Acoustic lensing and holographic reconstruction with metamaterials

Unmet Need

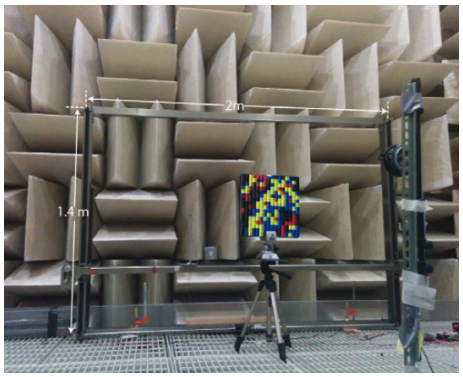
Manipulation of sound waves in air often requires many amps, transducers, and the electronics to control them, making applications like ultrasonic sensors for cars and wireless power transfer complex and power intensive. Acoustic holograms, which are conceptually similar to the more widely-known optical holograms, can be used to more precisely lens and direct sound waves to create more efficient ultrasonic sensors and wireless power transfer equipment – however, most acoustic holography techniques also require sophisticated circuitry and transducer arrays. There exists a need for new, efficient techniques for acoustic holography.

Technology

Duke inventors have developed a new, efficient approach to creating acoustic holograms. This approach greatly simplifies the transducer array to a single element, which is patterned with designs that manipulate incoming sound waves to reconstruct a desired acoustic pattern in the focal plane. Specifically, different arrangements of subwavelength labyrinthine unit blocks which are designed, 3D-printed, and then assembled into a metamaterial board that passively reconstructs an acoustic pattern. A change in the design and arrangement of the blocks leads to a corresponding change in the acoustic. This technology has been demonstrated in the lab in audible and ultrasonic ranges, showing good agreement with simulations.

Other Applications

Precise control of acoustic waves through holography could have wide-ranging applicability, including for medical imaging, therapeutic ultrasound delivery,



consumer audio speakers, nontactile displays, acoustic manipulation and levitation of small objects, and more.

Advantages

- Compact and simple design
- Less power consumption
- Easily constructed using 3D printing or CNC milling
- Lower cost for construction and manufacturing

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Patent Information

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Country United States of America

Meet the Inventors

Xie, Yangbo
Cummer, Steven
Jing, Yun
Shen, Chen

Contact For More Info

Dardani, Dan
919 684 3311
daniel.dardani@duke.edu

Department

Electrical & Computer Engineering (ECE)

Publication(s)

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External Link(s)

• From the lab of Dr. Steven Cummer