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Fabric-Elasticity Relationships in Cortical Bone

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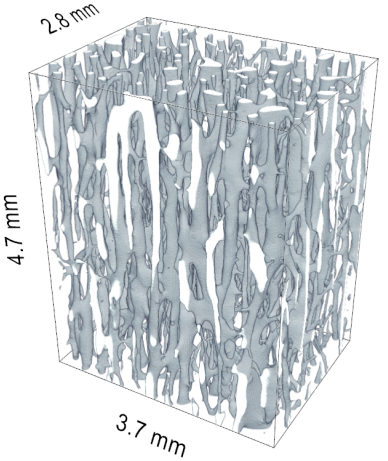
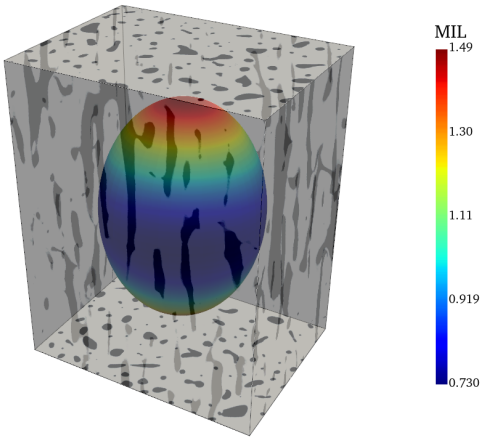
December, 2024

Material

Data

- 59 scans
- 6.5 µm voxel size
- RUS measurements
- CTAnalyser





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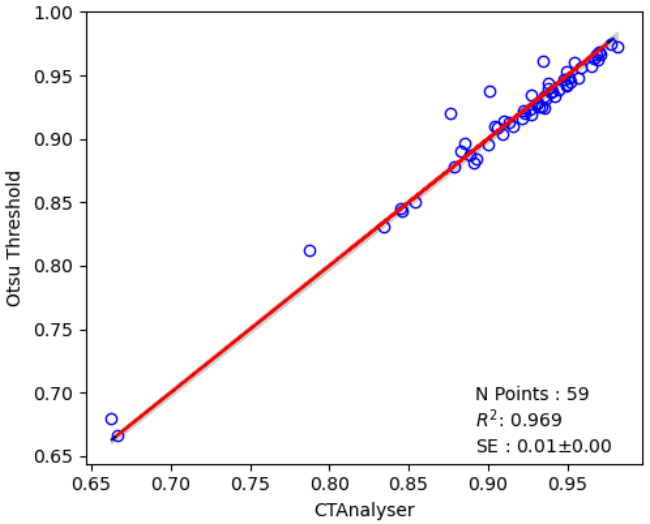
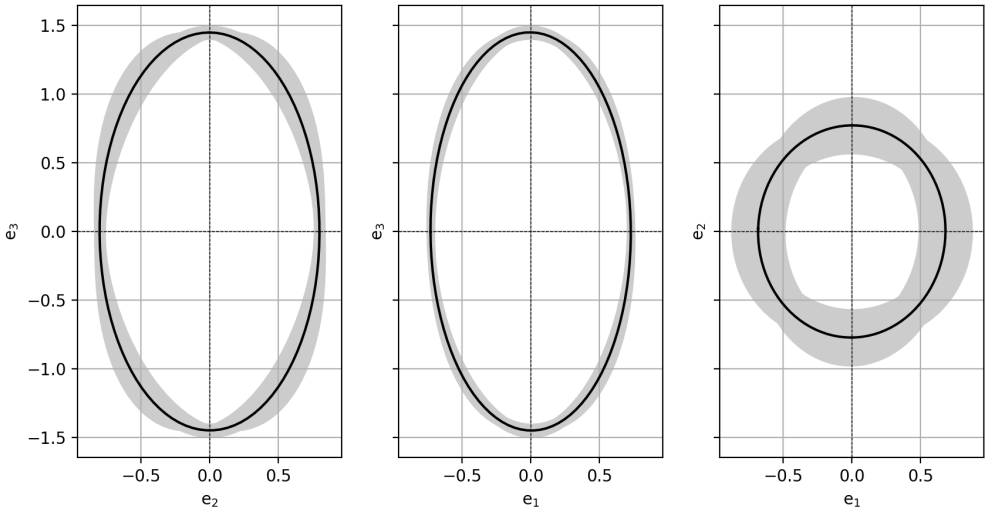
Segmentation

