Tissue Biomechanics UE 317.523

Submission due: 28.04.2025

Tutorial 2: Collagen fibril tensile properties

Total points: 10

A collagen fibril, isolated from the tail tendon of a mouse, was mechanically tested under tension and until fracture in a single ramp test. In the file given, the left column contains the force in micronewtons (µN) and the right column contains the fibril displacement in micrometers (µm). The initial gauge length of the collagen fibril is 75.8 µm while the collagen fibril is assumed to have a cylindrical shape with a uniform cross-section of 186 nm in diameter.

1. Plot the tangent stiffness (in N/m) versus stretch diagram (2.5pt).
2. Calculate and plot the stress (in MPa) versus strain and versus stretch diagrams.
    a. Once assuming a linear approximation of strain (2.5pt).
    b. Once using the Green-Lagrange strain approximation: eGL = 0.5 ($stretch^2$-1) (2.5pt).
3. Calculate and plot the tangent tensile modulus, (in GPa) versus stretch diagram (2.5 pt).