

Developement of automated system for measuring ultrasonic nonlinearity parameter

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In this paper, a new ultrasonic measurement system is introduced to evaluate elastic properties, which is named Ultrasonic Nonlinear Elasticity Tester (UNET). UNET can estimate longitudinal and transverse wave velocities, Young's modulus, Poisson's ratio, absolute ultrasonic nonlinearity parameter and 0.01% offset yield strength. UNET operates as following sequence. Firstly, The UNET conduct the linear measurement to obtain the transverse and longitudinal wave velocities and it also measure the relative ultrasonic nonlinearity parameter by conducting nonlinear measurement. Next, UNET calculates Young's Modulus, Poisson's ratio and absolute ultrasonic nonlinearity parameter from the measured values. Finally, it reconstructs the strain-stress relationship in elastic region from the Young's modulus and absolute ultrasonic nonlinearity parameter and can estimate the 0.01% yield strength. The series of whole measurement, signal processing and calculation method are conducted fully automatically. It is confirmed that UNET has high repeatability as about 98% in both linear and nonlinear measurement through ten-times repetition tests. In addition, the degradation specimen (SA508) and heat-treated specimens (Al6061-T6) were tested by UNET to verify that it calculates accurate elastic properties. As a result, the UNET provides high accuracy for elastic property estimation when comparing with tensile test. In conclusion, it is expected that UNET can estimate material degradation so that it can monitor the health condition for industrial structural material.