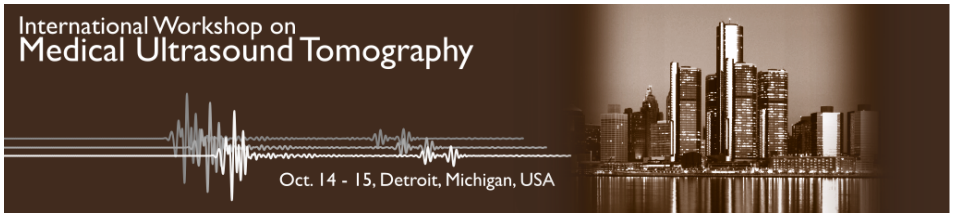

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Progress Towards an Open-Source, Low-Cost Ultrasound Computed Tomography Research System

Existing clinical UCT systems are custom-built at high cost and with a long lead time, which can be prohibitive for some research groups. At UCL we are developing FlexUCT: a design framework for a benchtop UCT system that will allow novel data acquisition protocols and reconstruction algorithms to be tested immediately on a physical system, accelerating progress towards fast and accurate UCT.

FlexUCT will be an open-source, low-cost design framework for an UCT ring array, that can be manufactured in-house with a short lead time, using commonly available rapid-prototyping technology and workshop equipment, and will be easily adaptable so that research groups can customise the system to suit their requirements. The hardware distribution will provide the complete specification needed to build a UCT ring array, including 3D printing design files, printed circuit board (PCB) layouts, Gerber files for PCB manufacture, and a bill of materials with an assembly procedure.

The basic FlexUCT system will comprise of a 220mm 256-element PZT ring array with Tungsten-Epoxy matching and backing layers , an interface to the Vantage Verasonics system with electrical impedance matching, and a scanning tank with a translation stage. We will present the progress made towards building FlexUCT, and detail the design and testing of 4-element array prototypes (see Figure).

Specifically, a low-cost method has been developed to manufacture matching and backing layers. Novel tranducer-array assembly methods have been used, following investigation into the accuracy of the PZT element orientation using microCT scans. The acoustic cross talk and internal reverberations within the prototypes have been characterised and are negligible, and methods to prevent electrical cross talk for low-cost matching networks have been explored. The bandwidth of the prototypes has been measured using broadband optoacoustic sources and is shown to be 61% with a centre frequency of 2MHz, but the flexible design allows PZT elements to be used with a resonance frequency between 0.5MHz-5MHz. Field scans of the 4-element prototype have been performed, showing a -3dB beam thickness of 9mm, and the directivity and SNR have also been characterised.

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