Biomedical Imaging FS 2019

Ultrasound 2

Please prepare solutions in pdf format and upload them on the Moodle platform (https://moodle-app2.let.ethz.ch/).

Exercise

This exercise is about a phased array and its operation. Consider a linear array of equidistant transducer elements (aligned in the y direction) sending ultrasound of 1.5 MHz into a water container that is adjacent in the x direction. The prepared Matlab code calculates the complex-valued amplitude of the resulting pressure wave in the x-y plane. It does so by summing up partial waves that emanate from the individual transducer elements. The array elements are assumed to be long in the z direction and of negligible width in the y direction such that the partial waves can be approximated as cylindrical.

Tasks

1. The number of array elements is initially set to just 1. Examine the resulting wave. If we view it as a limiting case of a single-transducer beam as discussed in the lecture, what are its NFB, lateral resolution, and broadening angle Θ?

2. Increase the number of transducer elements at the preset pitch of lambda/2. What happens? How does the many-element case relate to what you expect from a single flat transducer?

From here on, use 40 transducer elements.

3. Initially all transducers are driven in phase (=0). Now alter the phasing to deflect the beam by 20°.

4. Provoke a grating lobe.

5. Manipulate the phasing to focus at a depth of 5 cm.

6. As prepared, the code assumes unit amplitude for all transducer elements. Now vary the amplitude according to a Gaussian bell function along the array. Choose the width of the Gaussian such that its drops to about 10% for the outer elements.

Questions?

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