Classifying Images Post Hurricane using Satellite Imagery

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The problem we chose:

Problem statement	Context	The problem
Classifying buildings post Hurricane using Satellite Imagery and Deep learning techniques	• Damage assessment is vital to helpers and relief workers, post hurricane attack • It allows resources to be allocated efficiently	• This process is manual and hence, laborious • Hence, there arises a need to classify damaged and non-damaged buildings efficiently and quickly

Our approach to find a deep learning solution!

Step 1 → Step 2 → Step 3

Gather and explore data!

Our dataset comprised satellite images from "Geo-satellite sensor" and "Geo Bigdata".

Consists of 128x128 top view images of damaged and undamaged houses.

Train, test and interpret!

After training, we evaluated the model on the hold out sets.

Reconstructions were used to increase the CNN's interpretability.

Further enhancements!

We tried to understand research articles that address this issue.

Transfer learning can improve efficiency

Test the model on Hurricane Delta

Describing the data

Sample images from the dataset. Each image contains three channels (RGB) with dimensions 128x128

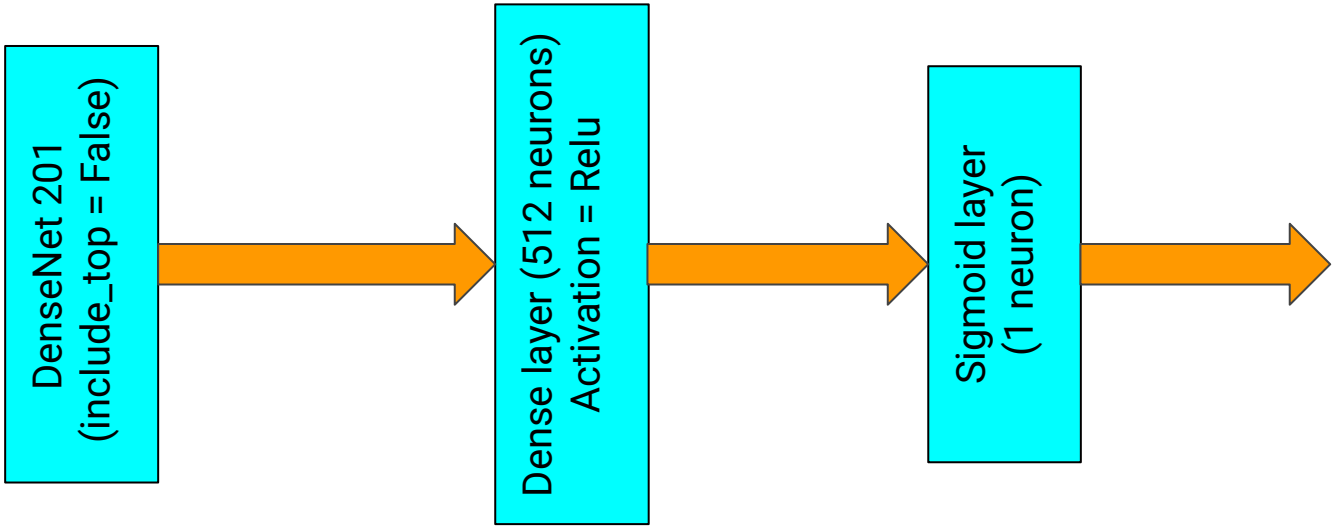
Train set: 5000 images in each class with data augmentation

Validation set: 1000 images in each class

Test set 1: 8000 images in ‘damaged’ and 1000 images in ‘undamaged’

Test set 2: 1000 images in each class

A peek into the algorithm



Libraries used:

- Tensorflow
- Numpy, Pandas, and Matplotlib
- OpenCV
- Tf_keras_vis
- Seaborn

Transpose convolutions as visualisations!

(Original image on the left and the reconstructed image on the right of each column)

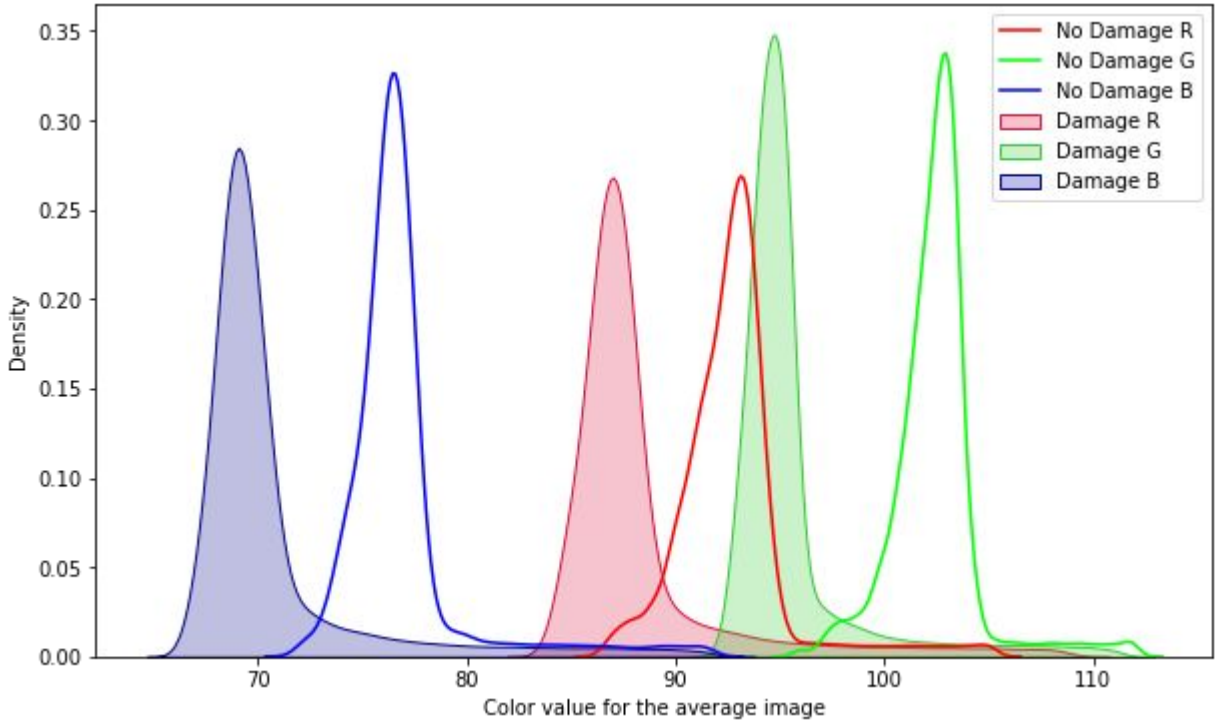
Result

The model's quality was measured with both true accuracy and Area Under the ROC Curve (AUROC which captures the trade-off between the model's true positive and false positive rates of detection - a helpful tactic when it useful to have more false positives than false negatives.

According to crisis responder feedback, 70% accuracy is the threshold for making high-level decisions in the first 72 hours after the disaster

Category	Accuracy	AUROC
test_another	96.2%	94.6%
test	93.4%	93.9%
validation	93.5%	-

RGB kde plot


No Damage R
No Damage G
No Damage B
Damage R
Damage G
Damage B
Density
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
70
80
90
100
110
Color value for the average image

Future work

- Generalize to different geographies
- Accurately assess damage around the globe
- A system that interacts with local support and expert analysts
- Building localization

Hurricane Harvey (2017)

Hurricane Iota (2020)