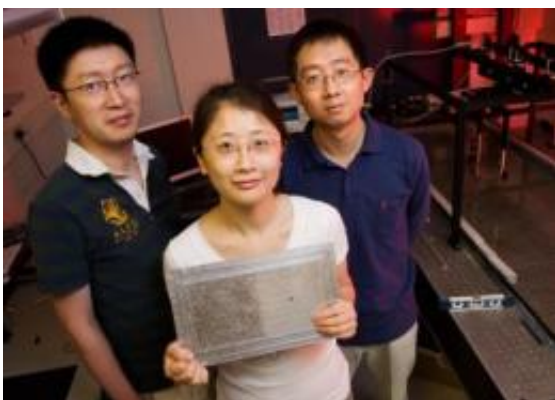


First acoustic metamaterial 'superlens' created

June 24 2009



A team of Illinois researchers led by Nicholas X. Fang, left, a professor of mechanical science and engineering, have created the world's first acoustic "superlens." Doctoral student Shu Zhang holding the lens and Leilei Yin, a microscopist at Beckman Institute, were co-authors. Credit: L. Brian Stauffer

A team of researchers at the University of Illinois has created the world's first acoustic "superlens," an innovation that could have practical implications for high-resolution ultrasound imaging, non-destructive structural testing of buildings and bridges, and novel underwater stealth technology.

The team, led by Nicholas X. Fang, a professor of mechanical science and engineering at Illinois, successfully focused ultrasound waves through a flat metamaterial lens on a spot roughly half the width of a wavelength at 60.5 kHz using a network of fluid-filled Helmholtz

resonators.

According to the results, published in the May 15 issue of the journal *Physical Review Letters*, the acoustic system is analogous to an inductor-capacitor circuit. The transmission channels act as a series of inductors, and the Helmholtz resonators, which Fang describes as cavities that house resonating waves and oscillate at certain sonic frequencies almost as a musical instrument would, act as capacitors.

Fang said acoustic imaging is somewhat analogous to optical imaging in that bending sound is similar to bending light. But compared with optical and X-ray imaging, creating an image from sound is "a lot safer, which is why we use sonography on pregnant women," said Shu Zhang, a U. of I. graduate student who along with Leilei Yin, a microscopist at the Beckman Institute, are co-authors of the paper.

Although safer, the resultant image resolution of acoustic imaging is still not as sharp or accurate as conventional optical imaging.

"With acoustic imaging, you can't see anything that's smaller than a few millimeters," said Fang, who also is a researcher at the institute. "The image resolution is getting better and better, but it's still not as convenient or accurate as optical imaging."

The best tool for tumor detection is still the optical imaging, but exposure to certain types of [electromagnetic radiation](#) such as X-rays also has its health risks, Fang noted.

"If we wish to detect or screen early stage tumors in the human body using acoustic imaging, then better resolution and higher contrast are equally important," he said. "In the body, tumors are often surrounded by hard tissues with high contrast, so you can't see them clearly, and acoustic imaging may provide more details than optical imaging

methods."

Fang said that the application of acoustic imaging technology goes beyond medicine. Eventually, the technology could lead to "a completely new suite of data that previously wasn't available to us using just natural materials," he said.

In the field of non-destructive testing, the structural soundness of a building or a bridge could be checked for hairline cracks with acoustic imaging, as could other deeply embedded flaws invisible to the eye or unable to be detected by optical imaging.

"Acoustic imaging is a different means of detecting and probing things, beyond optical imaging," Fang said.

Fang said acoustic imaging could also lead to better underwater stealth technology, possibly even an "acoustic cloak" that would act as camouflage for submarines. "Right now, the goal is to bring this 'lab science' out of the lab and create a practical device or system that will allow us to use acoustic imaging in a variety of situations," Fang said.

Source: University of Illinois at Urbana-Champaign ([news](#) : [web](#))

Citation: First acoustic metamaterial 'superlens' created (2009, June 24) retrieved 24 April 2024 from <https://phys.org/news/2009-06-acoustic-metamaterial-superlens.html>

<p>This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.</p>
--