ConcreteNet: A Deep Convolutional Neural Network for Deformity Detection and Classification in Ground-Penetrating Radar Images

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The integrity of concrete structures is essential for public safety and infrastructure longevity. Non-destructive testing (NDT) methods are used for inspection and assessment of concrete structures. However, traditional NDT methods, particularly ground-penetrating radar (GPR), face challenges in analyzing complex and noisy radargram data. To address these limitations, we propose ConcreteNet, a discriminative convolutional neural network optimized for GPR radargram classification. ConcreteNet leverages the "Network in Network" architecture, with AlexNet serving as the base model, to detect structural defects more effectively. The model will be trained on radargram data from recent scans of the Georgia Southern Engineering Research Building and validated using pre-existing GPR data from the Georgia Department of Transportation. Additionally, the creation of a publicly accessible GPR radargram dataset is a critical component of this research that warrants a paper of its own. Given the limited availability of GPR data, such a dataset would greatly facilitate researchers in training deformity detection models in this field. Benchmarking this dataset against state-of-the-art classification and object detection networks will further refine GPR-based deformity detection in concrete.