Deep Residual Net with Transfer Learning for Image-based Structural Damage Recognition

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Abstract

This poster aims to implement the state-of-art Deep Residual Net (ResNet) into traditional Civil Engineering areas, the study of images of structural damage recognition. With a labeled tiny dataset provided by Structural ImageNet, instead of training whole Convolutional Neural Network (CNN), Transfer Learning with fine-tuning were applied to ResNet-50 and ResNet-101 Models. Promising results were achieved, and Local Interpretable Model-agnostic Explanations (LIME) was applied to offer insights on the CNN via visualization.

Introduction

In this data explosion epoch, vision-based structural health monitoring and rapid damage assessment after natural hazards have become new focuses in civil engineering, and structural images, as the media, play a more important role in these fields. With the support of PEER database and NEEShub, a Structural ImageNet is established with labeled images. Meanwhile, AI and Machine Learning technologies are developing rapidly, especially in Deep Learning. Boosting with development of GPU and ImageNet challenge, Deep Learning in computer vision made a giant progress. Thus, it is a good chance to implement the state-of-art Deep Learning technologies to civil engineering areas such as image of structural damage recognition.

Deep Residual Network with Transfer Learning

Results & Visualization

(a) Component type identification
(b) Spalling condition check
(c) Damage level evaluation
(d) Damage type determination

<table>
<thead>
<tr>
<th>Tasks</th>
<th>ResNet 50</th>
<th>ResNet 101</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component type</td>
<td>Binary</td>
<td>Binary</td>
</tr>
<tr>
<td>Spalling condition</td>
<td>Binary</td>
<td>Binary</td>
</tr>
<tr>
<td>Damage level</td>
<td>3-classes</td>
<td>4-classes</td>
</tr>
<tr>
<td>Damage type</td>
<td>90.0% (72.0%)</td>
<td>94.5% (74.5%)</td>
</tr>
</tbody>
</table>

Acknowledgement

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