**Towards Real-time High Resolution Ultrasound Imaging of Individual Cells**

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**Introduction**

Scanning acoustic microscopy (SAM) with ultrasound in the frequency range 100 – 500 MHz has demonstrated a useful capability to image individual cells [1], providing information complementary to optical imaging. However, existing SAM systems are often cumbersome and slow, rather than offering the convenience of biomedical ultrasound imaging systems. One way to achieve this convenience at cellular level is to create micro-scale high frequency ultrasound annular arrays.

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**Research Aims**

- Design of Micro-scale high frequency (150MHz) kerfless annular arrays for imaging, to achieve high spatial resolution and depth focusing
- Fabrication and characterization of annular arrays
- The use of single crystal materials will be considered to enhance the device performance
- Imaging of developmental stages of chicken embryo
- Imaging of mouse bowel to understand clinical stages of bowel cancer

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**Fabrication of Commercial High Frequency Transducers**

**A. Micro-moulded Piezoelectric Composite**
- Surfaces of composite must be flat, parallel and smooth in preparation for photolithography
- After standard processing, the two dissimilar materials in the composite retain surface relief
- Lapping and polishing processes have been adapted to provide flat and smooth surfaces

**B. Advanced Surface Finishing**
- This process will be adapted for high frequency ultrasound array fabrication

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**High Frequency Ultrasound Scanning Bio-Microscopy**

- High resolution scanning is required to obtain accurate images with single element transducers
- Image displayed during scanning for on-line imaging
- Stable scanning system to reduce vibration noise
- System is capable of 2D and 3D image acquisition
- 2 µm scan resolution in X and Y directions

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**Initial Design and Simulation of Ultrasound Imaging Arrays**

- The resolution integral provides a standard for determining the performance of transducers before and after manufacturing
- It is a figure of merit for characterising ultrasound images in terms of the length over which the ultrasound beam remains focussed
- The resolution integral can give a good objective comparison of transducers based on the beam width and the penetration depth [2]

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**Summary**

- An annular array gives a high resolution integral with many fewer elements compared to linear or phased arrays
- The axial symmetry of the annular array leads to formation of good quality radiation pattern with fewer elements
- Annular arrays require mechanical scanning to produce images

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**References**


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