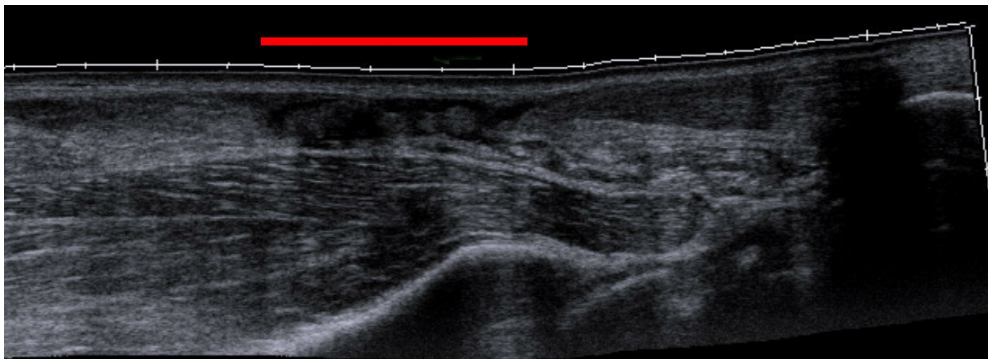
Master Project in Medical Image Analysis: Achilles Tendon Rupture Segmentation and Measurement

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Ultrasound of a ruptured Achilles tendon; the red marker spans the gap between the tendon ends.

Build a machine learning model that finds an Achilles tendon rupture in ultrasound and measures how severe it is.

What You'll Work On

The Achilles tendon is the strongest tendon in the body, and yet it ruptures surprisingly often: typically in active adults, during sport, with a sudden snap. Recovery takes months, and the choice between surgery and non-surgical treatment is still debated. In practice it is often made with little objective information about the injury itself. Ultrasound can change this. It is cheap, fast and available at the bedside, and it shows the two torn tendon ends and the gap between them, one of the few measurable features that could guide the treatment decision. The catch is that measuring that gap reliably is hard: image appearance depends on how the probe is held and how the foot is positioned, and the torn ends can be difficult to tell apart from the surrounding tissue.

In this project you will build, train and evaluate a machine learning model that segments the rupture in Achilles tendon ultrasound images and turns the segmentation into a measurement of the injury. Which measurement is clinically most meaningful, the length of the gap, its area or something else entirely, is an open question, and you will define it together with your supervisors and the clinical collaborators at Sahlgrenska. This is where you can be creative: the measure you choose shapes the annotation, the model and the evaluation.

You will be based in the geometric deep learning group GAPinDNNs at the Department of Mathematical Sciences at Chalmers, working day to day with its researchers and with Sindrion Technologies, whose existing ultrasound segmentation work the project builds on. The clinical collaborators at Sahlgrenska provide the images, the clinical input to the annotations and the expert measurements. You will prepare the annotated dataset, implement a deep learning baseline in Python and investigate a focused improvement of your own. Evaluation will assess both how well the model delineates the rupture and how closely its measurements agree with expert measurements on patients it has never seen, with an analysis of where and why the model fails. The deliverables are a trained model, reproducible research code and a documented evaluation.

Prerequisites

A solid understanding of Python and experience implementing deep learning models are required. Familiarity with PyTorch or image analysis is useful. Prior medical knowledge is not required. We are looking for an ambitious student who wants to work on an open research problem with a direct clinical use. Contact Jan Gerken at gerken@chalmers.se to discuss the project.

Start Exploring

- Fenech et al. (2024), *Ultrasound assessment of acute Achilles tendon rupture and measurement of the tendon gap*. *Australasian Journal of Ultrasound in Medicine*. doi.org/10.1002/ajum.12384
- nnU-Net, the standard baseline for medical image segmentation: Isensee et al. (2021), *Nature Methods* 18, 203–211. doi.org/10.1038/s41592-020-01008-z
- MONAI, the PyTorch-based framework for deep learning in medical imaging that the project will build on: project-monai.github.io