

Figure 1: Comparison of the same location before (right) and after (left) Hurricane Harvey.

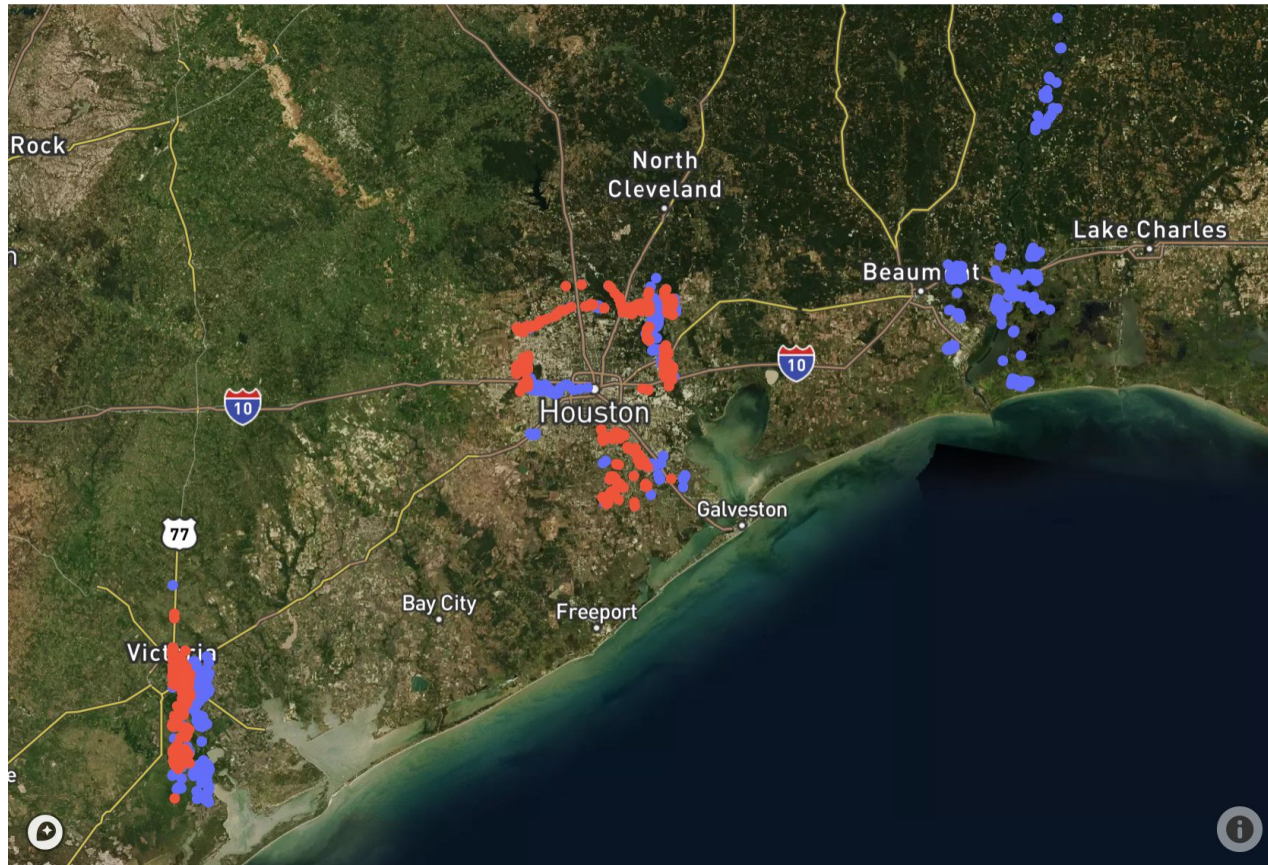


Figure 2: Map of the greater Houston area with labeled images. Red represents undamaged images and blue represents damaged images.

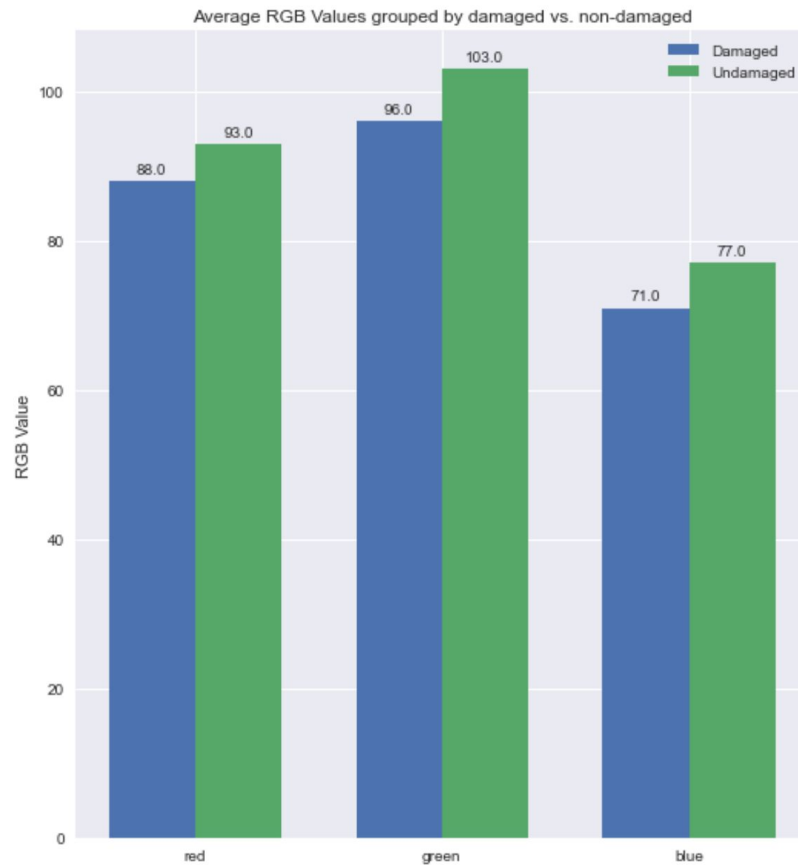


Figure 3: comparative bar chart of mean RGB values for undamaged (green) and damaged (blue) images.

