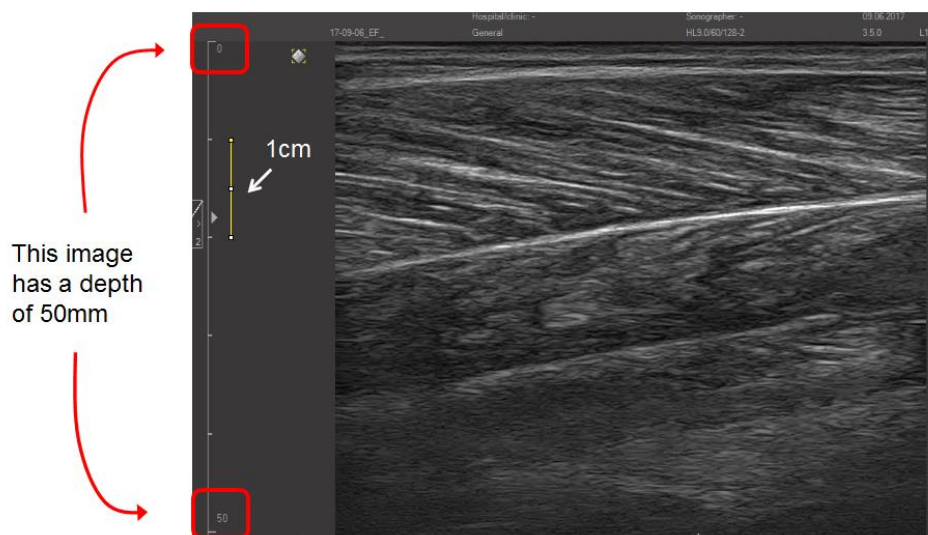


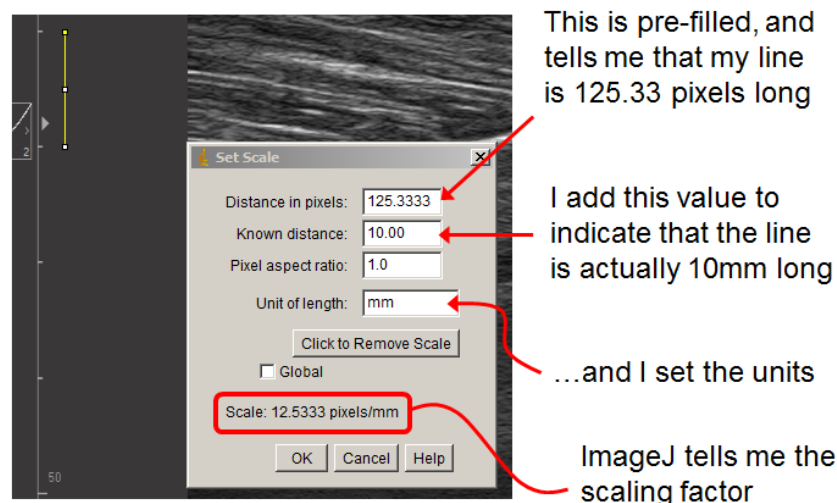
ImageJ is free software that is useful for a wide range of image processing tasks. It has a lot of built-in capabilities, as well as being extensible through a range of user-created plugins that can easily be accessed (and modified). Below are instructions for analysing features of ultrasound images such as muscle thickness, pennation angle or fascicle length. Note that nowadays I actually use Fiji rather than ImageJ, but they are virtually identical and use the same syntax. The instructions below will work for either programme:

1. Download ImageJ software (link: <http://rsb.info.nih.gov/ij/download.html>)
OR Fiji (<https://imagej.net/Fiji/Downloads>)

2. In the software, open the image that you want to analyse. You first need to calibrate the software so that it gives you correctly scaled measurements (without calibration, all results will be given in pixels). First, draw a straight line of a known length. For example, if you see a scale of some kind in your US image, you could draw a line representing 1 cm, as I have done in the image below:

