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Manufacturability and Acoustic Performance of Quarter-Wave Systems with different configurations

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One of the simplest and most common acoustic devices is the quarter-wave resonator. An adaptive-passive device shaped as a tube able to attenuate a frequency out of a range. This type of resonator is very attractive because it does not inject acoustic power in the system to reduce noise and because it is easy to manufacture. This device is widely used in many applications such as noise reduction in engine exhaust noise. Depending on the geometry of this device, diameter and length of the pipe, the value of this frequency (natural or resonance frequency) will change. So having a system containing all possible geometries will theoretically attenuate all frequencies. The aim of this work is to provide different configurations of systems formed by quarter-wave resonators in order to establish the acoustic performance of them. A variable that will also be considered is the manufacturability of each configuration.

All the resonator configurations proposed in this work sprout from the same idea: a perforated plate where each hole is a quarter-wave resonator. A 'random forest' where all holes have different length randomly assigned is the first configuration to study. Afterwards a fractal configuration following a Cantor Set generation is proposed; holes are geometrically related to each other through the fractal dimension. The distribution of the holes along rows will also take a place in our study. We will observe different configurations regarding rows placed following a quincunx alignment. Then, a comparison regarding manufacturability and acoustic performance will be studied.

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