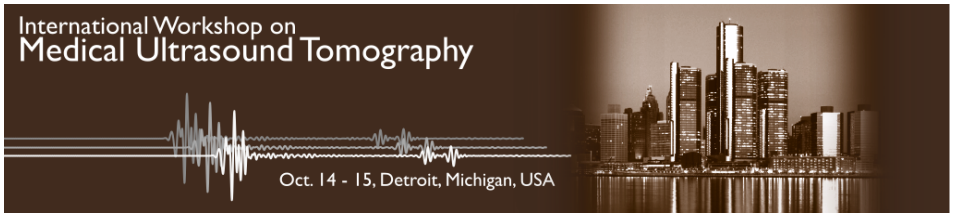

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First US performance measurements of next generation 3D USCT 2.5 transducers

The KIT's 3D Ultrasound Computer Tomography (USCT) II system has a multistatic setup of 2041 ultrasound transducers with approx. 1.5 MHz 6dB bandwidth and 36° 3 dB opening angle for 2.5 MHz. To increase the region of interest for a next USCT generation, the opening angle should be increased to approx. 60° and the bandwidth doubled..
To increase the opening angle the size of the transducer elements was decreased to approximately half the size. A circular aperture was chosen for homogenicity of the radiation pattern in 3D. The transducer design utilizes piezo-fibres by the established Fraunhofer IMT piezo-fibre composite technology. The fibres were fabricated from PZT powder using the polysulfone spinning process.
17 fibres were positioned with a mechanical mask and filled with a matrix of epoxy. From this rod piezo composite discs were sawed and polarized. Electrodes were generated by silver-filled epoxy adhesive on the top and bottom side. Materials for acoustic backing is a Tungsten-Polyurethane composite and for acoustic matching ia aluminium oxide composite material (TMM4).

Ultrasound characteristics were evaluated quantitatively with a Onda HNC-400 hydrophone in a 3-axis water tank for a randomly selected sample transducer (see Fig. a.)). Characteristics evaluated were the pressure field as function over frequency and angle in the far-field (see Fig. b.)), following the use-case. For excitation a linear encoded chirp was used, for SNR improvements averaging of measurements (64 to 256 times) was conducted. The analysis compensated for the hydrophon's frequency and angular damping characteristics.
The presented results show that the desired characteristics were mostly achieved: the 6 dB bandwidth could be vastly improved by roughly 200% (see Fig. d.)). The 6 dB pressure opening angle was approx. 50° (see Fig. c.)), not completly fullfilling the simulated expectations, an improvement by 31% was achieved. The results are promising for the next 3D USCT III generation.

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