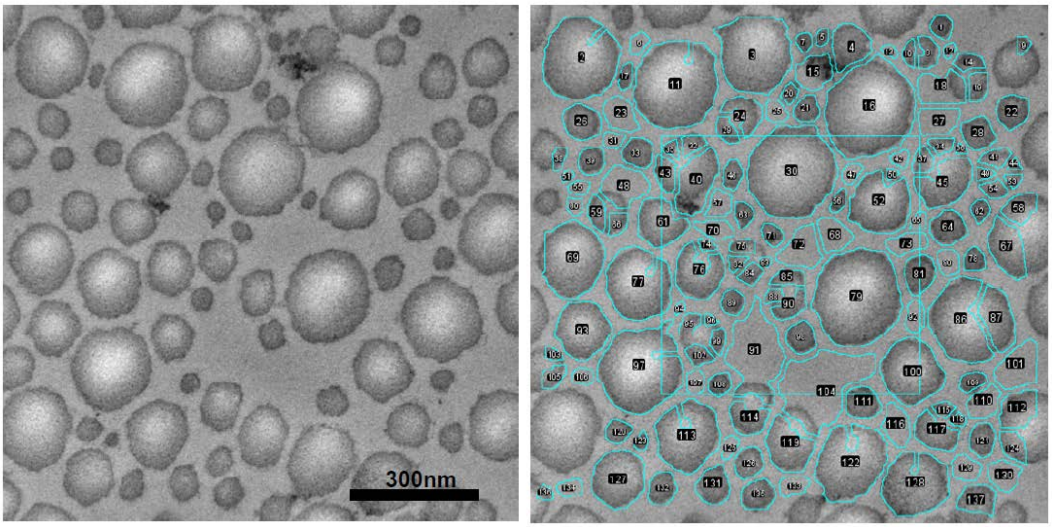
BSc project

Title: Automated segmentation of collagen in electron microscopy images of connective tissues.

Description:
Electron microscopy enables visualization of nanometer scale structures. The relation between structure and function is a key element to understand how connective tissues work. We study changes in tendons (tissue that connect muscle to bone) in relation to exercise and aging and we use electron microscopy to measure the dimensions and distribution (area, diameter, shape) of the collagen fibers that make up the connective tissue.

Electron microscopy relies on staining with heavy metals, making the collagen fiber appear dark on a grey background. However, the stain often has trouble penetrating the fiber causing only the surface to be stained. This means that the cross-section appears as a dark ring. Rings are difficult for the computer to separate using simple filters and thresholds.

The goal of the project is to develop a program that can automatically detect and measure the majority of collagen fibrils in an electron microscopy image. We have previously used the basic functions in the software "ImageJ" but more advanced methods may need to be manually implemented in Matlab.



Electron microcopy image of collagen fibers in cross-section. Left: raw image. Right: Fibers automatically outlined in blue using imageJ, some are correctly identified but many are not.

Required qualifications:
Our expertise is on connective tissue biology and not image analysis, so while we can lend some basic support, the students need to be fairly self-reliant (you will need to find relevant literature / scripts made by others, understand and implement the methods you may find). The practical work will to a large extent consist of reading and understanding the mathematics of different image filters and implementing them in a program, so an interest in math and programming will be required.

Responsible institution: Institute of Sports Medicine Copenhagen, Bispebjerg Hospital.

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Allowed no of students per report: 2

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