Guided Waves Propagation in Two-layer Tubes: Effects of the Inner Part in Contact with Air in the Cavity

Abstract

This paper studies the acoustic backscattering of short ultrasonic pulses by air-filled stainless steel-solid polymer two-layer cylindrical tubes immersed in water. The stainless steel one-layer tube is taken as a reference. The focus of this paper is on revealing the effects of physical characteristics of the solid polymer on the scattering phenomenon. The work is done from the calculation of the backscattered pressure, an inverse Fourier Transform, which provides a temporal signal. Wigner-Ville representation has been chosen in order to analyze the acoustic signal backscattered by each tube. For reduced frequencies ranging from 0.1 to 200, the resonance spectrum and resonance trajectories have shown the manifestations of the guided waves. In this respect, the bifurcation of the A0 wave to the A0- and the A0+ waves has been observed. The authors investigate the reduced cutoff frequencies of the symmetrical and the
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antisymmetrical guided waves, specially the curves changes. The findings are then compared with those obtained for the stainless steel one-layer cylindrical tube. Reduced cutoff frequency values have also been extracted from Wigner-Ville time-frequency images. A good agreement has, therefore, been obtained. The study of acoustic scattering by stainless steel-solid polymer two-layer tubes has revealed the sliding of the reduced cutoff frequencies of A1 and S1 guided waves towards low values, due the repulsion phenomena. The relationship between reduced cutoff frequency and velocity of wave in the solid polymer is linear; which is a very interesting result.

References

- Cohen, L. 1995 Time-Frequency Analysis, Prentice Hall, PTR, the City University of New York, 1-316.

**Index Terms**

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**Keywords**

Acoustic backscattering; Two-layer cylindrical tube; Resonance spectrum; Wigner-Ville time-frequency representation.