

The microstructural origin of biomechanical properties

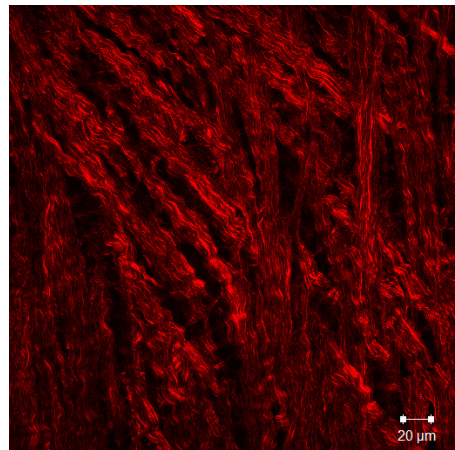
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The mechanical properties of many types of tissues are primarily linked to the distribution of long chained collagen molecules which provide structural integrity to the tissue. These molecules aggregate into microfibrils which again combine into mature fibres. The size, direction, and density of these structures are determines much of the biomechanical properties of tissue.

Collagen fibers can be imaged with a type of nonlinear microscopy called second harmonic generation (SHG) microscopy. SHG microscopy makes it possible to generate three dimensional images of the collagen structure of fresh tissue without fixation or staining. This is a tremendous advantage for future potential for in-vivo imaging.

At the department of physics we are developing a custom made setup for simultaneous SHG microscopy of collagen fibres and measuring the mechanical strain and stress applied to the tissue. This will allow us to study the microstructural properties that underlie the macroscopic mechanical properties. A better understanding of this relationship shows promise in a wide array of clinical applications.



Collagen fibrils in cartilage imaged using second harmonic generation microscopy

Project

The project involves the enhancement of the current system, acquisition of images and the analysis of these and thus comprises several aspects:

- *System integration.* This will involve programming (LabView, Matlab), integration of several software and hardware systems, and image analysis.
- *Acquisition of data.* This will involve sample preparation, measurement of mechanical properties and imaging, interpretation and analysis of images and comparison with mechanical data.
- *Interpretation.* Modelling of the relationship between the microstructural properties and the macroscopic biomechanical properties, development of biomechanical models.

The project is compatible with a project assignment, master thesis or both. Contact me by e-mail or come by my office if you want to discuss the project further.