

Impact-Echo for Crack Detection in Concrete with Artificial Intelligence based on Supervised Deep Learning

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Aging concrete infrastructure such as bridges and tunnels need to be appropriately maintained in their service life because these structures must be employed with ensured safety level. Inspection and maintenance with reasonable measures are typically operated for the reinforced concrete before severe damage and failure are developed. Especially, the crack propagation in concrete can significantly affect the structural integrity, durability and overall performance of structural elements. Effective maintenance strategies are required for material and structural assessment with detection and repair of cracks to prevent further deterioration. Identification of cracks in concrete is effectively operated to extend the service life of structures, mitigate the potential safety hazards and minimize the repair costs. In order to detect the cracks in the concrete structure member, non-destructive testing (NDT) system can be often introduced to satisfy the technical issues in terms of damage evaluation and estimation of repair condition. Currently, various NDT methods have been utilized for tomographic analysis of internal damage/defects using elastic wave method such as impact-echo method, focusing on wave velocity and attenuation as wave propagation parameters. In experimental laboratory tests, concrete specimens are usually prepared with interior damages (cracks) which are simulated as embedded plastic plate or styrofoam. In this study, starch-type polysaccharide sheet is used to form cracks in concrete specimen. This study aims at applying impact-echo method with AI (Artificial Intelligence) to identify the internal crack information based on the waveform characteristics obtained from the elastic wave propagation behavior. The waveform results are converted to frequency spectrum by FFT analysis. Consequently, it is found in this study that artificial intelligence (AI), which is employed by supervised deep learning models, successfully evaluates the data and displays the probability of crack existence in concrete. Since FFT is a powerful algorithm that quickly converts a signal from the time domain to the frequency domain, it gives efficient analysis to the impact echo method for crack detection with the application of AI system.