

SATELLITE IMAGE PREPROCESSING FOR ENHANCED EDGE DETECTION

By: Joshua Abraham

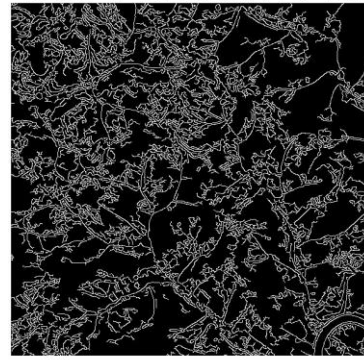
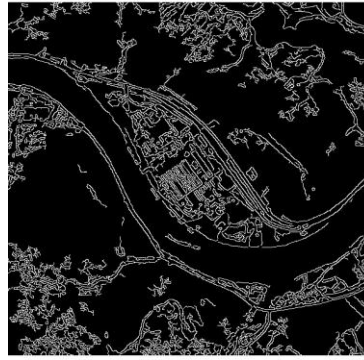
EECS 4422

Scientific Stream



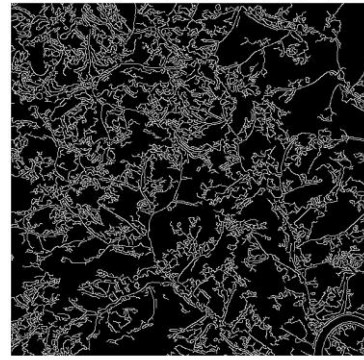
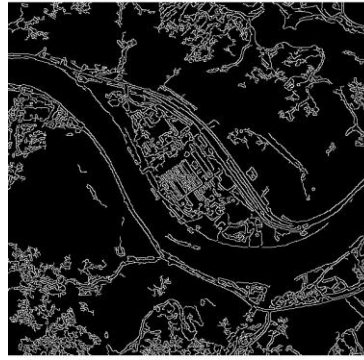
PROJECT MOTIVATION

- *Satellite imagery is widely used in:*
Cartography, Industrial Planning, Agriculture, and Oceanography
- *Interesting social limitations on this subset of images*
Fear from general public of privacy issues
Demand for higher image resolution from industry
- *Prove that improving image resolution is not the only way to extract more meaningful information from an image*
- *Edges are very useful for detecting:*
Roads, buildings, shorelines, and farmland divisions



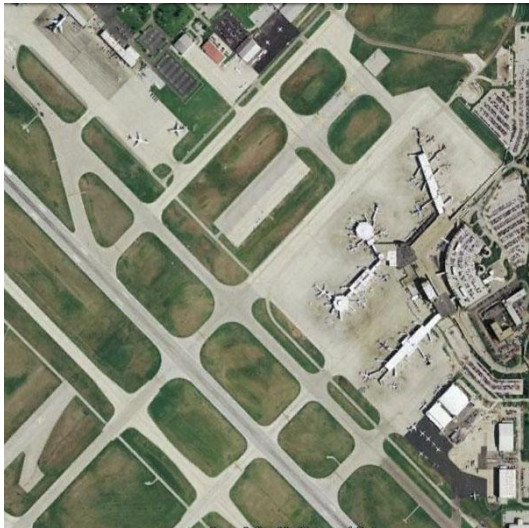
PROJECT OVERVIEW

- *Run Canny edge detection on the original images*
- *Preprocess the images*
- *Run Canny edge detection on the preprocessed images*
- *Compare the original and preprocessed Canny detections against a ground truth for similarity using the Structural Similarity Index (SSIM)*

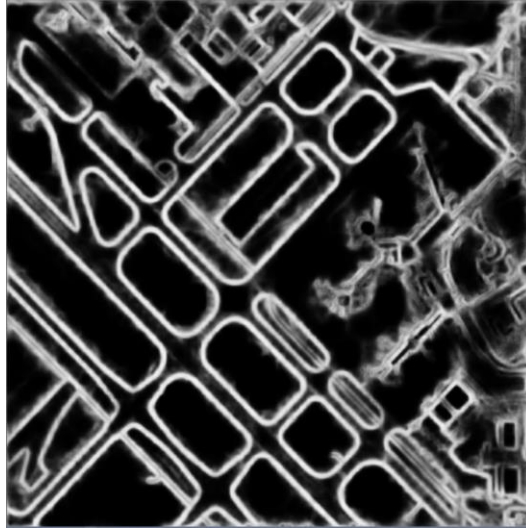


PROJECT OVERVIEW: CREATING “GROUND TRUTHS”

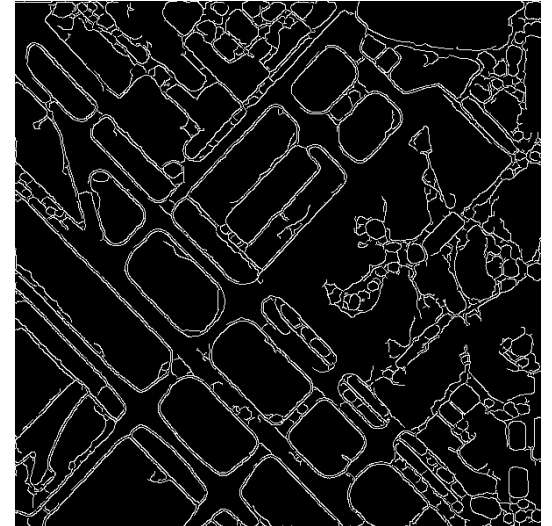
- *No ground truths available for the dataset I am working with*
- *Uses the Holistically-Nested Edge Detection CNN_[1] to generate a “ground truth”*



