



Contribution ID: 28

Type: Oral

The New Generation of the KIT 3D USCT

Friday, November 3, 2017 3:40 PM (20 minutes)

The first clinical studies with our current prototype, 3D USCT II, enabled us to identify the necessary improvements for transition of the method to clinical practice. The main goals are to improve the contrast of reflection tomography, the resolution of transmission tomography, and to optimize imaged volume of the breast. Furthermore, the fabrication of the transducer arrays needs to be cost-effective and the data acquisition and readout time should be reduced.

(2) Material and Methods

We optimized the different possible transducer distributions using simulations in respect to contrast, coverage of the region of interest (hemisphere of 20 cm diameter), and minimization of artefacts. The patient bed was evaluated by test series. The design of the aperture was adapted to image as close as possible to the chest wall and to cover also parts of the pectoralis. To reduce the costs for the transducer arrays we designed an ASIC, which can handle the readout and driving of 9 transducers up to 120 V. By this design, we can now use each transducer as emitter and receiver.

(4) Discussion and Conclusion

So far, all known demands of 3D ultrasound tomography are fulfilled to achieve all three modalities reflection-, speed of sound, and attenuation tomography with high image quality.

(3) Results

Most of the parts of the new system are ready for assembly. The aperture was enlarged to 35 cm, see Fig.1, to cover a hemispherical volume of interest with a diameter of 20 cm without loss of image quality. The distribution of transducers over the aperture's surface is homogeneous and random to allow statistical sampling of the volume. The simulations promise an increase of contrast for the reflection tomography of a factor 6 and significant more homogeneous contrast for transmission tomography. The data acquisition time of 1.2 · 10⁶ A-scans will be 1 to 2 minutes and the readout within 1 minute. The ASIC and new transducer design has a resonance frequency of 2.5 MHz and a bandwidth of 4 MHz.

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Session Classification: Session 11: Clinical application III

Track Classification: Main Track