Recent Demonstrations of L_{CR} for Measuring Stress Gradients and Deformation Damage

The unique capability of the L_{CR} ultrasonic technique for stress evaluation was demonstrated in two projects earlier this year.

First is a round robin organized by Texas Tech University to demonstrate the usefulness of various nondestructive stress measurement techniques for determining stress at depth for a Ti-6Al-4V titanium bar that had been bent in a 4-point bend setup. This method gave a stress gradient at depth on both sides of the bar. We were able to obtain L_{CR} data for the compressive stress field on the convex side of the bar at 2.25 MHz and 5.0 MHz frequencies. We were furnished a bent sample as well as one where the stress field was known to be zero. The results are given in a presentation by Texas Tech at the Residual Stress Summit in Oak Ridge in October2007. Their presentation can be downloaded at:

http://tinyurl.com/cq5zda (an intro page linked to Powerpoint presentation)

On that page, click Round Robin Description at the left and their Power Point Presentation will be downloaded. If this is not available. please contact us for a copy of their Power Point presentation.

The researchers note that on the convex side our data indicate a stress slope of 584 ksi/in., compared to the Abaqus prediction of 537 ksi/in. Our L_{CR} technique cannot function on a concave side.

Because our participation in the project was unfunded, we used an existing L_{CR} probe, i.e. the excitation angle and frequency choice was governed by what was available in our lab. Other, better-funded labs were able to obtain multiple data points. Their results varied. Our results show good agreement in the comparison.

It is reasonable to expect that a more complete experimental process could further enhance the application of the L_{CR} technique for these samples.

Another project demonstrated the ability of the L_{CR} technique by combining travel-time and frequency analysis to better evaluate material damage in steels due to loading beyond the yield point. In this presentation, an analysis shows also the likelihood that the technique could be used to detect hydrogen damage in steels. See Downloads for a Power Point presentation covering this material.