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Experimental approaches to estimate concrete properties with ground penetrating radar

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1 Abstract

When faced with the problems of aging infrastructure and historic constructions, there are many unknowns such as physical properties and arrangements of materials. This information is necessary for estimating the capacity, safety, and overall condition and for ensuring successful maintenance or repair of the structure. Often, this information is only available through invasive means, which can be unsightly, legally prohibited, or too expensive. Ground penetrating radar (GPR) is a noninvasive assessment tool successful at infrastructure inspection, feature detection, and condition assessments. An experiment was designed to investigate the ability of GPR to predict the physical properties (compressive strength, young's modulus, and porosity) of concrete samples. A set of samples with variable properties and mix designs was fabricated. The samples were tested both with traditional methods (physical destructive testing) and by noninvasive GPR scanning at 7, 14, 28, and 56 days. A variety of machine learning approaches were used to investigate correlations between the physical property data and the GPR data, resulting in a model that predicts the density, compressive strength, and porosity of concrete with some success (R^2-values between 0.4 and 0.8). This predictive model is currently being further developed and tested on several case studies.

Keywords: ground penetrating radar; material properties; non-destructive testing; historic buildings; concrete

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