

Smart material prototype challenges Newton's laws of motion

May 18 2023



The prototype metamaterial uses electrical signals transported by these black wires to control both the direction and intensity of energy waves passing through a solid material. Credit: University of Missouri

For more than 10 years, Guoliang Huang, the Huber and Helen Croft Chair in Engineering at the University of Missouri, has been investigating the unconventional properties of "metamaterials"—an artificial material that exhibits properties not commonly found in nature as defined by Newton's laws of motion—in his long-term pursuit of designing an ideal metamaterial.

Huang's goal is to help control the "elastic" energy waves traveling through larger structures—such as an aircraft—without light and small "metastructures."

"For many years I've been working on the challenge of how to use mathematical mechanics to solve engineering problems," Huang said. "Conventional methods have many limitations, including size and weight. So, I've been exploring how we can find an alternative solution using a lightweight material that's small but can still control the low-frequency vibration coming from a larger structure, like an aircraft."

Now, Huang's one step closer to his goal. In a new study published in the *Proceedings of the National Academy of Sciences*, Huang and colleagues have developed a prototype metamaterial that uses [electrical signals](#) to control both the direction and intensity of energy waves passing through a [solid material](#).

Potential applications of his innovative design include military and commercial uses, such as controlling radar waves by directing them to scan a specific area for objects or managing vibration created by air turbulence from an aircraft in flight.

"This metamaterial has odd mass density," Huang said. "So, the force and acceleration are not going in the same direction, thereby providing us with an unconventional way to customize the design of an object's structural dynamics, or properties to challenge Newton's second law."

This is the first physical realization of odd mass density, Huang said.

"For instance, this metamaterial could be beneficial to monitor the health of civil structures such as bridges and pipelines as active transducers by helping identify any potential damage that might be hard to see with the human eye."

More information: Qian Wu et al, Active metamaterials for realizing odd mass density, *Proceedings of the National Academy of Sciences* (2023). [DOI: 10.1073/pnas.2209829120](https://doi.org/10.1073/pnas.2209829120)

Provided by University of Missouri

Citation: Smart material prototype challenges Newton's laws of motion (2023, May 18) retrieved 27 April 2024 from <https://phys.org/news/2023-05-smart-material-prototype-newton-laws.html>

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.