National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Acoustic Attenuation of Periodic Helmholtz Resonator and Their use in Designing Periodic Scatterers for Outdoor Noise Control
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Venue	: ID 312 MS Team (Meeting ID: 426 848 114 257 Passcode: h7D5Wf)
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Abstract	:

This thesis presents the study of various configurations of Helmholtz resonators, combined with various acoustic elements such as perforated plates, micro-perforated plates and porous materials. It also emphasizes the noise control and metamaterials perspective including designing periodic scatterer made with array of Helmholtz resonators along its length for outdoor noise control in low frequency regime.

The research starts with studying a Helmholtz resonator from acoustic metamaterial perspective. Helmholtz resonator is a single negative metamaterial where the effective bulk modulus is negative. The said fact has been re-established analytically and verified by results obtained from simulations. First the scattering parameters have been calculated from transfer matrix which have been used to calculate the effective acoustic properties with an assumption that the material under investigation is homogeneous, and width of the sample is much smaller compared to the wavelength corresponding to maximum frequency of interest. Additionally, the experimental results are presented which support the said observations.

Next, various configurations of Helmholtz resonators have been studied to attain double negative effective properties. The various configurations are Helmholtz resonators in series, parallel, and the dual Helmholtz resonators in series and parallel. The said configurations are also studied with the similar and dissimilar resonators. Out of seven configurations, it has been shown that with five configurations attain double negative properties. Additionally, with an array of Helmholtz resonators, it has been demonstrated that the effective bulk modulus and the effective density are getting negative at resonance frequency regime having elevated frequency bandwidth.

Following, the acoustic elements such as perforated plate (PP) and micro-perforated plate (MPP) have been combined with Helmholtz resonator and have been studied to attain double negative effective properties in broadband. Total eight different configurations have been conceptualized and corresponding analytical solutions supported with experimental measurements have been presented.