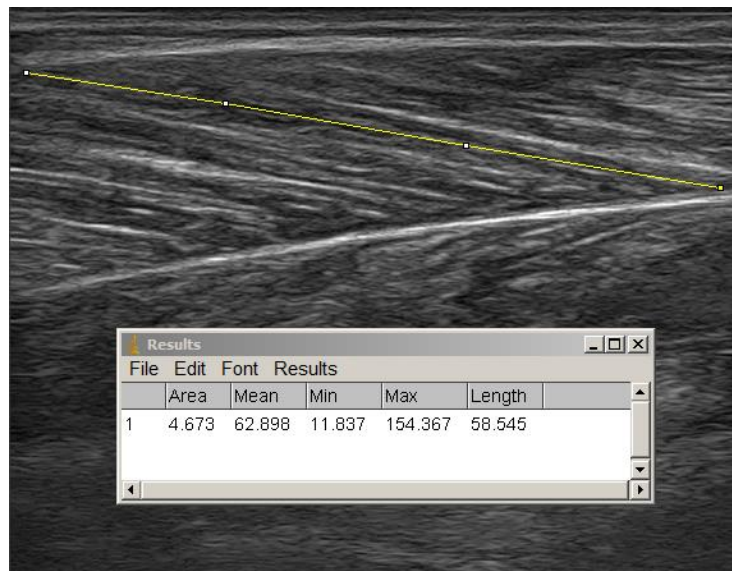


3. From the dropdown menu, click 'Analyze' then 'Set scale'. When the window appears, enter the known distance (e.g. 10mm), and choose mm as the unit, then ok (you will need to calibrate each time you re-open ImageJ):

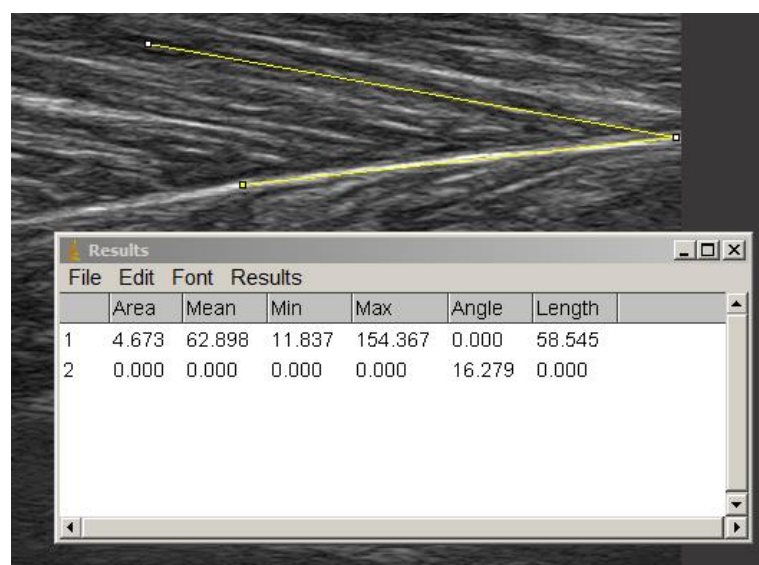


4. Now you are ready to analyse. Use the straight line/segmented line tool to draw a line that matches the length (or width) of the object you want to measure (you can switch between straight and segmented line by right clicking its icon).

5. From the dropdown menu, click 'Analyze' then 'Measure' and in the results window that appears, the length is displayed. In the example below, I used a segmented line to estimate fascicle length, but the same process could be used to measure muscle thickness. Because I've already calibrated (see 2 and 3 above), the length is given in mm:



6. To estimate pennation angle, you can use the Angle tool. After drawing your lines to represent the target angle, click 'Analyze' and then 'Measure' as before. If you don't clear the results window, each time you press 'Measure' again, the new result will be added to the results window below the previous result:



7. You can save your results directly to an excel spreadsheet, by using the Dropdown menu on the results window (File, Save As).