A Machine Learning-Based Framework for Automatic Bridge Deck Condition Assessment Using Ground Penetrating Radar

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ABSTRACT

Ground Penetrating Radar (GPR) is a non-destructive technique that has been used to evaluate the quality of concrete bridge deck. However, the lack of automated GPR data processing and interpretation methods hinders the use of GPR in large-scale bridge deck assessment. The objective of this research is to automate bridge deck condition assessment from GPR data based on image processing methods. An automated workflow is proposed to generate bridge deck deterioration map using GPR scans, which consists of three steps. First, the Random Forest classification model is trained to detect rebar regions in GPR scans using Histogram of Oriented Gradients (HOG) features. Second, robust hyperbolic fitting is used to fit each hyperbolic signature in the rebar region, and thus localizing the rebar by finding the peak of the fitting hyperbola. Third, detected rebars and their locations and depth-corrected amplitudes are used to create deterioration map. Field experiments were conducted on two bridge decks, and the results indicate the efficiency of the developed method. The proposed method achieves 98.6% accuracy on real GPR scans from the two bridge decks, which consists of thousands of individual rebar features. The developed workflow will help automate the processing of GPR scans and thus expedite the bridge deck inspection and evaluation.