

Measurement Technique for the Absolute Acoustic Nonlinearity Parameter Employing Only a Narrowband Pulser

Dong-Gi Song¹, Clifford J. Lissenden², Kyung-Young Jhang³

¹Department of Mechanical Convergence Engineering, Hanyang University, Republic of Korea,

¹Department of Engineering Science and Mechanics, The Pennsylvania State University, USA, ¹School of mechanical engineering, Hanyang University, Republic of Korea

Among the nonlinear ultrasonic techniques, the measurement of the absolute acoustic nonlinearity parameter is employed to obtain quantitative material nonlinearity. In the piezoelectric method, this measurement involves two processes: calibration and harmonic measurements. In the calibration process, the transfer function is measured, and the distortion of a propagating wave is assessed in the harmonic measurement. In the conventional method for this measurement, a narrowband pulser is typically used for harmonic measurement, while a broadband pulser is used for calibration measurement. In this study, we propose a novel technique that utilizes a narrowband pulser for both harmonic and calibration measurements. First, we introduced the proposed method to measure the transfer function in the calibration measurement employing the narrowband pulser. Then, we compared the results of the transfer function and the absolute acoustic nonlinearity parameter obtained using both a narrowband and broadband pulser. Based on the experimental results, we found that the results obtained using both the proposed and conventional methods are highly similar, confirming the validity of the proposed measurement technique. In conclusion, even though we exclusively employ the narrowband pulser, we can accurately measure the absolute nonlinearity parameter, leading to a reduction in the required measurement equipment. Therefore, this approach can minimize the complexity of the measurement setup compared to the conventional method.