

## Passive Attenuation with Multiple Resonator Rings for Musical Instruments Equalization

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**Abstract :** In this paper, a series of ring-shaped attenuators utilizing Helmholtz and quarter wavelength resonators in variable, fixed, and combined configurations have been manufactured using a 3D printer. We illustrate possible uses by incorporating such devices into musical instruments (e.g. in acoustic guitar sound holes) and audio speakers with a view to controlling such devices tonal emissions without electronic equalization systems. Numerical investigations into the transmission loss values of these ring-shaped attenuators using finite element method simulations (COMSOL Multiphysics) have been presented in the frequency range of 100- 1000 Hz. We compare such results for each attenuator model with experimental measurements using different driving sources such as white noise, a maximum-length sequence (MLS), square and sine sweep pulses, and point scans in the frequency domain. Finally, we present a preliminary discussion on the comparison of numerical and experimental results.

**Keywords :** equaliser, metamaterials, musical, instruments

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