# Researchers discover way to allow 80 percent of sound to pass through walls

June 21 2013, by Bob Yirka

Credit: Oula Lehtinen/Wikipedia

(Phys.org) —A team of researchers in Korea has discovered a way to allow sound to pass through walls almost as if they were not there at all. As the group describes in their paper published in the journal *Physical Review Letters*, the technique involves drilling very small holes in a wall and then tightly covering them with a thin sheet of plastic.

In this new effort, the researchers sought to extend prior research done by Thomas Ebbesen and colleagues in 1998 where it was discovered that holes, made in a metal sheet that were smaller than the wavelength of light shone on it, allowed more light to pass through than expected—a property that has come to be known as extraordinary optical transmission . Subsequent research found the principle did not apply to sound waves due to rigid parts of the barrier reflecting back most of the applied sound. The researchers on this new team suspected that altering certain aspects of the barrier might allow for the property to hold for sound after all.

They began by drilling several holes (10 millimeters in diameter) in a 5-millimeter -thick piece of metal. Next, they placed a speaker on one side of the "wall" and a microphone on the other. With just the holes, they found the wall blocked sound almost as effectively as if there were no holes drilled in it. Next, they covered one side of the wall with a thin tensioned membrane (plastic wrap). After playing the sound again, the researchers discovered that the addition of the membrane allowed much more sound to pass through the wall—on average 80 percent more—almost as if the wall weren't there at all.

The membrane, the team explains, allows for "zero resistance" as the sound encounters the holes. At the resonance frequency of the membrane (1200 hertz), air moved in the holes as if it had no mass at all. That in turn allowed sound waves to move through very quickly. The sound in the holes was actually concentrated as it passed through, suggesting that the technique might be used as a way to magnify small signals. One application of this discovery could be walls that serve as security barriers.

**More information:** Giant Acoustic Concentration by Extraordinary Transmission in Zero-Mass Metamaterials, *Phys. Rev. Lett.* 110, 244302 (2013) prl.aps.org/abstract/PRL/v110/i24/e244302

**Abstract**
We demonstrate 97%, 89%, and 76% transmission of sound amplitude in air through walls perforated with subwavelength holes of areal coverage fractions 0.10, 0.03, and 0.01, respectively, producing 94-, 950-, and 5700-fold intensity enhancements therein. This remarkable level of extraordinary acoustic transmission is achieved with thin tensioned circular membranes, making the mass of the air in the holes effectively vanish. Imaging the pressure field confirms incident-angle independent transmission, thus realizing a bona fide invisible wall. Applications include high-resolution acoustic sensing.



Citation: Researchers discover way to allow 80 percent of sound to pass through walls (2013, June 21) retrieved 16 May 2024 from https://phys.org/news/2013-06-percent-walls.html