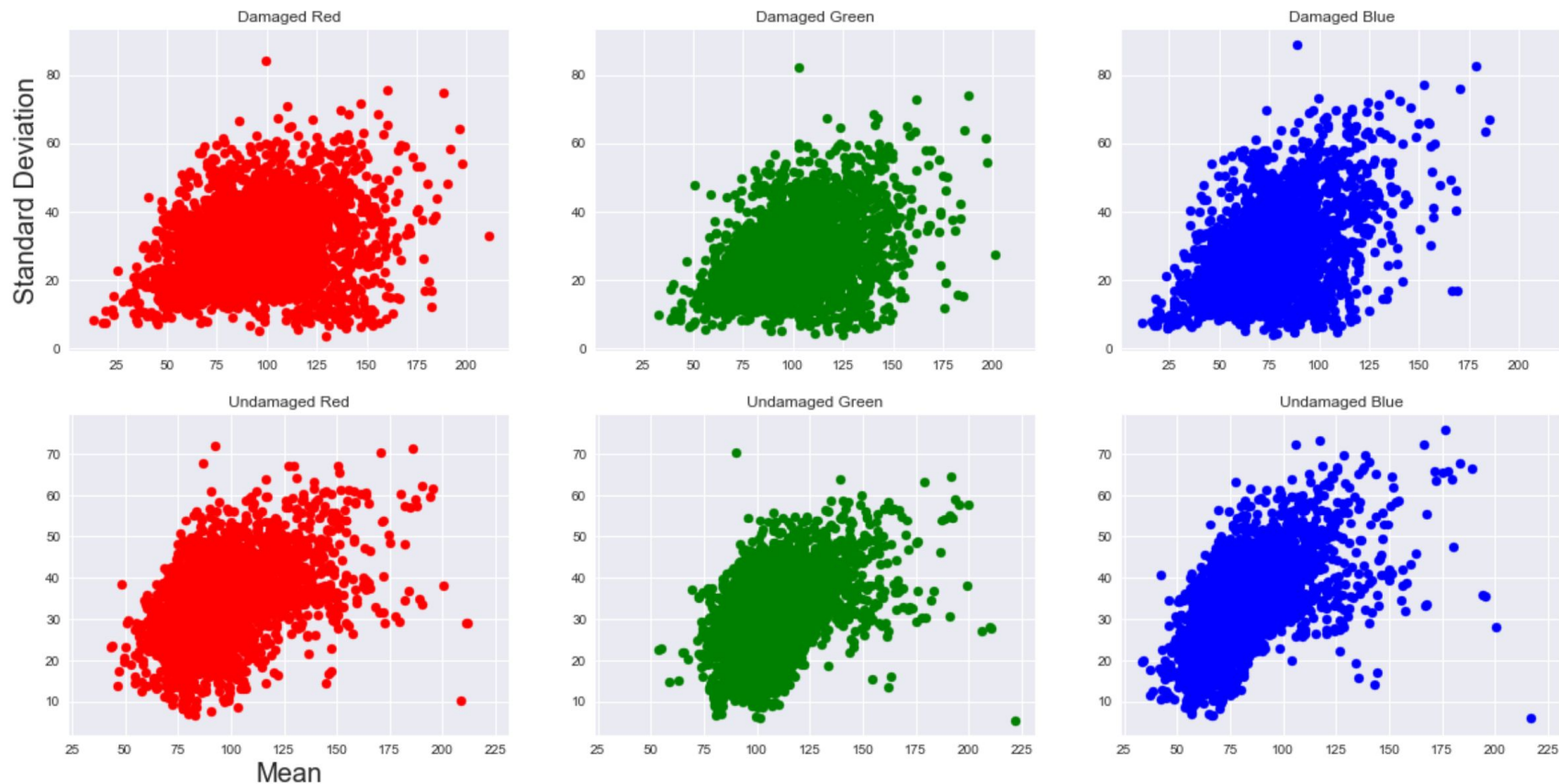


Figure 4: Standard deviation vs. mean in all three color channels. Damaged images are on the top and undamaged images are on the bottom.

