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Project 5

WP 3: Statistical Finite Element Modeling for the VSD

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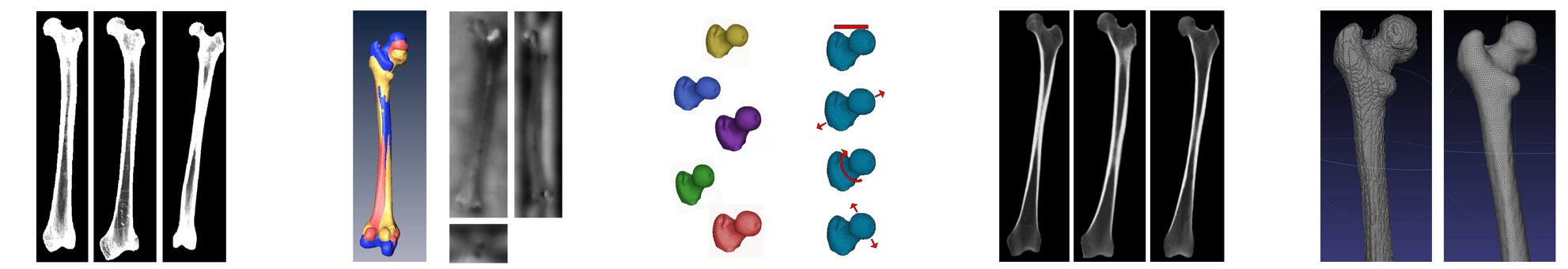
Introduction

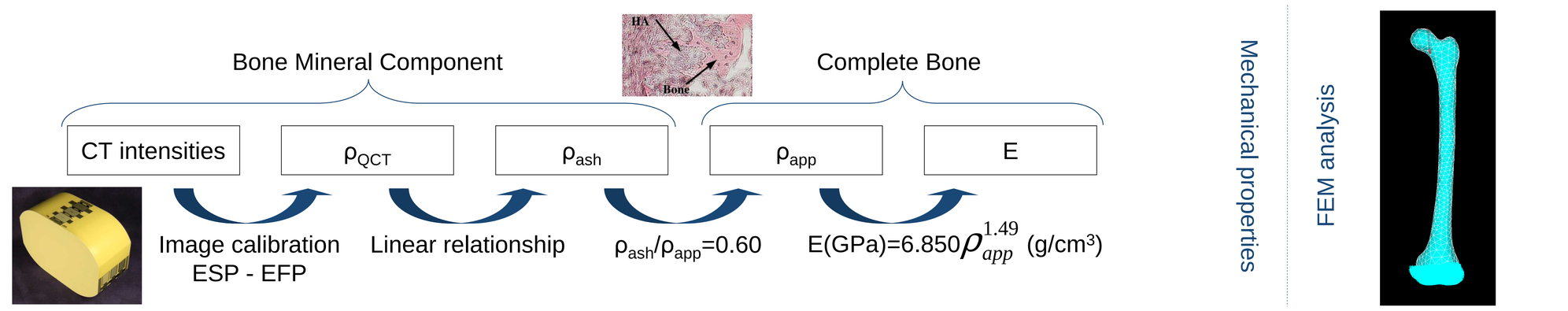
Finite element models developed from Computerized Tomography (CT) data are commonly used to evaluate the mechanical performance of bones without taking into account variations in bone geometry and material properties. We propose a method to include bone anatomical variations for the mechanical simulation of bone performance using Statistical Shape Model (SSM). The proposed concept and current developments are shown on a simple example.

Methods

Statistical Model

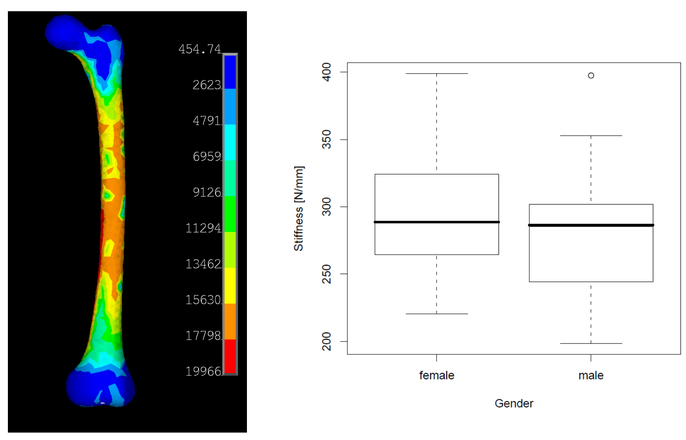


Mechanical Simulation



Results

- CT Data
  - 80 for females (64±17 years)
  - 57 for males (65±15 years)
- Statistical Shape Model
  - Use of the first 4 modes (77% of variation for females, 83% for males)
  - Generation of 40 instances for each gender
- FE Calculations
  - 10-node tetrahedral mesh
  - L = 800N
  - Distal part encastred



Discussion

An (nearly) automatic pipeline was developed to build Statistical Shape Models from CT images. Although the method is generic, it has been used to evaluate biomechanical differences between male and female femoral bones. Next steps will include a further automation of the Finite Element model generation, simulation and data processing.

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