1.3.54. SUBSURFACE RESIDUAL STRESS MEASUREMENT IN FRICTION STIR WELDING USING THE CRITICALLY REFRACTED LONGITUDINAL (L_{CR}) ULTRASONIC WAVE

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Introduction. In this paper, the L_{CR} ultrasonic wave method for subsurface residual stress measurement in Friction Stir Welding (FSW) is presented. Due to solid state nature of friction stir welding, in this process, the temperature remains below the melting point of joined sheets.

Although low residual stress in FSW process is one of its main advantages, however, determination of residual stress level in welded structures could be useful for more precise estimating of its life. Residual stress in this process is lower than traditional fusion welding processes, nevertheless, it may affect crack initiation and growth, corrosion resistance and the assessment of welded structures.

Many of methods used are either destructive or semi-destructive, consequently, they are costly in the life assessment procedure of structures.

The ultrasonic method is a useful tool for nondestructive determination of residual stresses. Critically Refracted Longitudinal (L_{CR}) ultrasonic waves were used in this study. Results were compared with computer simulations and at the end of this paper, future works are discussed.

Material and method. Critically Refracted Longitudinal (L_{CR}) ultrasonic wave has highest sensitivity to existing stress in wave propagation direction between various types of ultrasonic waves. L_{CR} wave is longitudinal bulk wave that propagates under surfaces. A normal probe and a special fixture, which was custom design were used to produce the L_{CR} wave.

A nano second resolution A / D card is implemented. Figure 1 shows the setting of the experiment.

Results and Conclusion. Residual stresses in the order of 50 percent of material yield stress were observed. Level of effectiveness on life assessment was considered. Different results were gained through simulation and experiments. Figure 2 shows the simulated results. The observed differences could be assigned to oversimplification which remained a major concern throughout the simulation process.

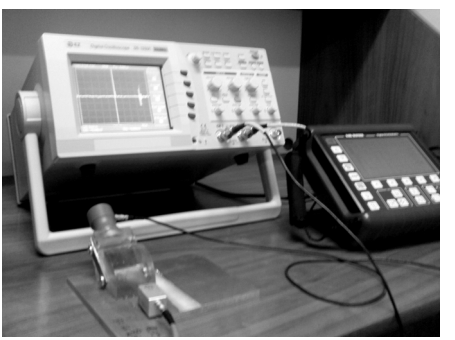
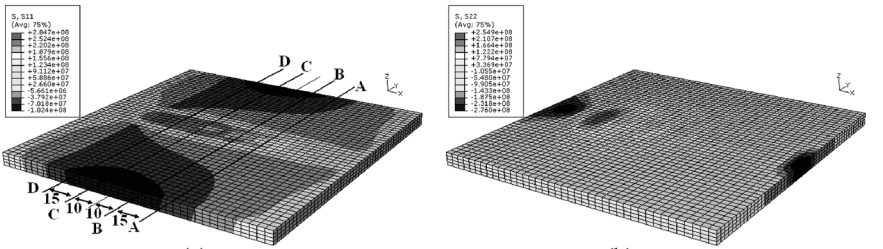


Fig. 1. Setting of the experiment



(a) (b)

Fig. 2. Simulated residual stress distribution

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