

## **Evaluation of Crack Depth Using Nonlinear Acoustic Effect**

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### **Abstract**

The detection of micro-cracks in materials at the early stage of fracture is important in many structural safety insurance problems. The nonlinear ultrasonic technique (NUT) has been considered as a positive method for this, since it is more sensitive to micro-crack than conventional linear ultrasonic methods. The basic principle is that the waveform is distorted by the partial contact of crack-faces when the ultrasonic wave transmits through, and resultantly higher order harmonics are generated. This phenomenon is called as the contact acoustic nonlinearity (CAN). Magnitude of higher order harmonic is dependent on the crack opening distance (COD) and the closing stress of micro-crack. This paper shows an application to detect fatigue cracks. For this, we prepared fatigue specimens of Al6061 material with V-notch to initiate the crack, and the amplitude of second order harmonic was measured by scanning along the crack direction. From this result, we could see that the harmonic amplitude had good correlation with COD and it was able to detect the crack depth in more accurately than the common 6dB down echo method.

**Key word:** Nonlinear ultrasound, fatigue crack, closed crack