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Ben Ikenson

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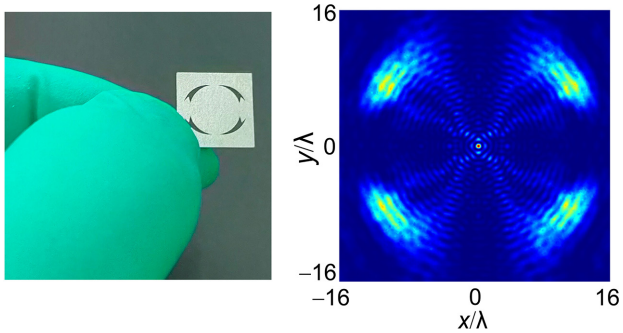
By separating the image's main lobe from its cumbersome sidelobes, the lens can improve far-field ultrasound resolution



While wave physics researchers have made considerable progress addressing diffraction limit issues in imaging resolution by manipulating evanescent waves in the last decade, their improved methods still must contend with inherent resonant loss and require complex, expensive fabrications. In more recent years, a strategy of super-oscillation has been employed to make the focusing spot smaller than the diffraction limit, but this too has a drawback: the subwavelength main lobe is unavoidably encircled by nontrivial sidelobes, severely hindering its various potential applications.

Zeng et al. proposed a novel meta-lens with four centrosymmetric dart-like apertures, each with three sharp corners, to modulate wave intensity into a delta-like function at the source plane's corners. Without complicated processes or expensive setups, the researchers constructed the apertures by overlapping two basic circles and then employed rotation and translation operations to remarkable effect.

"We achieved a high-quality subwavelength ultrasonic focusing underwater at 5 MHz by using the sharp-corner acoustic meta-lens," said author Yu-Gui Peng. "The size of the tiny main lobe is beyond the diffraction limit and the nontrivial sidelobes are far away from the vision, at least ten wavelengths away from the central spot."

The authors suggest their new strategy can be easily transferred into other wave systems and may have immediate uses.

"This new type of meta-lens can be further combined with medical ultrasound systems to improve the resolution of imaging or treatment," said author Xue-Feng Zhu. "Furthermore, since the focusing spot is very small, it can precisely and selectively stimulate a single nerve for the interdisciplinary study of behavioral neurology."

Source: "Far-field super-resolution focusing with weak side lodes and defect detection via an ultrasonic meta-lens of sharp-edge apertures," by Long-Sheng Zeng, Zhi-Min Li, Zi-Bin Lin, Hao Wu, Yu-Gui Peng, and Xue-Feng Zhu, *Applied Physics Letters* (2022). The article can be accessed at https://doi.org/10.1063/5.0094606.

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