Underwater Acoustic Transducers, Narrowband and Wideband (Design, Fabrication, Evaluation)

Underwater Research Lab, Simon Fraser University

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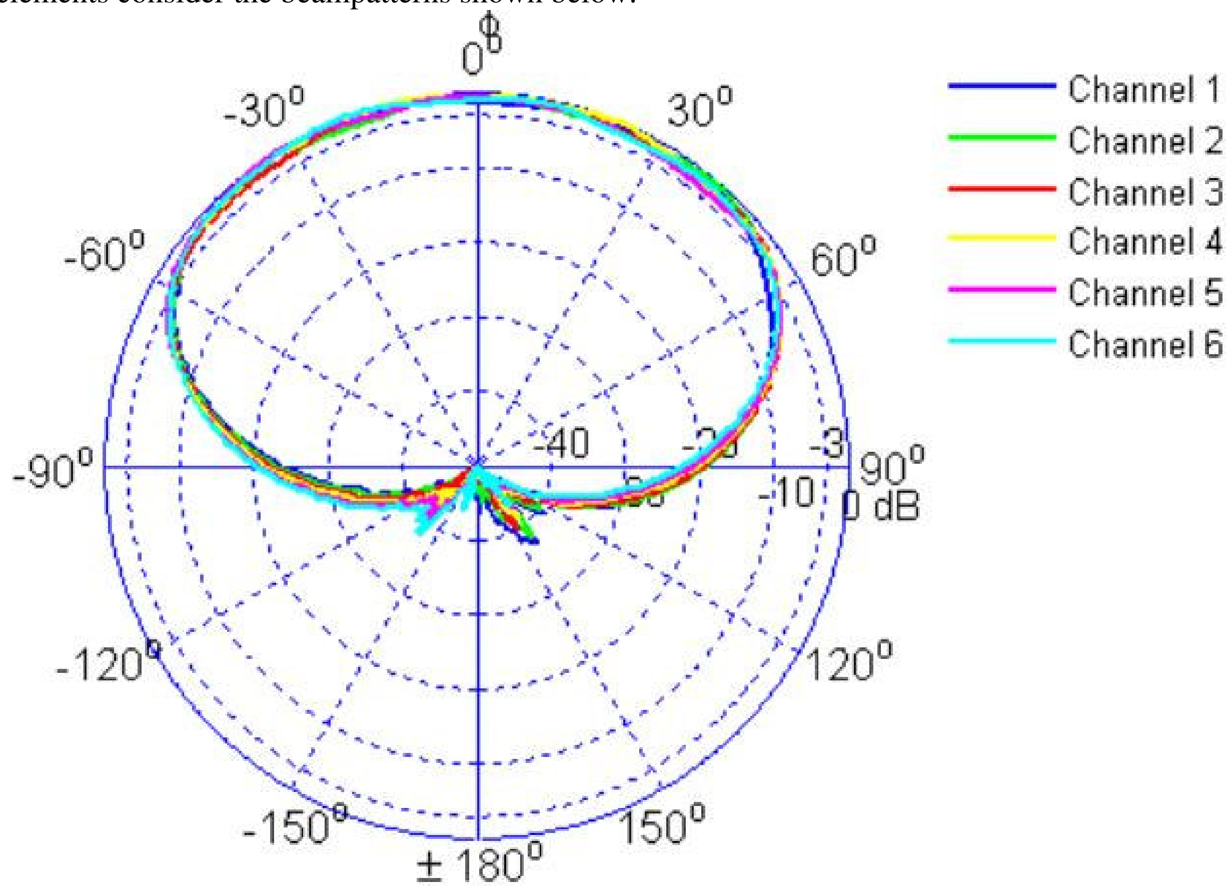
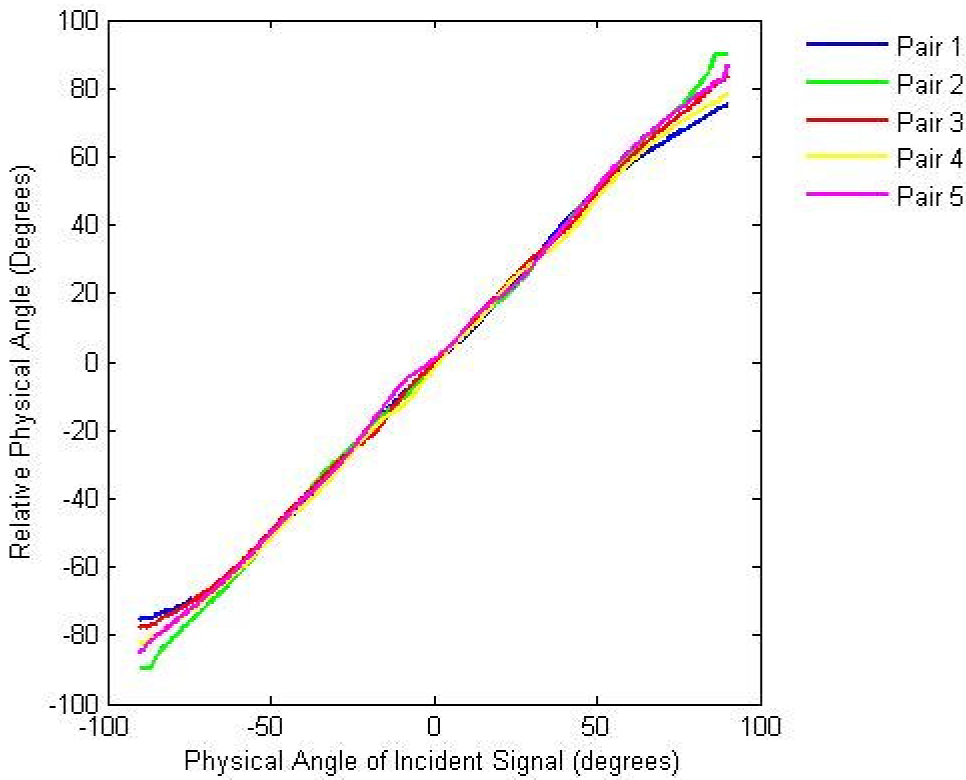
The Underwater Research Lab at Simon Fraser University has been researching the design, fabrication, and evaluation of underwater acoustic transducers since 1995. Our focus is on special purpose (e.g. broadband) single element transducers and multi-element sidescan transducers for 3D sidescan applications. We have designed, fabricated and tested 3D sidescan transducers for shallow water (300 m), and deep water (3000 m) applications, operating in the frequency range from 180kHz to 300kHz. Special features of these transducers include wide beampatterns (beamwidths 100 to 115 degrees) uniform across all elements, and a linear phase response across elements.

