NBE-E4310 D - Biomedical Ultrasonics 2023

Independent/group work 16.11.2023 at 12-14h; Submission: Please submit your responses via MyCourses as one zip file containing your responses in pdf and Matlab/Python format. The deadline for submitting your Exercise 3 responses is at 1:00 PM on November 27, 2023.

Please, note that not all details needed for the exercises have been necessarily presented during the lectures. If missing information, please refer to open sources or course book. Students are expected to have basic knowledge of signal processing and Matlab/Python skills.

TASK 1 (14 points)

You have an acoustic fountain of water that has a maximum height of 3 mm.

a. What is the time-averaged intensity of the sound field?(3p)

b. If the fountain is generated with a train of pulses that yield a duty cycle of 35%, what is the pulse-average intensity?(2p)

c. Assuming linearity of the wave, what is the peak pressure of the wave?(3p)

d. With the linearity assumption, what is the mechanical index? Assume f = 1 MHz.(3 p)

e. Is cavitation likely to be present?(2p)

f. How many times the intensity would be the intensity of Task *1a* if the fluid would be mercury?(3p)

TASK 2 (11 points)

You have an object immersed in water. Consider that you have a planar source that travels in a direction normal to a flat surface and the wave meets that surface from water with impedance $Z_{water} = 1.5$ MRayl. Consider that the object has a varying impedance from Z_{object} = 1.5 MRayl to 15 MRayl.

a. Plot the reflection coefficient of pressure as a function of Z_{object}.(5 p)

b. Plot the transmission and reflection coefficients for pressure.(4 p)

c. Plot the transmission and reflection coefficients for intensity.(2 p)

TASK 3 (10 points)

Considering the case of Task 2, plot the magnitude of the drag coefficient as a function of Z_{object} if the transmitted wave is fully absorbed into the object.(10p)