# Acoustic Vortex Beam Generation by a Piezoelectric Transducer Using Spiral Electrodes

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## Abstract

Acoustic vortex beams with spiral phase dislocations have attracted great attention in recent years, whose energy and phase distributions make them show great potential for application. Non-contact transfer of the angular momentum enables acoustic vortex beams to be used as acoustic wrenches. The circular distribution of acoustic power enables them to be used as acoustic tweezers. And the multi-order in the topological dimension indicates a great potential of channel multiplexing in acoustic communication. However, the generation of acoustic vortex beams is involved with the complexity of the overall circuit of the system substantially causing difficulty in integration and bringing high costs.

Aimed to obtain the acoustic vortex beans with high power, we employed an interdigital transducer array coated with paired spiral electrodes in this paper. An focused acoustic vortex beam can be generated by applying its beam synthesis principle. With the design of the electrode, the phases of the beams are controlled.

Using COMSOL finite element simulation software, the acoustic field excitation characteristics of the active acoustical vortex beam generation transducer are studied and analyzed. The results show the advantages compared with the traditional approaches based on passive and active methods, such as higher acoustic power, simpler operation and lower cost.

Hence, this kind of structure makes the compactness, integration and flexibility of the active vortex beam generation transducer greatly improved. And it provides a theoretical basis for promoting the practical application of acoustic vortex beams in acoustic communication and manipulation of particles, microorganisms, and cells in the future.

## References

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