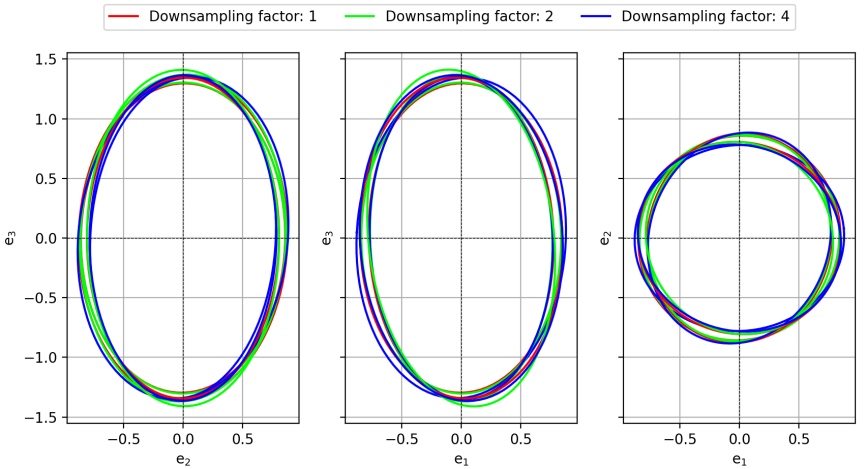
Mean Otsu threshold

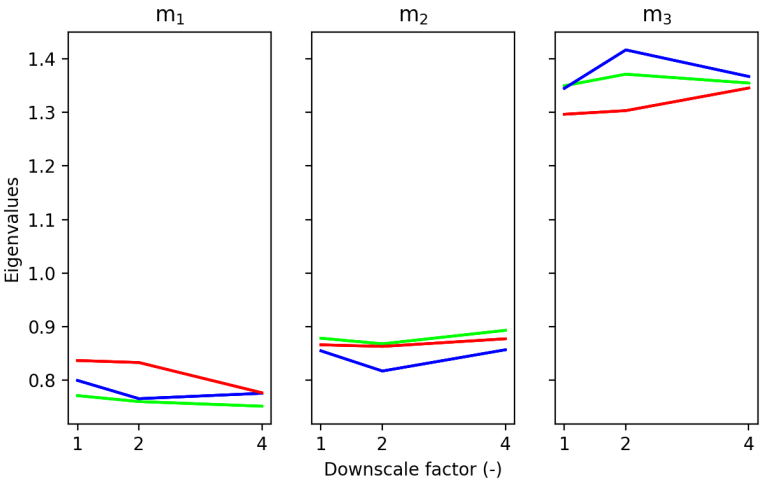


Fabric distribution

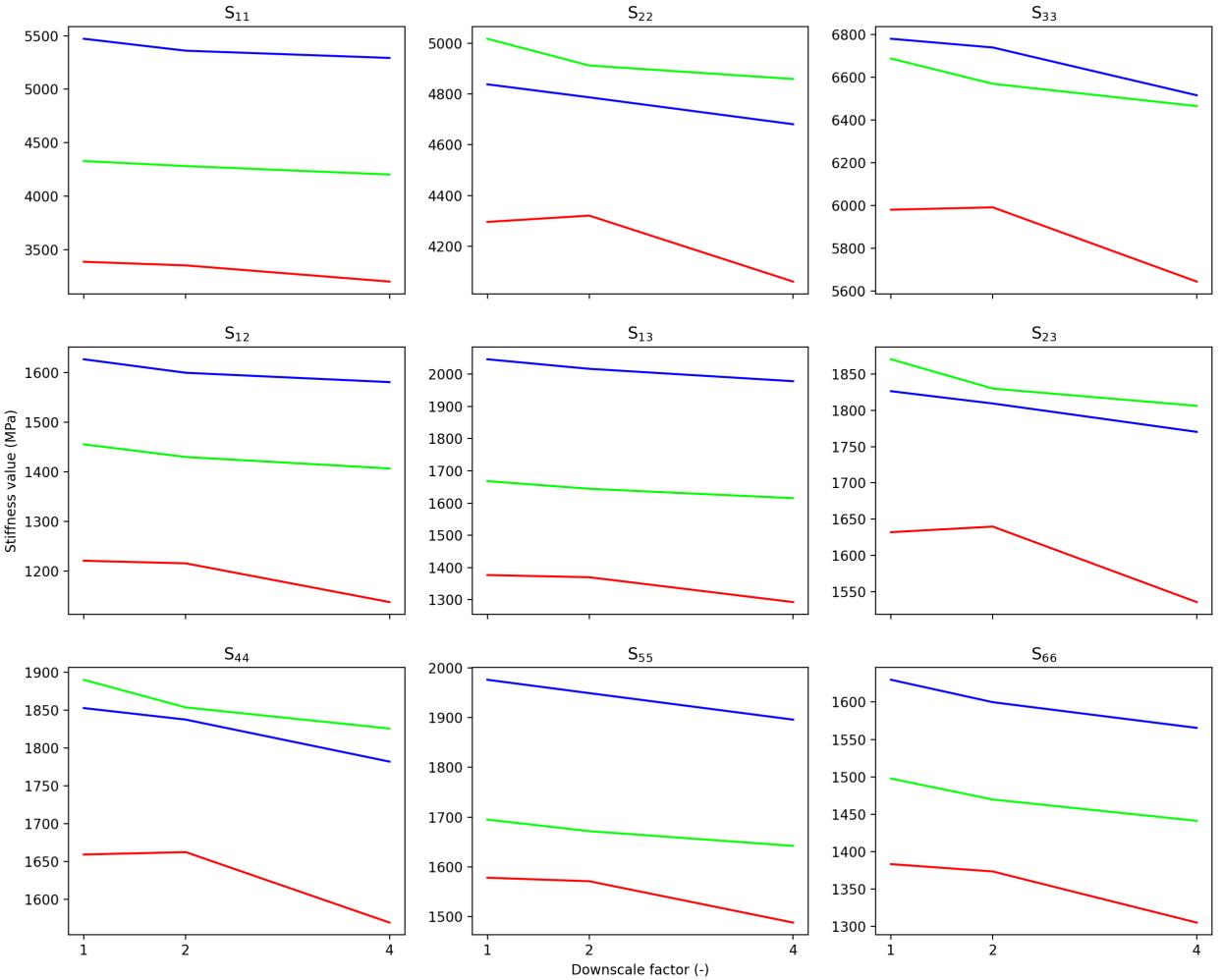


Resolution Effect - Fabric

