Chapter 4

Development of a System for Detecting Weld Failures

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ABSTRACT

Considering the possibility that from the area of electronics can be provided feasible solutions in the field of non-destructive testing, this chapter present a prototype and methodology that allows energize an ultrasound transducer. This system is used to evaluate for detecting weld failures at the junctions of metallic parts. Subsequently, in order to validate the design quality of that source, a computer system that allows control of a card developed ultrasound. Finally, it is implemented the ultrasonic imaging by time of flight diffraction technique, in order to obtain an objective comparison methodology to both systems.

INTRODUCTION

Ultrasonic methods of non-destructive testing have been widely used in welding inspection; however, varied defectology, search and interpretation, is often highly dependent on subjective factors such as visual fatigue, mood and physical fatigue of the evaluator, which affects the quality of the inspection (Polikar, Upda & Taylos, 1998).

Now; venture into the field of non-destructive testing, or ultrasound, involves having access to appropriate instrumentation and often expensive, so that its development has leaded to the realization of projects with the participation of students and teachers interesting challenges. In that vein, it was designed and built an essential component in ultrasonic instrumentation; that is, the excitation system (also called button). The purpose: to design and build an ultrasonic system that allows the capture of acoustic information from welded joints to identify any discontinuities present in them. With the capture of echoes generated by any defects, develop and implement algorithms for the ultrasonic imaging and diagnosing faults that threaten the integrity in industrial components such as welded joints. The development of ultrasound

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systems and ultrasound imaging algorithms can become a source of research narrows the links between industry and academia, while conducive to more simplicity and reliability of the work of the inspectors.

**FUNDAMENTALS OF ULTRASOUND**

The sound generated beyond 20,000 Hz is called ultrasound, but the frequency range used in nondestructive testing ranges from 100,000 Hz to 50 MHz, and like any sound wave meets the physical properties of sound, but differs in the short wavelength, because it can interact with small particles, such as discontinuities eventually in welded joints regions. Considering that the wavelength is inversely proportional to frequency, it follows that to achieve short wavelengths it is necessary that the disturbance in a particular environment often vibrate every second.

$$\lambda = \frac{c}{f}$$  \hspace{1cm} (1)

It is known that the human ear, on average, is capable of capturing vibrations between 20 and 20,000 Hz, as it cannot perceive the range below 20 Hz and above 20,000 Hz, infrasound and ultrasound regions, respectively. See Figure 1.

Among the physical properties that obey ultrasound, are the reflection, scattering, refraction and diffraction, all of them are very useful in non-destructive testing with ultrasound. As is known, the light is also a wave disturbance, but there is a notable difference between light waves and sound waves. While light can propagate in a vacuum, sound cannot do it; ie, the sound needs a medium to be spread, whether it is fluid or solid.

The sound propagates in fluid media as a longitudinal disturbance; this means that the traveling direction is parallel to vibration the medium through which it propagates. However, in solid media, the sound is propagated as a longitudinal wave and as transverse cutting wave, which means that the molecules vibrate perpendicularly to the direction of sound propagation. Also, exist Rayleigh waves; these have an elliptical vibration surface, and Lamb, which are disturbances whose wavelength is greater than the thickness of the solid through which they propagate (Charlesworth, J. P. 2001).

Considering a longitudinal transmission of a sound wave when moving by a certain medium, which occurs are spatial variations in time due to the compression and expansion of the molecules making up said means to measure the pressure wave propagates. See Figure 2.