Nonlinear microscopy of heart valves (2012-2013)

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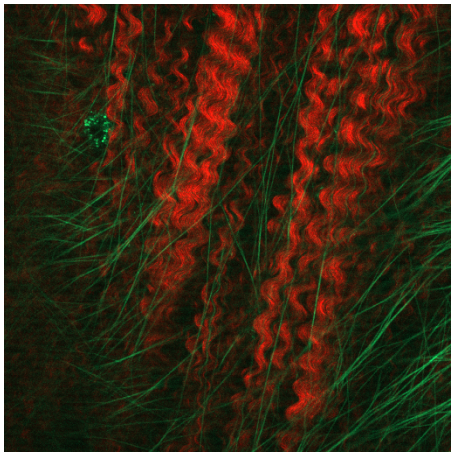
Healthy heart valves are essential for the proper functioning of the heart. These valves ensure that the blood is pumped in the correct direction the the heart muscle contract, pumping oxygenated blood into the body and not vice versa. Sometimes these valves deteriorate due to disease and must sometimes be replaced. It is the change in the biomechanical properties which cause the valves to malfunction and a good understanding of the biomechanical properties of the valves is therefore essential for understanding the disease progression.

Heart valves consist mostly of collagen and elastin fibres which provide the mechanical strength and elasticity to the valves. Both these types of fibres can readily be imaged by nonlinear microscopy, collagen by second harmonic generation (SHG) and elastin by two-photon excited fluorescence (TPEF). The image below is from the chordae tendinae which attach the heart valves to the heart muscle. SHG from collagen is shown in red and TPEF from elastin is shown in green (some TPEF from a cell, probably a fibroblast can also be seen).



The goal of this project is to quantitatively image the structure of heart valves using nonlinear microscopy and derive structural parameters which can subsequently be implemented in biomechanical models.

Project tasks

- Preparation of heart valve samples for imaging
- Imaging of valves using non-linear microscopy
- Quantitative imaging analysis to extract parameters for 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.