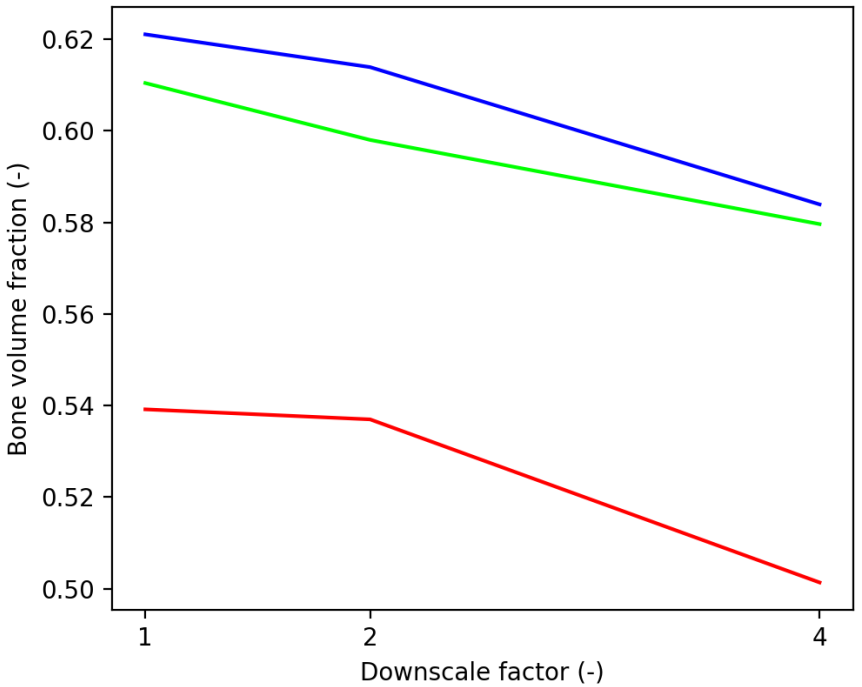


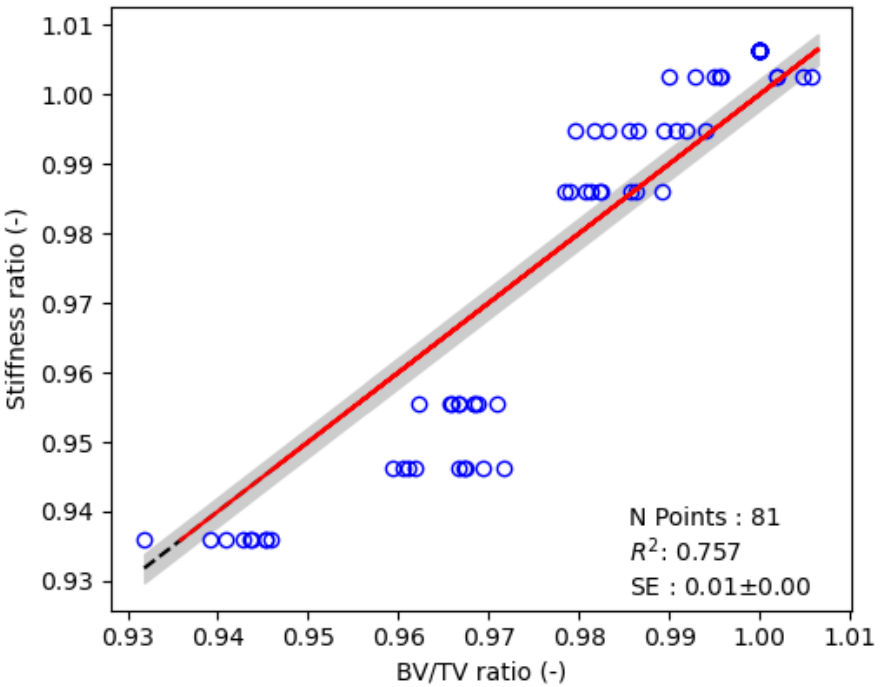


Resolution Effect - Elasticity



Resolution Effect - Elasticity II



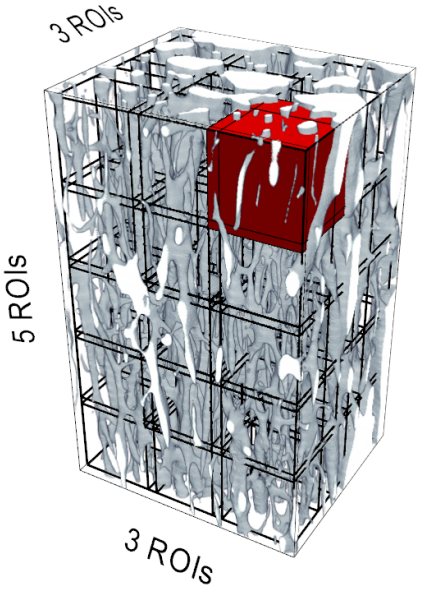


