

Final Report Summary

Modelling of a Frequency Steered Ultrasonic Transducer Array



Tritech International Ltd
<http://www.tritech.co.uk>



University of Paisley
<http://www.paisley.ac.uk>

A feasibility study was undertaken to determine if Finite Element Analysis (FEA) could be utilised for the design and characterisation of frequency steered ultrasonic transducer arrays. This involved a partnership between the Tritech International Limited, Aberdeen (with their expertise in sonar imaging) alongside the Microscale Sensors Research Group at the University of Paisley (with their expertise in computer simulation).

Tritech International Ltd is the most decorated oil-related company in Scotland. The company is a current winner of the prestigious Queen's Award for Innovation. Past honours include the Royal Society of Edinburgh's Millennium Award and the Queen's Award for Export Achievement. Tritech is an industry leader in the provision of sensors and tools for Remotely Operated Vehicles (ROV) and Autonomous Underwater Vehicles (AUV). Tritech provide full acoustic survey packages including ROV obstacle avoidance sonars, profiling sonars, side-scan sonar systems, bathymetric systems, altimeters and sub-bottom profilers.

Microscale Sensors is part of the University of Paisley's Schools of Computing and Science & Engineering. The group has attracted in excess of £1million of funding in the last two years to support a strong cohort of researchers and excellent state-of-the-art research labs. The group has expertise in ultrasonic design and applications underpinned by generic skills in mathematical modelling and FEA. Microscale Sensors collaborate with academic groups and commercial organisations at local, national and international levels – establishing joint projects through a variety of mechanisms including CASE studentships, TTOM, KTP, dti LINK, EPSRC funding and EU project schemes.

For acoustic packages, frequency steered ultrasonic transducer arrays would have significant commercial and technical advantages over the conventional single-element mechanically scanned transducers currently used by Tritech. These advantages include the possibility of:

- electronic scanning that permits the very rapid coverage of the areas of interest, typically an order of magnitude faster than the single-element mechanical system.
- beam forming that permits the selected beam angles to be optimised ultrasonically by orienting them perpendicularly to areas of interest
- beam steering that permits the mapping of areas of interest at appropriate angles to optimise the probability of detection
- electronic focusing that permits optimising the beam shape and size at the areas of interest

The results of the feasibility study are best summarised with the following graphs depicting pressure versus arc-length a distance 50cm from a frequency steered ultrasonic transducer array.

TTOM.org.uk

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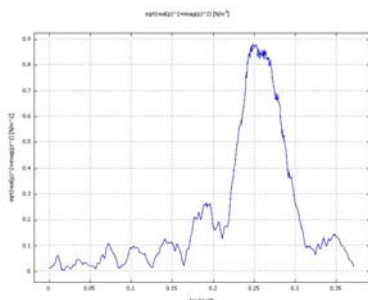


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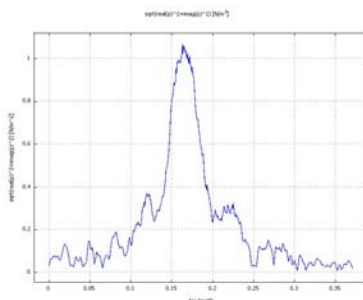


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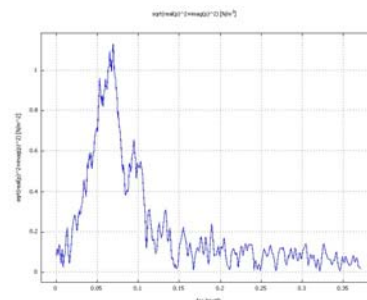




Frequency Of Operation: 350kHz



Frequency Of Operation: 400kHz



Frequency Of Operation: 500kHz

Over a sweep of 150kHz, it can be clearly seen that the main lobe emitted by the array rotates through an arc-length of approximately 0.25m – which corresponding to an angle of almost 30°.

For Tritech International Ltd, the feasibility study showed how FEA can be used to:

- reduce the time taken to develop a commercial ultrasonic transducer array by identifying failure issues whilst still in the design stage
- reduce the time taken to market and associated costs by testing computationally as opposed to iterative 'prototyping and testing'
- gain additional product knowledge by having a better understanding of the performance the ultrasonic transducer arrays thereby improving competitiveness

Upon completion of the feasibility study, the partnership between the University of Paisley and Tritech will continue by constructing and characterising commercial devices, as well as developing and refining the predictive software. Various means of further funding is being explored.