

ABSTRACT OF THE DOCTOR THESIS

Design and characterization of acoustics metamaterials based on waveguide

by

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The aim of this work has been to obtain acoustic metamaterials which exhibit double negative behavior in their effective parameters from structures made of materials that are considered acoustically rigid. To accomplish this objective, an acoustic metamaterial whose scattering units consist of drilled cavities inside two-dimensional waveguide are considered. A parametric study of the effective dynamical mass density and effective bulk modulus as a function of frequency was performed. This study has demonstrated new acoustic metamaterials that possess a negative behavior in one or both effective parameters that characterize them, enabling the possibility to design new acoustic devices.

The significant results of the work performed include the theoretical and experimental demonstration of an acoustic metamaterial having to a dynamical mass density less than of the surrounding medium and bulk modulus having a resonant behavior over range frequencies. Furthermore, the design of the scattering unit allows one to obtain metamaterials which exhibit a near zero density in over a range of frequencies and that, in another range of frequencies, has a double negative behavior in their effective parameters.

Based in this work novel application in the field of acoustics are possible including the tunneling effect, controlling the radiation field, and a acoustic wave guide splitter. All these applications are made possible by making use of near zero density behavior that exhibited by some of the metamaterials studied in this work. Another interesting application that has been proposed is the possibility of designing an acoustic lens using cavities localized inside of the waveguide.