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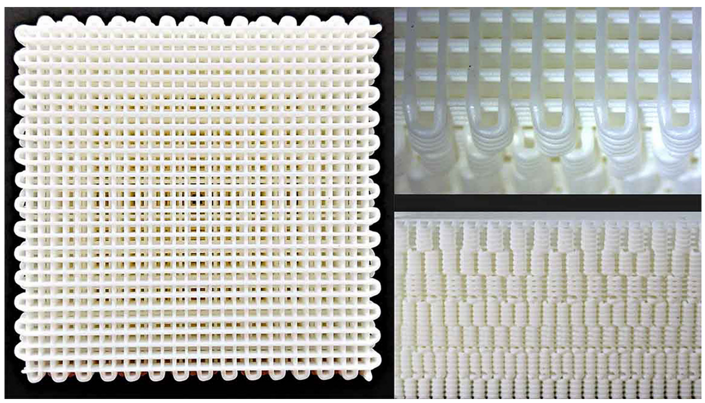
Researchers present process to design, optimize and manufacture continuously graded acoustic porous materials with near-perfect noise absorption in given frequency range.



If you enter a music recording studio, you'll notice foam lining the wall. The material serves a practical purpose – absorbing sound so the walls don't reflect it. Absorption of acoustic waves is of interest in numerous industries for both mechanical and practical reasons. Boulvert et al. present a process for how to manufacture an optimally graded porous material for high levels of sound absorption.

Most open-cell porous material used in acoustic treatments can absorb sound waves at distinct frequencies with low absorption values. The researchers developed a gradient optimization algorithm that can be applied to 3D printing for manufacturing sound absorbing materials across a wide range of frequencies.

“In the strictest sense, the perfect absorption condition can only occur at isolated frequencies,” said author Jean Boulvert. “However, the absorption coefficient of the optimized graded porous treatment is very close to being perfect over a wide frequency band, thus largely improving on usual porous treatments. For instance, our 30 mm thick broadband optimized material achieves an absorption greater than 99.7% between 3900 and 19500 Hz.”

The team developed their algorithm by examining and gaining understanding of porous materials at their microstructures. For rigidly backed material, they obtained higher absorption across frequencies by creating a sequence of low and high porosity in the profile. The 3D printing technique the researchers employed allowed for this accurate control over materials’ microstructure.

“In the near future, we will optimize graded anisotropic materials for diffuse field absorption which is when sound waves are propagating in all directions,” said Boulvert.

Source: “Optimally graded porous material for broadband perfect absorption of sound,” by Jean Boulvert, Théo Cavalieri, Josué Costa-Baptista, Logan Schwan, Vicente Romero-García, Gwénaël Gabard, Edith Roland Fotsing, Annie Ross, Jacky Mardjono, and Jean-Philippe Groby, *Journal of Applied Physics* (2019). The article can be accessed at http://doi.org/10.1063/1.5119715.