

Ultrasonic Evaluation of Periodic Rough Inaccessible Surfaces from Back Side

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Abstract : The surface roughness is an important parameter for evaluating the quality of material surfaces since it affects functions and performance of industrial components. Although stylus and optical techniques are commonly used for measuring the surface roughness, they are applicable only to accessible surfaces. In practice, surface roughness measurement from the back side is sometimes demanded, for example, in inspection of safety-critical parts such as inner surface of pipes. However, little attention has been paid to the measurement of back surface roughness so far. Since back surface is usually inaccessible by stylus or optical techniques, ultrasonic technique is one of the most effective among others. In this research, an ultrasonic pulse-echo technique is considered for evaluating the pitch and the height of back surface having periodic triangular profile as a very first step. The pitch of the surface profile is measured by applying the diffraction grating theory for oblique incidence; then the height is evaluated by numerical analysis based on the Kirchhoff theory for normal incidence. The validity of the proposed method was verified by both numerical simulation and experiment. It was confirmed that the pitch is accurately measured in most cases. The height was also evaluated with good accuracy when it is smaller than a half of the pitch because of the approximation in the Kirchhoff theory.

Keywords : back side, inaccessible surface, periodic roughness, pulse-echo technique, ultrasonic NDE

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