Convergence Study

Setup

- 1mm ROI side length
- 3x3x5 ROIs
- 65 µm margin
- Groups of 1, 2, ..., 45 ROIs

→ ~2^{45} possibilities

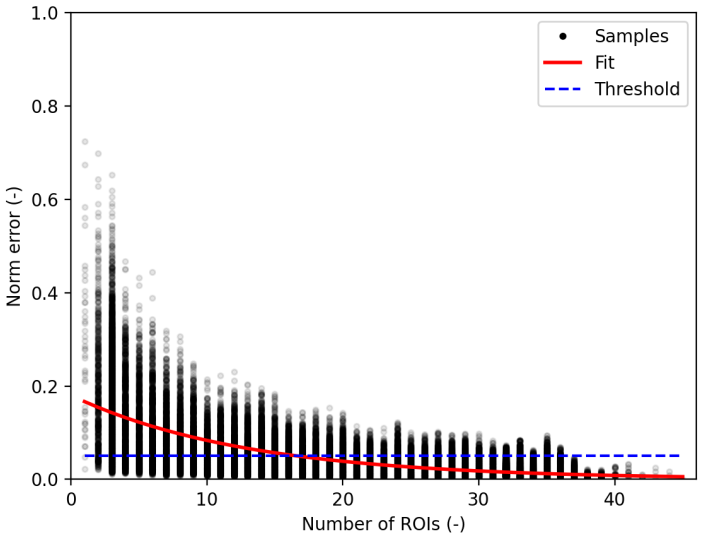


Convergence Study

Sampling

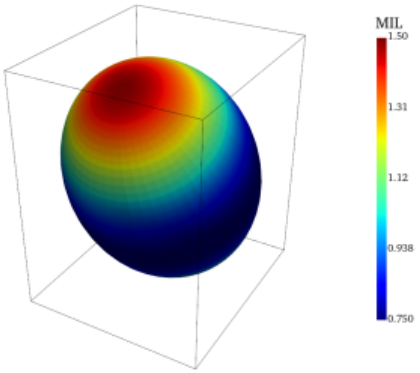
- Balanced clustering
  → Linear sum assignment
  → $216*10^6$ possibilities
- N samples = 1000
- Norm Error
- Threshold = 0.05

