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Inverse shape reconstruction for thinning flaw of plates using ultrasonic guided waves

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In this paper, we present a new method for inverse shape reconstruction of local plate thinning from reflection coefficients of guided waves based on guided wave scattering. The far-field reflected wave field is expressed by an integral concerning Green's function and total wave field over the surface of thinning flaw. It can be proved that, by introducing the Born and the far-field approximations into the integral form, the depth of plate thinning is obtained as a function of the horizontal coordinate by performing the inverse Fourier transform of the reflection coefficients in wavenumber domain. This method can not only detect the thinning flaw's location, but also depict its size and shape, and can be applied in quantitative non-destructive investigation. Numerical examples are given and the accuracy of proposed inverse approach is discussed by means of parametric comparisons for different wave modes, frequency ranges and various thinning shapes.

Keywords: Plate thinning flaw, Ultrasonic guided wave, Inverse problem, Born approximation