Exercise 7

In this exercise we will work with a numerical implementation of the axisymmetric KZK equation and hydrophone measurements with simulated results.

1. Simulation

a) Run the m-script *PistonSim.m*, it is setup in linear mode. Notice the overall good validity for the axial profile of figure 1. Why is this not the case for the maximum-amplitude-of-the-spectrum profile in figure 2? Take for instance a look at `figure, plot(p_Axial(:, 150), 'b-'), hold on, plot(p_Ana(:, 150), 'r--')`, showing the time signals for the KZK and analytical solution at a certain depth.

b) Set `z_End` (line 34) to 90mm and run the script again. What has happen to the axial profile of figure 2 and why? Also take a look at figure 3 which shows the envelope of the pressure signals for each radial sample. Plot the time signal at `z_End` with `figure, plot(p_Axial(:, end), 'b-'), hold on, plot(p_Ana(:, end), 'r--')`.

c) Set the radial range `N_r` (line 62) to `3*N_Apert` and run the script again. Note that the field is now again wide enough to give good results for both axial profiles.

d) Read the highlighted part from the article of Lee and implement the nonlinearity algorithm (equation 24 and 25) in the function *Nonlin.m*. Keep it simple, just use *for*-loops.

e) Turn on the plotting of harmonics by setting `PlotHarBln` (line 38) to `1` and run the script again.

f) Zoom in on the fundamental profile of figure 1. Why is the match with the analytical profile reduced at larger depths?

g) Look at the lateral profile of figure 4. Which typical characteristic of the second harmonic profile, in respect to the fundamental profile, can be observed?

2. Hydrophone measurements

Instructed on site!