→ 15-16 ROIs



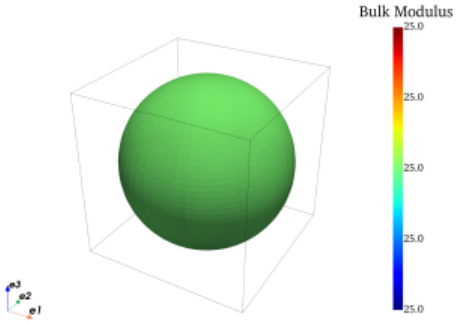
Material Effect

Structure

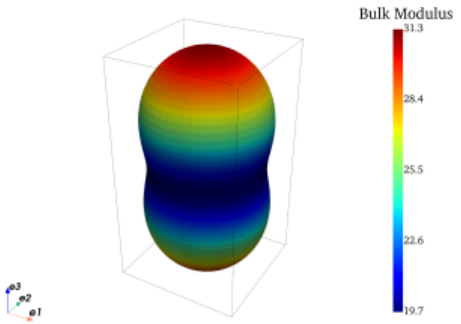


Fabric

Material

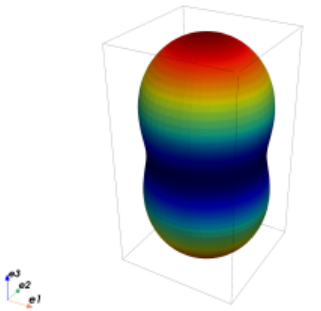


Isotropic



Transverse Isotropic

Mechanics



Transverse Isotropic

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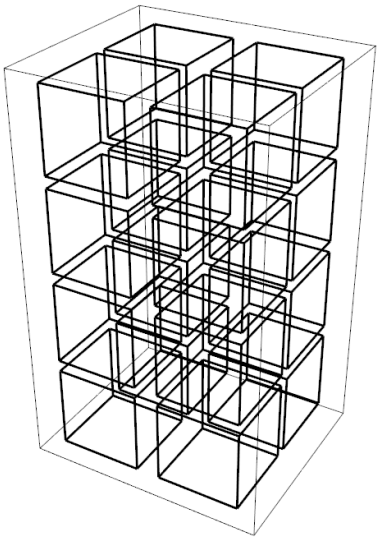
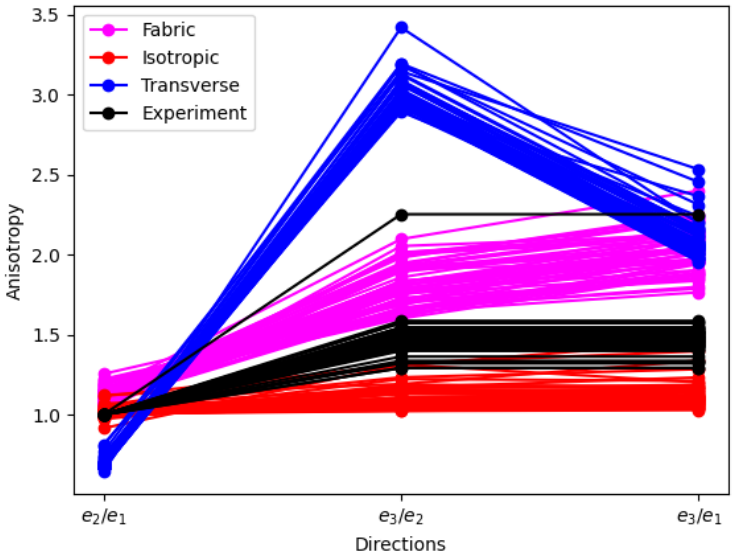
Homogenization

Setup

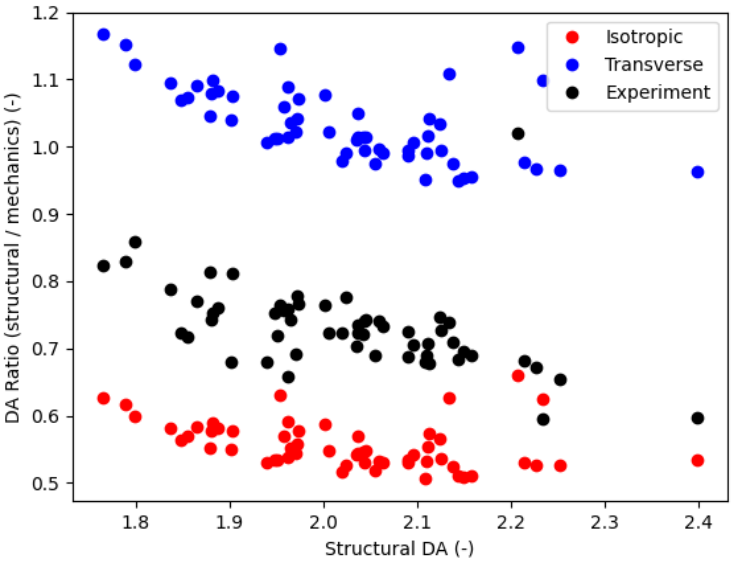
- Downsampling factor: 2
- 16x1mm^3 ROIs
- Isotropic vs transverse
- Mean $\mathbb{S}$ / Sample



