Experimental Validation of a 3D-Printed Quadratic Residue Metadiffuser

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Abstract

At the previous 2018 Symposium on Acoustic Metamaterials in Xátiva, the importance of acoustic diffusers and metadiffusers was discussed in the context of room acoustics. Different from standard diffusers, metadiffusers are based on locally resonant materials; a strategy first used to design deep-subwavelength absorbers making use of the slow sound induced by the strong dispersion introduced by the resonant building blocks. As such, instead of focusing on absorptive or transmitting properties, metadiffusers emphasize on obtaining a uniform angular scattering distribution. This is accomplished using a slotted panel with thin slits, each one loaded with a set of Helmholtz resonators. Such structures are of particular interest due to their particular scattering patterns, that can be designed on demand by optimizing the geometry of the metamaterial. The deep-subwavelength nature of these metasurfaces can lead to dimensions 20 to 46 times smaller than the design wavelength, i.e. about a 1/20th to 1/10th of the thickness of traditional phase grating designs. A specific design of a Quadratic Residue metadiffuser will be herein studied through an experimental validation of the 3D-printed structure, leading to a discussion on the potential applications of such metasurfaces in critical listening environments.