

Research on Automatic Picking Algorithm of Ultrasonic Arrival Time for Concrete Structures

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ABSTRACT

Approximately 40% of buildings in Korea are over 30 years old since their approval for use, necessitating mandatory safety inspections. Non-destructive testing, particularly Ultrasonic Pulse Velocity (UPV), is widely used for this purpose. In concrete, UPV employs direct and indirect methods to evaluate concrete quality based on the velocity of ultrasonic pulses, assessing attributes such as compressive strength, crack depth, and the presence of internal defects (KS F 2731:2008; KATS 2023). Accurately determining the arrival time of ultrasonic signals is crucial for understanding ultrasonic pulse velocity (Carpinteri et al. 2012). This study evaluates the performance of the AIC, Hinkley Criterion, Amplitude Threshold-picker, and STA/LTA algorithms with specific time intervals in determining the arrival time of ultrasonic signals. The evaluation is based on simulations and UPV experiments conducted on models of reinforced and non-reinforced concrete using both direct and indirect methods. The efficacy of these algorithms was validated through detailed interpretation of the simulation and experimental data. The STA/LTA algorithm with specific time intervals was found to have similar performance to the other algorithms, as shown in Table 1. Additionally, it was observed that the absolute velocity deviations were generally larger in experiments compared to simulations, in reinforced concrete compared to non-reinforced concrete, and when using the indirect method compared to the direct method.

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Table 1 Median of the absolute velocity deviation [unit : m/s]

Data	Specimen	Measurement Method	AIC	Hinkley	Threshold	STA/LTA
Simulation	Non-reinforced concrete	Direct method	-	38.81	27.89	54.75
		Indirect method	-	107.47	117.01	55.69
	Reinforced Concrete	Direct method	-	17.92	69.56	16.25
		Indirect method	-	200.79	216.01	185.24
Experiment	Non-reinforced concrete	Direct method	31.35	71.46	52.15	26.30
		Indirect method	425.79	516.79	496.98	261.72
	Reinforced Concrete	Direct method	317.91	390.60	449.07	445.52
		Indirect method	249.87	483.53	528.33	215.68

ACKNOWLEDGEMENTS

The research described in this paper was financially supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIT) [No. NRF-2021R1A5A1032433].

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