Ultrasonics 2023
Demo exercise 1

Be prepared to present your solutions in the exercise session on Wed 14.2.

Scanning Acoustic Microscope -Exercise

1. Draw a schematic and explain the parts needed to make a scanning acoustic microscope and their working principles. Also describe the signal path in the device and how the signal changes in every part of the system (amplitude, phase and frequency).

2. You are given one A-line signal (csv), analyse the signal according to the following steps. You can use the matlab template or take inspiration of it and do analysis in other software.

    1. Plot raw data in time and frequency domain (use FFT). Sampling frequency used is 1 GHz

    2. Determine signal envelope and find the peak amplitude. Use for example Hilbert transform

    3. Assume that the signal represents a measured material. Use following reference measurements to determine impedance with a linear fit. Give an estimation what the material measured based on the acoustic impedance you calculated. (https://www.signal-processing.com/table.php)

Calibration	Amplitude (V)	Acoustic Impedance (MRayls)
PVC	0.15	2.854
Aluminium	0.80	16.65
Steel	3.83	45.45

Transducers-demo Exercise

During the transducer demo session, you chose a delay line of an unknown material. To determine the material, you measured the length of the delay line with a calliper, and the time of flight of an ultrasonic pulse travelling through the delay line.

a) Using your data, determine the speed of sound in the material with uncertainty (Exercise 1, problem 1). Remember to use the correct propagation path for the pulse (pulse-echo/through-transmission). For error propagation, use reasonable assumptions for the uncertainty of your measurements.

b) What is the most likely material of the delay line?

If you were absent during the demo or have misplaced your measurement results, ask a friend to share theirs. Alternatively, contact julius.korsimaa@helsinki.fi.