

Dam 4.0 – smart monitoring of cracking in concrete dams

Summary

Automatic methods for crack recognition and characterization in images of concrete surfaces is a hot topic in these days, namely through computer vision methods based in convolutional neural networks which are delivering promising results. However, challenges still persist, primarily due to the confusion added by the myriad of elements commonly found on concrete surfaces, requiring to train models for each specific case, which is cumbersome because these are dataset hungry models and since these are case-dependent it disables its use in different scenarios.

This work focus on generalizing neural models to achieve high performance in crack classification and segmentation in images from domains slightly skewed, comparing to those used during training. More specifically, this work suggests to achieve that by using transfer learning, adapting domains using small unlabeled datasets and injecting crack related information in neural networks to leverage their performance. To achieve the goals proposed, this work is organized as follows: 1) State of the art review on automatic methods based in neural networks for recognition of cracking on surfaces of concrete structures; 2) Neural network based models for classification of cracking in concrete surfaces.

A baseline implementation as a reference for the state-of-the-art; 3) Explore neural network based methods for generalization of models aiming at widen its domain of application, concerning both environmental conditions and complexity of surface; 4) Exploring guided attention methods to leverage neural models performance in crack classification; 5) Customized neural models for segmentation of cracking in images of concrete surfaces; 6) Graph-based neural methods to explore crack geometric shape in classification and segmentation of cracks in images of concrete surfaces; 7) Application of the methods developed in the inspection of a real infrastructures - case studies of a dam and a bridge. At this stage Tasks 2 and 3 are completed while Tasks 1 and 4 are in development. Case studies are being addressed in order to identify structures of interest for crack inspection in the scope of this work.

Keywords

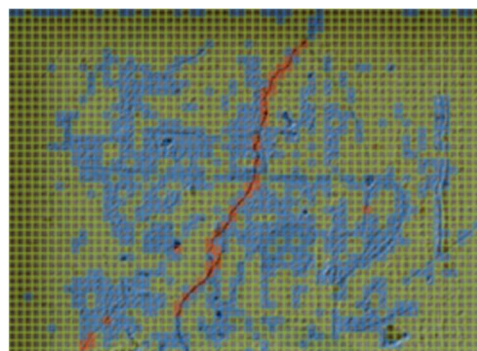
Crack classification, crack segmentation, structural concrete, computer vision, neural networks, deep learning, domain-adaptation.



Panoramic view of the Itaipu dam, Brazil-Paraguay Border.



Patch level classification of cracks.



Full image view of crack classification - patch classification with sliding window method.



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