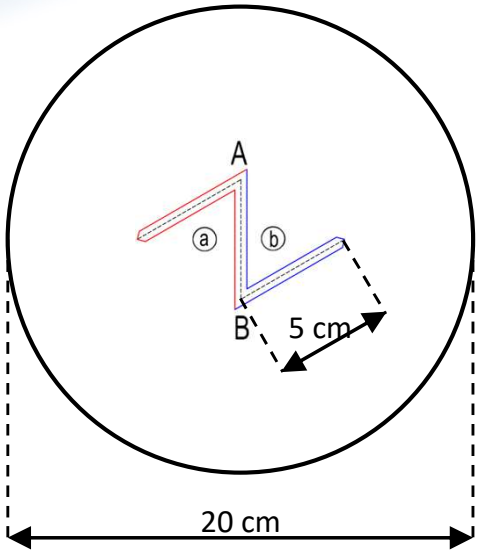
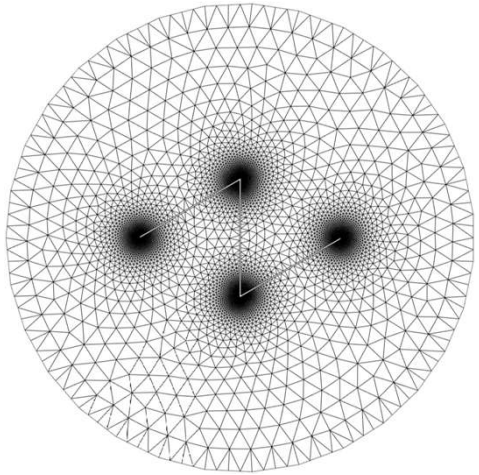
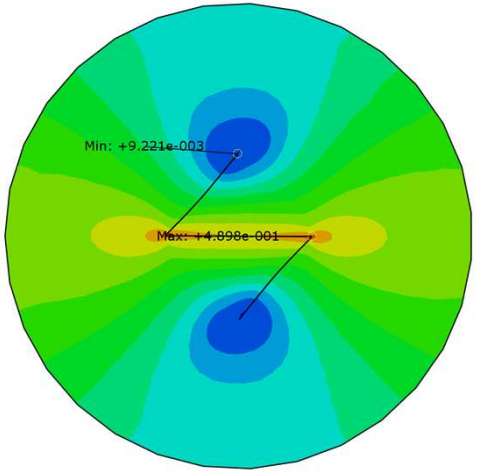
Skin corrective surgeries

The Z-plasty

FEM modeling







Model definition:

- Geometry
- Material parameters
- Boundary conditions

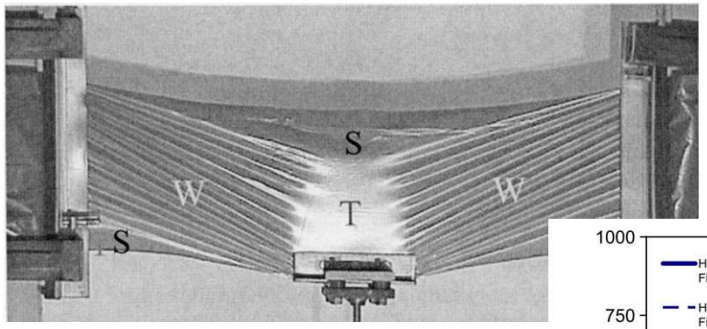
Model creation algorithm:

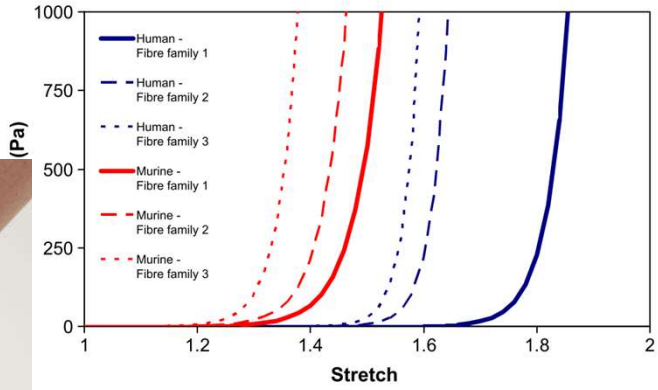
- Mesh refinement
- Suture multi-point constraint

FEM analysis

Future developments

- Membrane wrinkling modeling (relaxed stiffness in compression)
- Anisotropy of the material
- Non planar skin surgeries modeling





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Thank you for the attention