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INFLUENCE OF PHASED ARRAY PATTERN ON BEAM DIRECTIVITY

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Abstract. *An ultrasonic transducer for in-air application has been fabricated using ferroelectric polymer technology. Beam forming theory is applied for enhancing directionality. The theoretical parametric phased array pattern are discussed. The directivity property of the planar array is investigated in terms of the audio pressure and corresponding simulation has been done. It is shown that the element number and array pattern have significant effect on the audio pressure. The proper amount and special array pattern of the elements can suppress the side lobe amplitude, eliminate the back lobes, and lead to sharper directivity which is the necessary characteristic for ultrasound beam in-air applications.*
Keywords: High-directivity, Beamforming, Phased array pattern, Ultrasonic transducer

1. **Introduction.** Since the 1950s, much attention has been paid to the phased arrays which can focus a high-directional ultrasonic beam. Two kinds of arrays, antenna array and sonar array, have been widely used in detecting, acquisition, and imaging in the fields of fluid and solid. But another kind of phased transducer array which is aimed at producing high directional ultrasonic in air and being applied to directional audio system has not been developed as maturely as the above two. The potential demands, such as video conferencing, car phones and multi-channel surround sound systems, etc. [1], have lead more and more attention to this kind of phased transducer array.

In the early 1980s, T. Kamakura and his cooperators firstly presented their ideas of creating sound by the nonlinear propagation effect of ultrasonic [2]. Thereafter, more researchers [3,4] attempted to fabricate loudspeakers to make directional sound by nonlinear effects of ultrasonic, but failed. Significant problems of distortion, power requirement, ultrasonic exposure, and general device feasibility made most of them abandoned. In 2002, Pompei [5] in MIT made further refinement about the distortion and frequency response. At the same time, the American Technology Corporation offered a more successful sample of parametric array loudspeaker, which was named "Hypersonic Sound (HSS)" [6]. But it was proved to be a limited success because of the resonance frequency decreasing. Another group in Nanyang Technological University of Singapore [1,7] has done much related research on the signal processing since 1998. The transducer parametric array has been optimized both in configuration and arrangement [8].