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CHARACTERIZATION OF THE CRITICALLY REFRACTED LONGITUDINAL (LCR) WAVES AND THEIR USE IN DEFECT DETECTION

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Abstract: The critically refracted longitudinal (LCR) waves are used in various domains of nondestructive evaluation, especially for residual stress measurements. However, few works have characterized the associated ultrasonic beam. In this article, the characterization of the LCR ultrasonic beam, both numerically and experimentally, is first clarified in order to provide some answers to questions that arise about its behavior in elastic solids. The aim of the second part of this work is to investigate the use of the LCR waves for the detection of surface defects of different sizes in aluminum. For that, the effect of defects at fixed depth (5 mm) with various diameters (2, 4, 6, and 8 mm) and fixed diameter (8 mm) with various depths (5, 7, and 10 mm) in an aluminum sample have been investigated at frequencies around 1 MHz. It has been experimentally found that the amplitude of the (LCR) wave decreases and its frequency spectrum changes with a given defect. The rate of the decrease of the amplitude and the change in the spectrum is related to the increase of the defect depth. The study shows that the effect on the propagating of the LCR waves is larger as the defect depth increases.The critically refracted longitudinal (LCR) waves are used in various domains of nondestructive evaluation, especially for residual stress measurements. However, few works have characterized the associated ultrasonic beam. In this article, the characterization of the LCR ultrasonic beam, both numerically and experimentally, is first clarified in order to provide some answers to questions that arise about its behavior in elastic solids. The aim of the second part of this work is to investigate the use of the LCR waves for the detection of surface defects of different sizes in aluminum. For that, the effect of defects at fixed depth (5 mm) with various diameters (2, 4, 6, and 8 mm) and fixed diameter (8 mm) with various depths (5, 7, and 10 mm) in an aluminum sample have been investigated at frequencies around 1 MHz. It has been experimentally found that the amplitude of the (LCR) wave decreases and its frequency spectrum changes with a given defect. The rate of the decrease of the amplitude and the change in the spectrum is related to the increase of the defect depth. The study shows that the effect on the propagating of the LCR waves is larger as the defect depth increases.

Keywords : critical angle, critically refracted longitudinal (LCR) wave, main lobe, NDE, NDT, surface defect