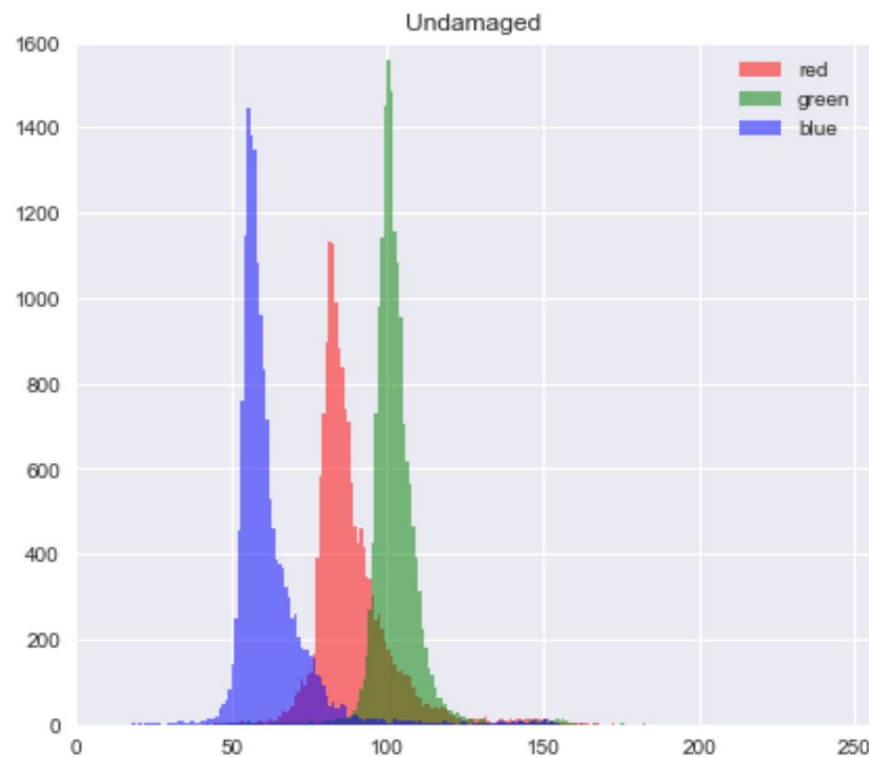
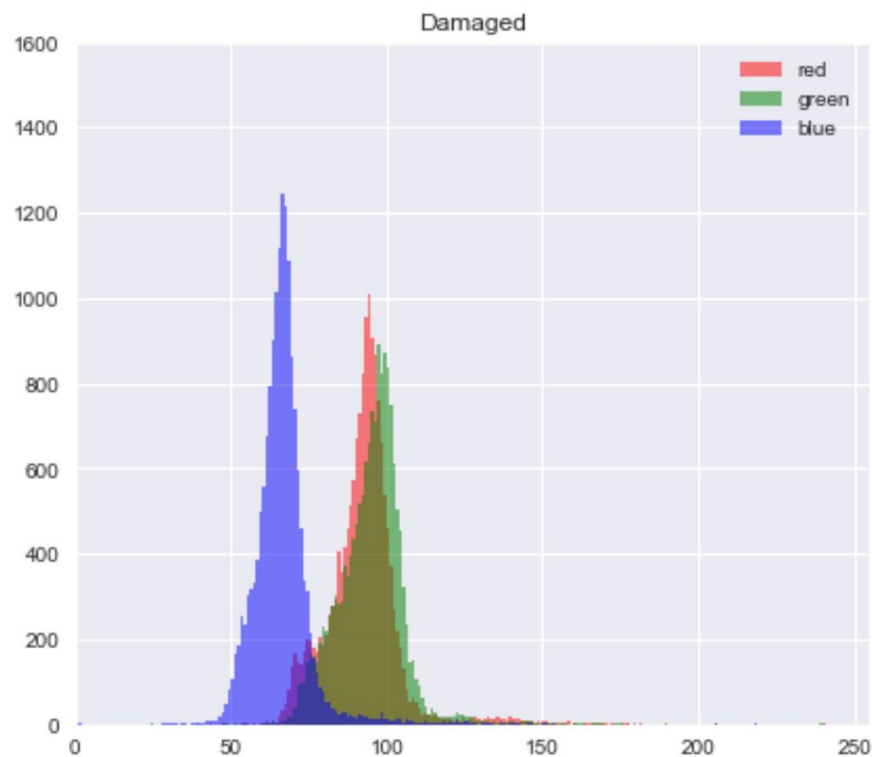


Figure 5: Histogram of RGB values for damaged and undamaged images.

