Ultrasonics 2021
Demo exercise 1

Deadlines: *Longitudinal and shear waves measurements are performed during the demo 30.3., answers to both the aforementioned and the USM tasks are to be sent to Axi by email (axi.holmstrom@helsinki.fi) at latest on 6.4. 23:59. Solutions are presented and discussed in the exercise session 7.4.*

Download data and script for the USM questions here:
https://www.dropbox.com/sh/odwa9au4h4xebel/AABijloTx7qQCfA2c9Ibksrka?dl=0

Longitudinal and shear waves

Do these demo exercises with pair or on your own. Ask help if you are not sure what to do. Take photos of all signals that you are measuring. A Phone camera photo is enough.

In longitudinal wave demo we put in to practice using pulse echo measurement with 1-8 MHz longitudinal transducer.

(1) (1 point)

In the demo you will measure speed of sound in a brass cylinder and an aluminum delay line.

What are the speed of sound in these objects.

(2) (1 point)

Next, set the brass object on the top of delay line and put ultrasound gel between objects and transducer.
Do pulse echo measurement from top of the brass object. Look from the signal how many times echoes from aluminum will come back before second brass bottom echo.

(3) (2 points)

In the shear wave demo we use two 5 MHz shear wave transducers. Now we do pitch-catch measurement, where one of the transducer is a transmitter transducer and other one is a receiving transducer.

We use honey as a contact gel. We measure shear signals in brass object in area where is no holes. We place transducers on the opposite sides of the object and keep transducers in the same position compare to each other.

Then we send signal and check that we receive signal back. After this turn the receiving transducer by 90 degrees compared to transmitting transducer. Does there happen something in receiving signal?

Turn second time the receiving transducer 90 degrees, what is the difference compared to first signal before turning receiving transducer (=180 degrees)?

Turn third time the receiving transducer 90 degrees, what is the difference compared to first signal before turning receiving transducer (=270 degrees)?

Ultrasound microscope

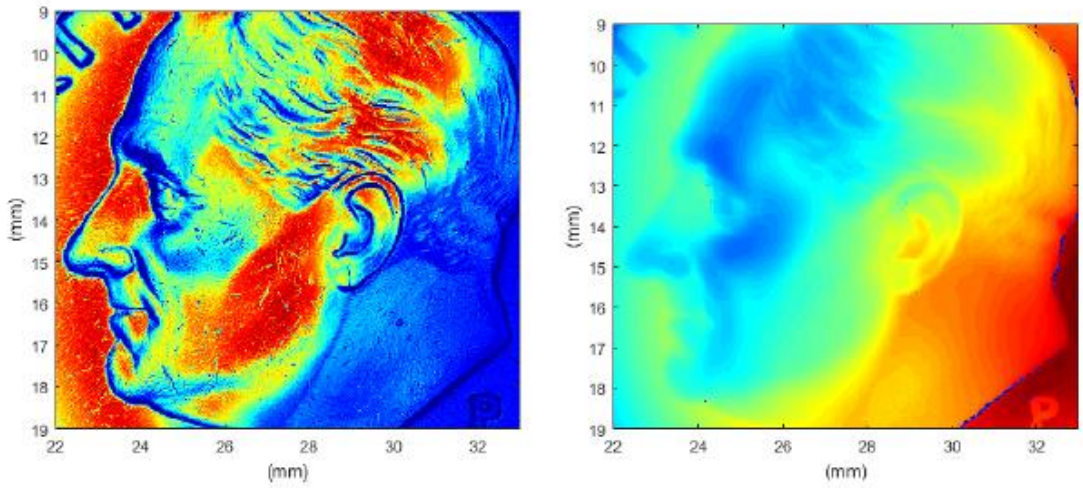
Download and unzip scan2_0.zip. Open the *read_and_plot_scan_ex* –script and do the following:

1. (1 point) Add a code that finds the maximum values and indices of the sample echo for each A-line. Hint! You can do this similar to how it's done for lens echoes:
`[max_value_lens, max_ind_lens] = max(lens_echo,[],1);`

2. (1 point) Calculate the time-of-flight (TOF) from the lens to the sample and back. Hint! Add `cut_offset` and subtract `max_ind_lens`, then convert indices to time by multiplying them with the time step `dt`.

3. (1 point) Run the script for all data files. Hint! For loop j=1:j_max
4. (1 point) Plot the amplitude and TOF images.

Images should look similar to the images below, but of a smaller area:



Extra! You can plot a topology map from TOF by using speed of sound in water (1500m/s).