Homogenization - Anisotropy

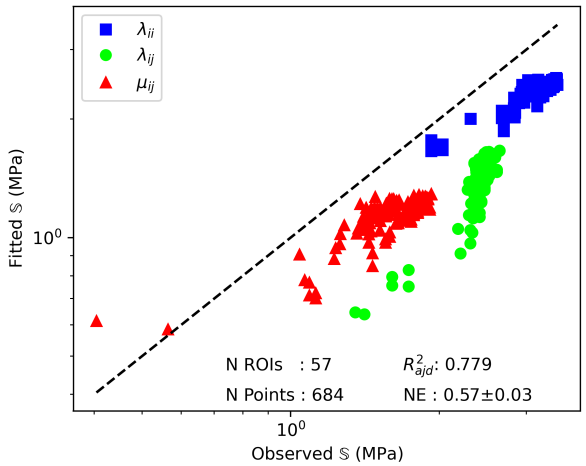


Main directions DA

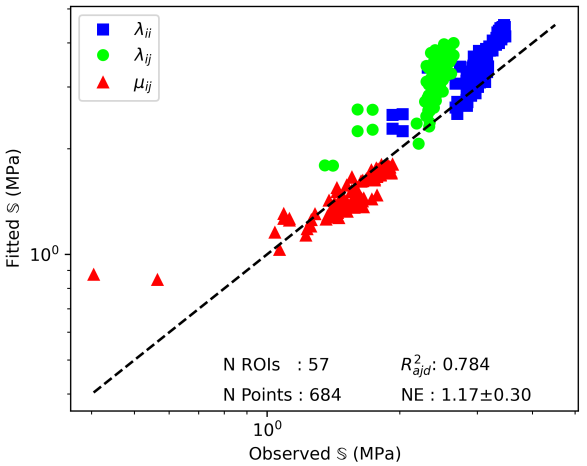


DA ratios (e_3/e_1)

Homogenization - Comparison with RUS



Isotropic Material

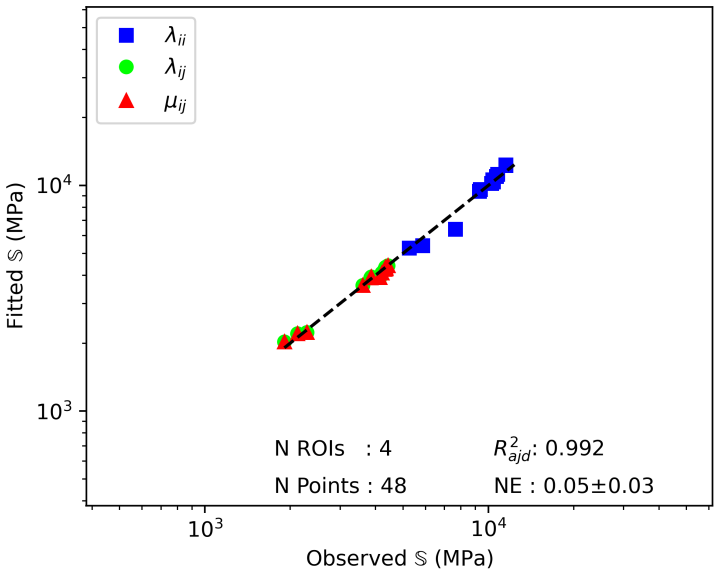


Transverse Isotropic Material

Homogenization - Isotropic

Setup

- Fabric at original resolution
- BV/TV at original resolution
- Isotropic material
- Mean $\mathbb{S}$ / Sample



Parameters:

λ_0	λ'_0	μ_0	k	l
3132	4944	4944	1.978	0.121