

SA 1: Generalized MSSCM

- Full fiber network model for both collagen and Elastin
- Integrated experimental structural measurements
- Utilizing layer specific measurements

Validation for Ovine Pulmonary Artery

- Recruitment Effect
- Prediction using fiber structural measurements

Validation for Mitral Valve Leaflets

- Layer specific mechanical response
- Predicting the fibril-level measurement of SAXS

SA 2: Extensions for EXL

Develop an EXL Model for the response of collagen, matrix and fiber Interactions.

Develop a Permanent Set (PS) Model for EXL Tissue.

- Apply the model for static, cyclic, and stress controlled experiment data
- Based on first order kinetics of the scission healing process

Develop a damage model for collagen

- Assume pre-tearing stage
- First order kinetics for rate of loss

SA 3: Organ-level Applications

Develop a FE implementation of the MSSCM and EXL extensions in FEniCS.

Validation by Simulating PS Experiments

AWT Study on Tri-leaflet BHV
Predicting 3D geometrical changes measured from micro-CT

Parametric Study on the effect of mechanical fatigue in response to

1. Mapped fiber microstructures
2. The impact of initial geometry
3. Geometrical changes due to PS
4. Stress distribution leading to deterioration

Fatigue Damage Model Refinement