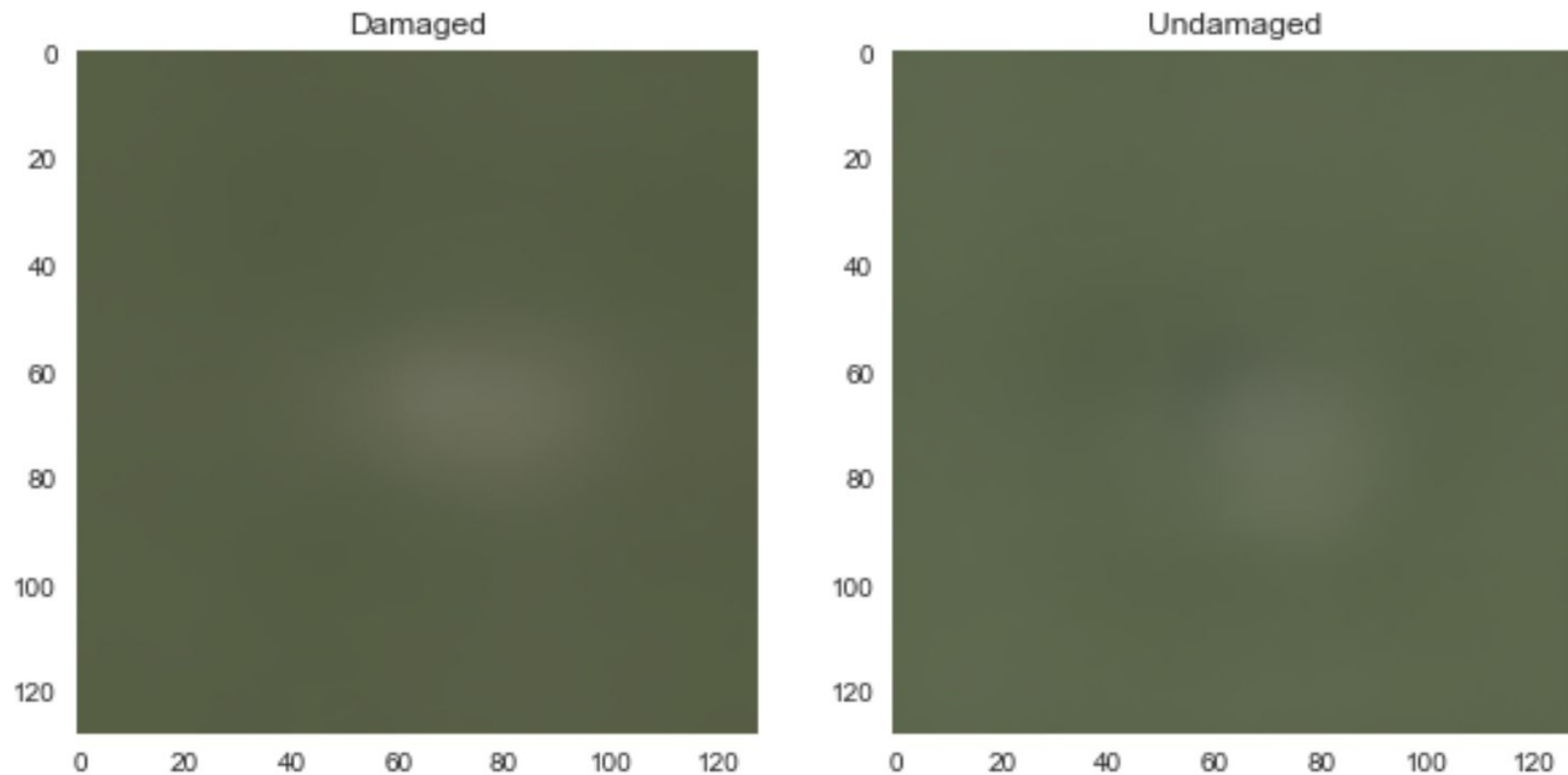


Figure 6: Mean image of damaged and undamaged images.

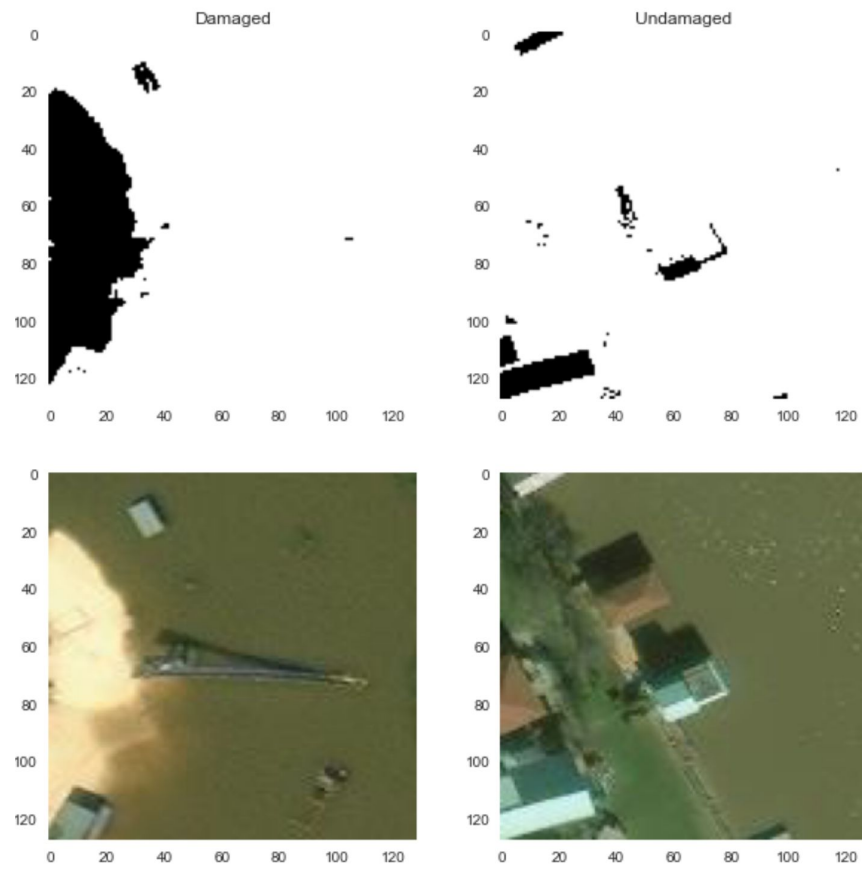


Figure 7: Original image (bottom) compared to image after thresholding (top).

