

Air-coupled ultrasonic inspection of resin materials using single-probe vertical reflection method

Taku Yano¹, Masashi Ishikawa², Hideo Nishino²

¹Department of Graduate School of Sciences and Technology for Innovation, Tokushima University, Japan, ²Department of Graduate School of Technology, Industrial and Social Sciences, Tokushima University, Japan

Air-coupled ultrasonic inspection is a noncontact and convenient non-destructive testing method. However, its vertical reflection method using a single probe (i.e., pulse-echo mode) is known to be difficult to realize, although it is frequently used mode in conventional contact or water immersion ultrasonic testing. This is because the reflectivity of ultrasound at the boundary between air and the surface of inspection object is enormous, and faint signals received after transmitting into the object are difficult to detect. In this study, in order to realize the air-coupled ultrasonic single-probe reflection method, suitable transmitted ultrasonic waveforms and data processing methods were investigated, and its effectiveness was verified via experiments on resin materials. Experimental results showed that transmitting chirp signals (waves with a linearly frequency modulation) with an appropriate window function and applying pulse compression technique (cross-correlation process between the received signal and a reference chirp signal) is effective in detecting the faint reflection signals after propagating through resin materials, and that the proposed method enabled to detect the reflection signal from an artificial defect in a polystyrene resin specimen. These results demonstrate the feasibility of non-destructive testing using the air-coupled ultrasonic vertical reflection method and could show an important step toward its future practical application.