PROPAGATION OF GUIDED WAVES IN A HOLLOW CIRCULAR CYLINDER APPLICATION TO NON DESTRUCTIVE TESTING

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SYNOPSIS
Advanced research into non destructive control of industrial pipe works provides several acoustical methods for inspection of their structural integrity. The use of guided waves is one possible solution to detect and identify different flaws. In this paper, we are studying the propagation of guided waves in a tube and the correlation of these last by defects of surface. The dispersion curves of symmetrical modes (longitudinal and torsion) and asymmetrical mode (inflection) have been established. The mode chosen to generate it the second longitudinal mode, for this mode the radial element of displacement is very weak in front of the axial element in the point produced frequency thickness equal to 0.99 MHz.mm where from a weak attenuation, according to our experimental results the L (0, 2) mode is sensitive to the depth variation and the defect circumference.

INTRODUCTION
Ultrasonic guided wave inspection is expanding rapidly to many different areas such manufacturing and in service inspection.
Our work consists, in its theoretical part (Denos.C.Gazis, 1959); to establish the dispersion equation for three families of guided modes susceptible to propagate in tubes. We supposed the normal stresses equal to zero then the hollow circular cylinder vibrates free in the space. Drawing the scattering curves will allow the chose of the best adapted mode for the structure inspection. In our case, the chosen mode is the L (0, 2) mode.
The experimental part allowed us to check the theoretical forecasts. The first stage of this experimental part is generating only the L (0, 2) mode and the identification of the echo reflected by the edge of a tube. The variation of the acoustic pressure according to the circumference of the defect, and the depth, was studied. The results of the modal decomposition method (John J.Ditri, 1994), concerning the amplitude of the modes diffracted by circumferential defects according to the circumference of the defect, were presented and confronted with the experimental measures results.
A relation of proportionality between the amplitude of the signal reflected by the defect and its depth was established (Lowe, M.J.S., Alleyne, D.N. and Cawley, P, 1998). It was
verified besides that guided waves are able to detect defect when their size are smaller than the wave length wave.

**RESULTS**

In this work, the curve of variation, amplitude of the L(0, 2) mode diffracted by notches, various circumferences, is compared with our experimental results. We used, several tubes on which, of the notches of various circumferences $\alpha$ and of constant depth $p = 0.5$ mm, were carried out.

![Graph](image)

*Fig. 1 Relation between the amplitude of the reflexive signal and size circumferentially of the defect, experimental results (■) predictions of the modal decomposition method (*) .*

The figure (Fig.1) watches a good agreement between the theoretical predictions of the modal decomposition and the experimental results.

**CONCLUSIONS**

After having studied, the various families likely to be propagated in a tube, and having plotted the curves of dispersion their speeds of phase and group, one could, to choose the mode to be generated and the experimental method to use.

To generate the mode of compression L (0, 2), one used a piezoelectric transducer of centre frequency 1 MHz, the weakest frequency we have. To have the product frequency-thickness low possible, we choose a tube of which the thickness is of 1mm. The point of operation chosen is on the nondispersive zone of the curve of dispersion of the second longitudinal mode.

It was noted, a sensitivity of the emitted mode, with the variation depth and the circumference of the defect.

**REFERENCES**