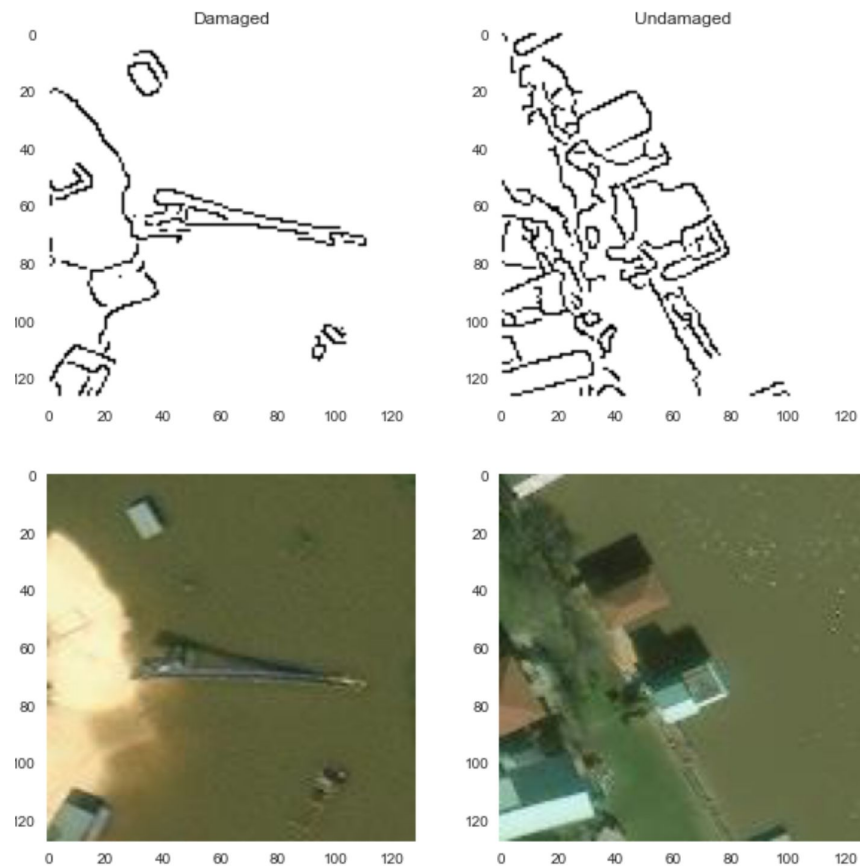


Figure 8: Original image (bottom) compared to image after using Canny edge detector (top).

Input image



Histogram of Oriented Gradients

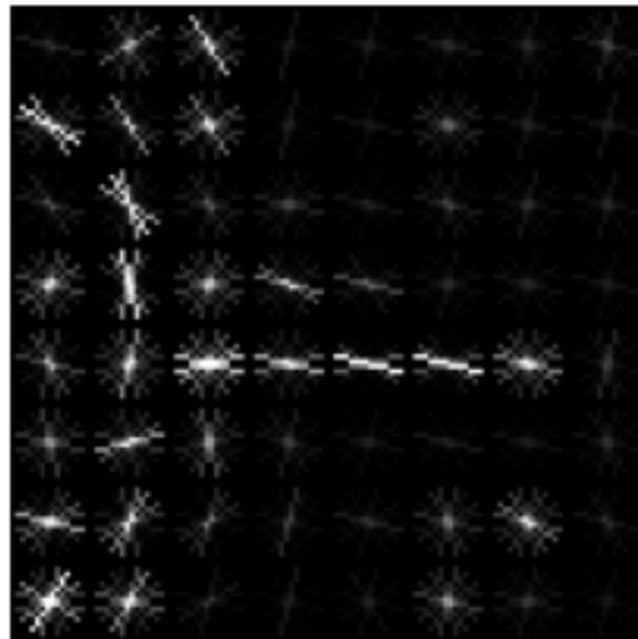


Figure 9: Original image (left) compared to image of HOG transformed image(right).

| Metric | Training | Validation | Balanced Test | Unbalanced Test |
|-----------|----------|------------|---------------|-----------------|
| Loss | 0.04 | 0.06 | 0.04 | 0.04 |
| Accuracy | 0.98 | 0.98 | 0.99 | 0.98 |
| F1 Score | 0.98 | 0.98 | 0.99 | 0.92 |
| Recall | 0.99 | 0.99 | 0.98 | 0.97 |
| Precision | 0.98 | 0.97 | 0.99 | 0.89 |

Table 1: Summary of model metrics.

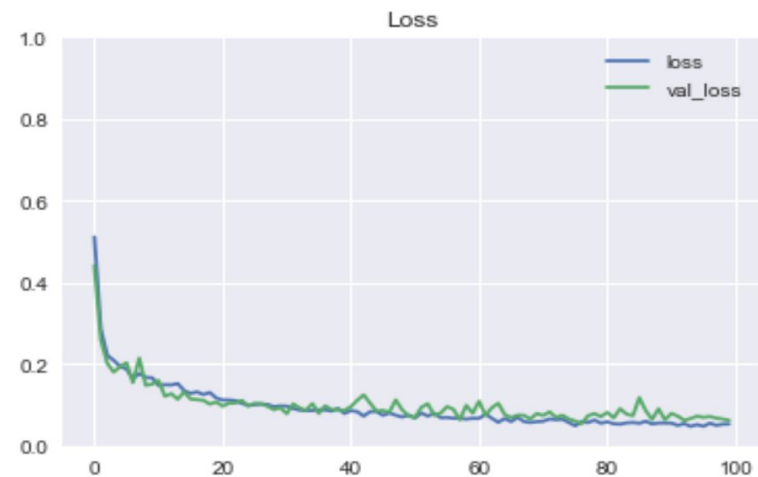
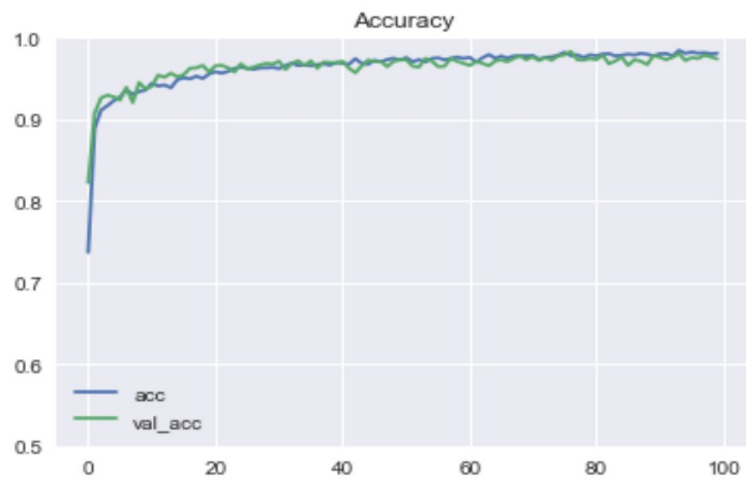


