World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:15, No:01, 2021

Laser Ultrasonic Imaging Based on Synthetic Aperture Focusing Technique Algorithm

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Abstract : In this work, the laser ultrasound technique has been used for analyzing and imaging the inner defects in metal blocks. To detect the defects in blocks, traditionally the researchers used piezoelectric transducers for the generation and reception of ultrasonic signals. These transducers can be configured into the sparse and phased array. But these two configurations have their drawbacks including the requirement of many transducers, time-consuming calculations, limited bandwidth, and provide confined image resolution. Here, we focus on the non-contact method for generating and receiving the ultrasound to examine the inner defects in aluminum blocks. A Q-switched pulsed laser has been used for the generation and the reception is done by using Laser Doppler Vibrometer (LDV). Based on the Doppler effect, LDV provides a rapid and high spatial resolution way for sensing ultrasonic waves. From the LDV, a series of scanning points are selected which serves as the phased array elements. The side-drilled hole of 10 mm diameter with a depth of 25 mm has been introduced and the defect is interrogated by the linear array of scanning points obtained from the LDV. With the aid of the Synthetic Aperture Focusing Technique (SAFT) algorithm, based on the time-shifting principle the inspected images are generated from the A-scan data acquired from the 1-D linear phased array elements. Thus the defect can be precisely detected with good resolution.

Keywords : laser ultrasonics, linear phased array, nondestructive testing, synthetic aperture focusing technique, ultrasonic imaging
Conference Title : ICNDTM 2021 : International Conference on Non-Destructive Testing and Methods
Conference Location : Paris, France
Conference Dates : January 25-26, 2021