DBUS
A flexible 2-D scanning system

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Introduction

Ultrasound is frequently used for detecting and characterizing breast tumours. Using Delay and Sum based algorithms it is feasible to compute the echogenicity of the tissues. However, to improve the specificity, it is important to reconstruct acoustic medium parameters (e.g. sound speed). Reconstructing these parameters requires advanced imaging methods such as Contrast Source Inversion (CSI).

Typically, advanced imaging methods are tested using synthetic data; at first representing a 2-D scan of a tumorous breast followed by advanced setups (e.g. 3-D scans). To ease the step towards experimental data, it is important to start with 2-D scans. To meet the demand from the USCT society for these scans, we built a flexible 2-D scanning system.

System

The 2-D scanning system, referred to as Delft Breast Ultrasound Scanner (DBUS), consist of a water tank (0.75 m x 0.75 m x 0.65 m) with two rotary stages to independently rotate the object and the receiver, see Fig. 1. The source is mounted in the corner of the tank. The temperature of the water is kept constant within 1ºC using heating mats and a temperature controller.

For each A-scan, an electric pulse (f_0=0.5 MHz) is generated by an AWG (Agilent 33250A), damped (JFW Industries, 50BR-036), amplified (E&I 210L 40 dB) and finally applied (Panametrics V318). The resulting pressure field is measured by an identical transducer which is sampled at 400 MHz by a 14 bit A/D converter (Spectrum M3i.4142-exp - PCI). For each A-scan, the raw RF data and information such as temperature, source and receiver positions, etc. is stored.

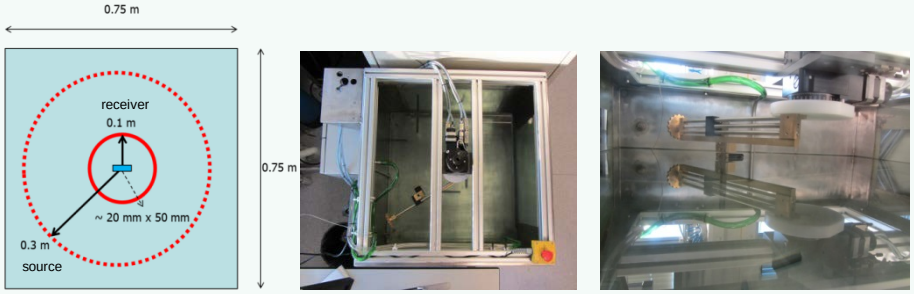

Fig. 1:
The DBUS scanning system; top view (left and middle) and side view (right):

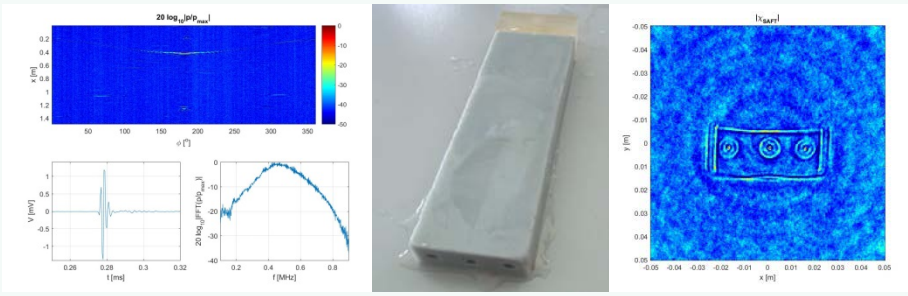

Fig. 2:
Preliminary results;
B-scan in absence of an object (left); a tissue mimicking (TMM) phantom (middle) and a SAFT reconstruction of the phantom

Results

An example of a B-scan in absence of an object is shown in Fig. 2. As a test object, an agar based phantom was scanned using 45 source and 450 receiver locations. From the obtained data, a SAFT image was reconstructed.

Conclusion

A 2-D scanning system has been built and tested successfully. Preliminary results show that the scanning system works properly and generates excellent data which after processing clearly shows the object with the inclusions despite the low frequencies.

Acknowledgement

We would like to acknowledge Henry den Bok, Edo Bergsma, Emile Noothout, Bastiaan Dekker, and Elmer Jansen for their contributions to building and testing the DBUS system.