Figure 10: Accuracy & loss over training epochs.

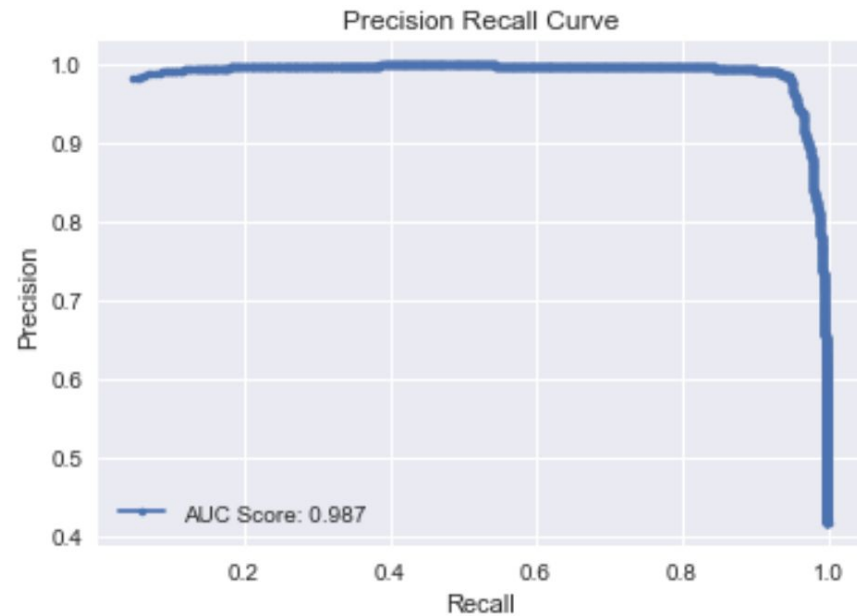
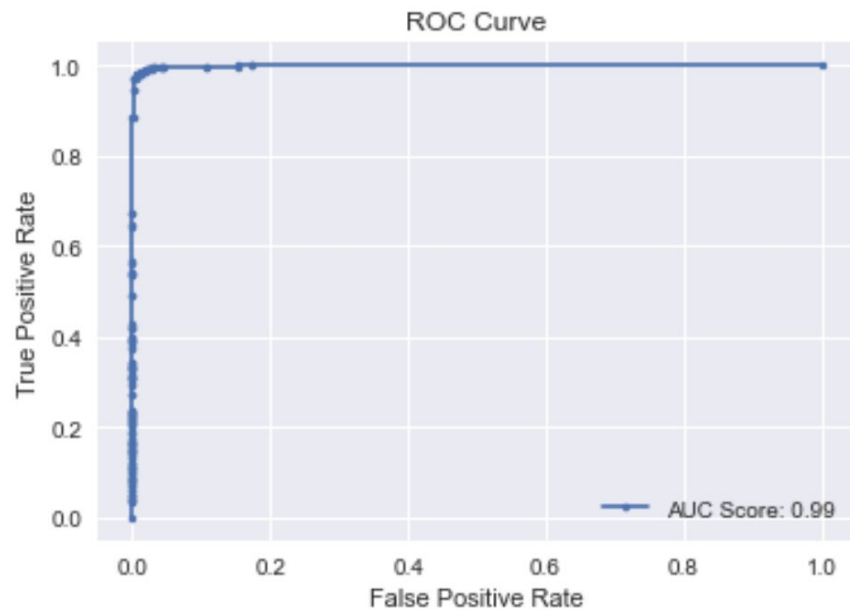


Figure 11: ROC curve (left) & precision-recall curve (right) for our CNN.



Figure 12: False positive images.



Figure 13: False negative images.