As an example of the performance of a 200kHz deep water 3D sidescan transducer with six elements consider the beampatterns shown below.



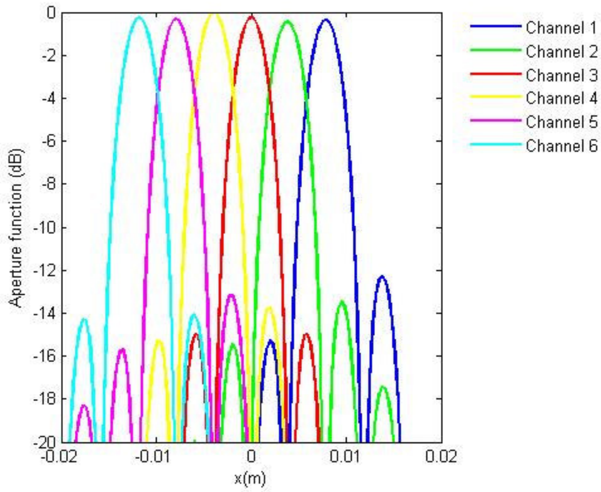
These beampatterns were measured using the URL's eight channel coherent beampattern measurement system. Note that the beams are uniform and smooth (low ripple) indicating a low level of crosstalk. The back lobes are down 37 dB and the beamwidth for all six elements is 115 degrees.