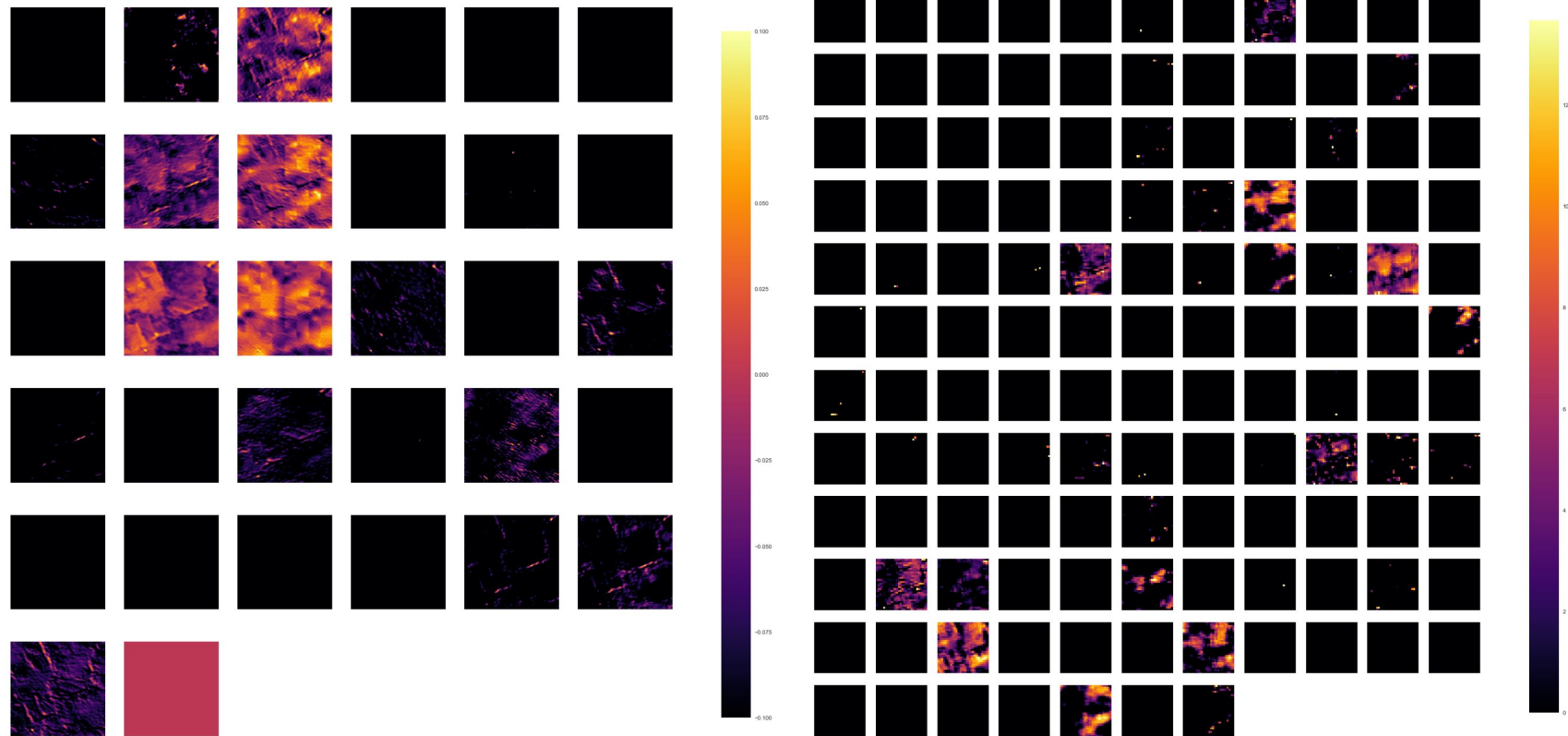


Figure 14: Visual representation of activation layers of a single undamaged image. First activation layer is on the left and third activation layer is on the right.