In addition, to multi-channel beampatterns the URL beampattern measurement system also measures relative angle response and the location of the element phase centers. The figure shown below is the relative phase response for the deepwater 200kHz transducer discussed above.

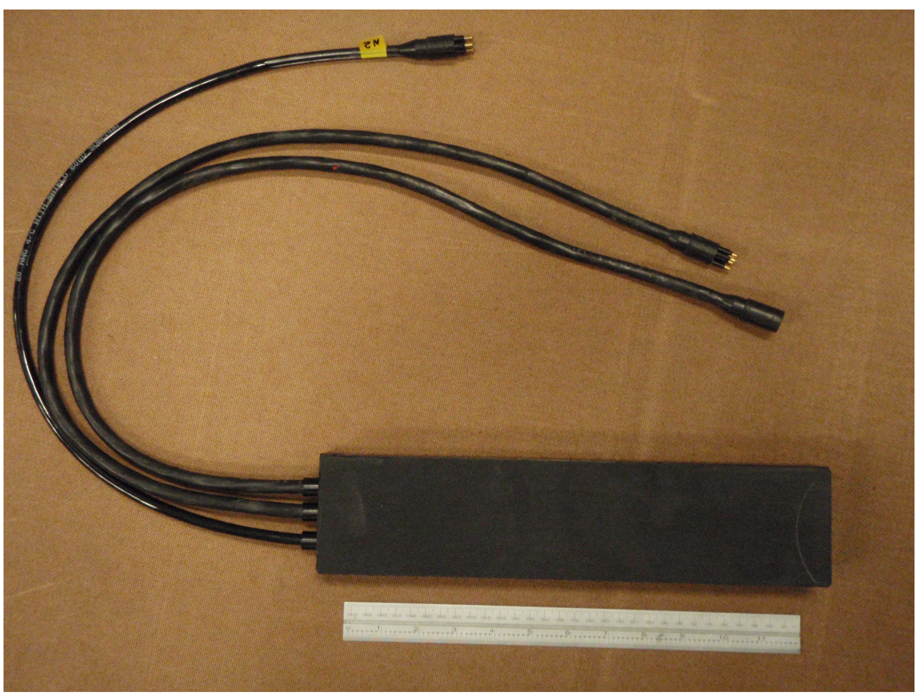


The relative phase response shows the signal incident angle on the x axis and the estimated arrival angle on the y axis. The estimated arrival angle is determined by estimating the relative electrical phase angle between neighbouring elements and converting this to the physical arrival angle. Ideally, this plot should be a straight line with the real incident angle (x axis) being the same as the estimated arrival angle (y axis). It is evident that this 200kHz deepwater transducer has a very good relative angle response and therefore the transducer will perform very well in angle estimation applications.

In commissioning transducers for angle estimation applications it is important that the phase centers of the elements match the designed spacing for the array elements. The multi-channel beampattern measurement system in the URL is capable of processing the coherent beampattern data to provide an estimate of the phase center for each array element. The figure shown below is a plot of the estimated phase center as a function of spacing across the array. The estimated phase center for an array element is at the maximum of the curve for that particular element. It can be seen that the maximums occur at a spacing of 0.375 cm which is one half of a wavelength at 200kHz.



Shown below is a picture of one of the URL's deepwater 285kHz 3D sidescan transducers.



Wideband Transducers

Although not shown here we have designed, fabricated, and tested single element wideband transducers with center frequencies ranging up to 1.6MHz.

Commercialization

We are looking for partners who would like to help us commercialize our underwater acoustic transducer technology including the beampattern measurement system. Also, we are open to considering designing, prototyping, testing, and possibly manufacturing transducers for potential partners.