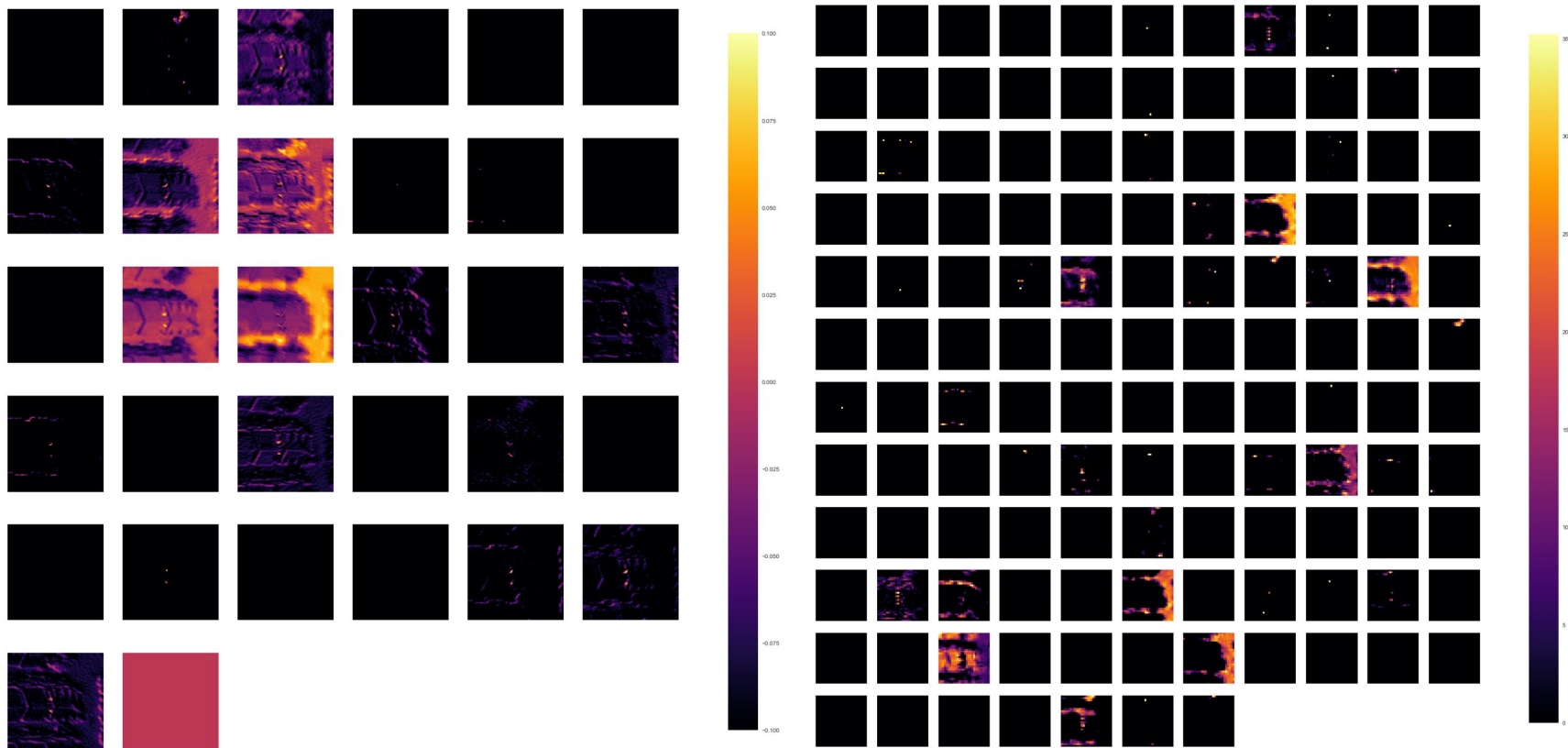


Figure 15: Visual representation of activation layers of a single damaged image. First activation layer is on the left and third activation layer is on the right.

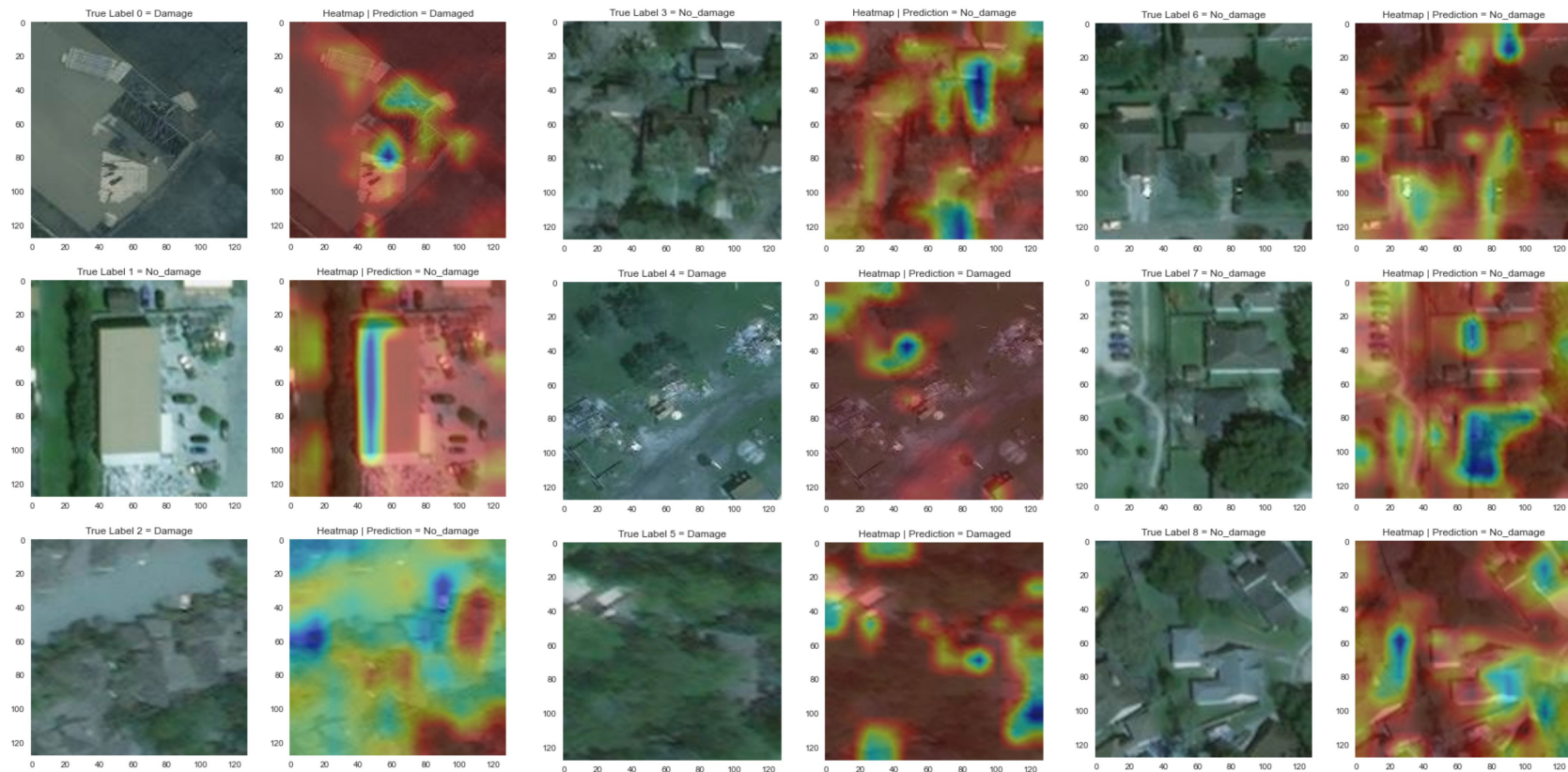


Figure 16: Original image and its true label compared to highlighted gradients and the prediction label.



Figure 17: Model misclassifications from new images.