Original Image



HED Image



Canny-like HED Image

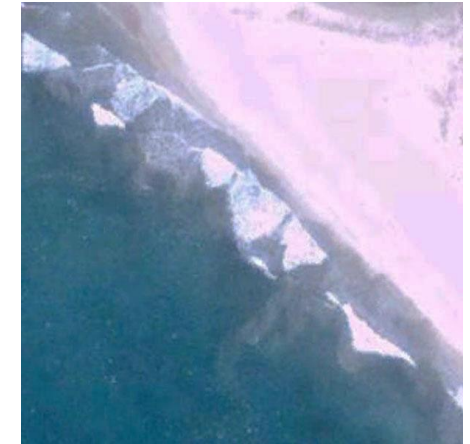
PROJECT OVERVIEW: PREPROCESSING TECHNIQUES

- *Blurring*
- *Secondary blurring based of image histogram*
- *Median blur*
- *Contrast Normalization*
- *Automatic White Balancing*
- *Fuzzy Histogram Hyperbolization*
- *Anisotropic diffusion filter*

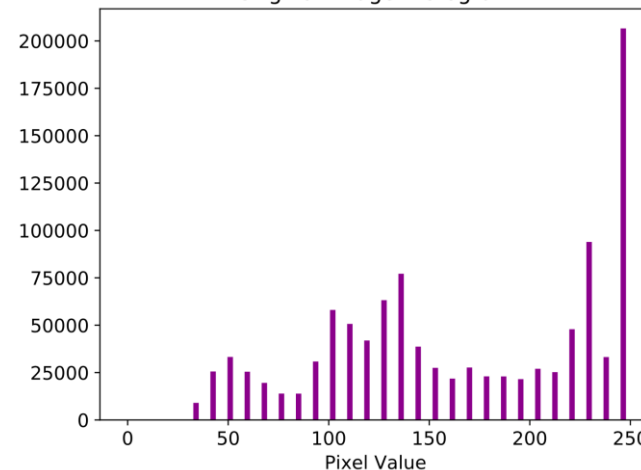
Original Image



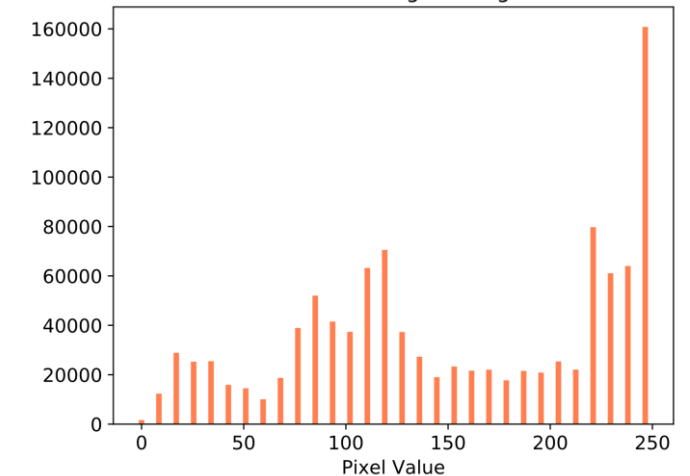
Contrast Normalized Image



Original Image Histogram



Normalized Image Histogram

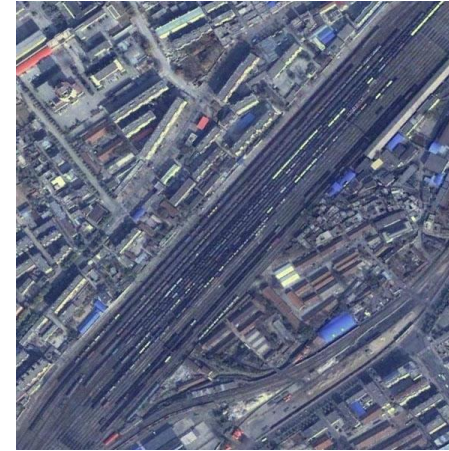


PROJECT OVERVIEW: PREPROCESSING TECHNIQUES

White Balancing

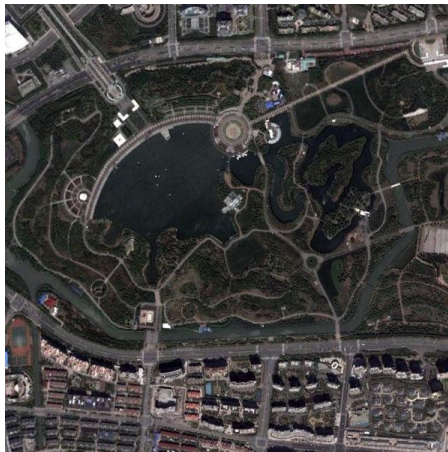


Original Image

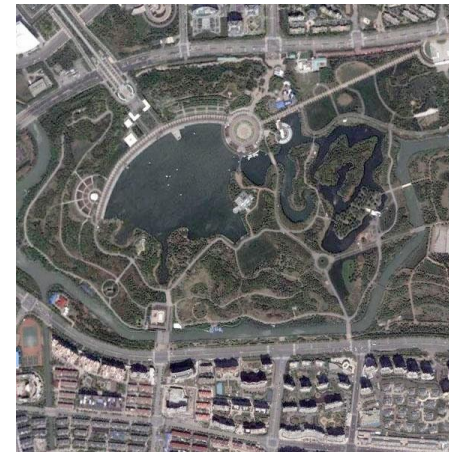


White Balanced Image

Fuzzy Histogram Hyperbolization

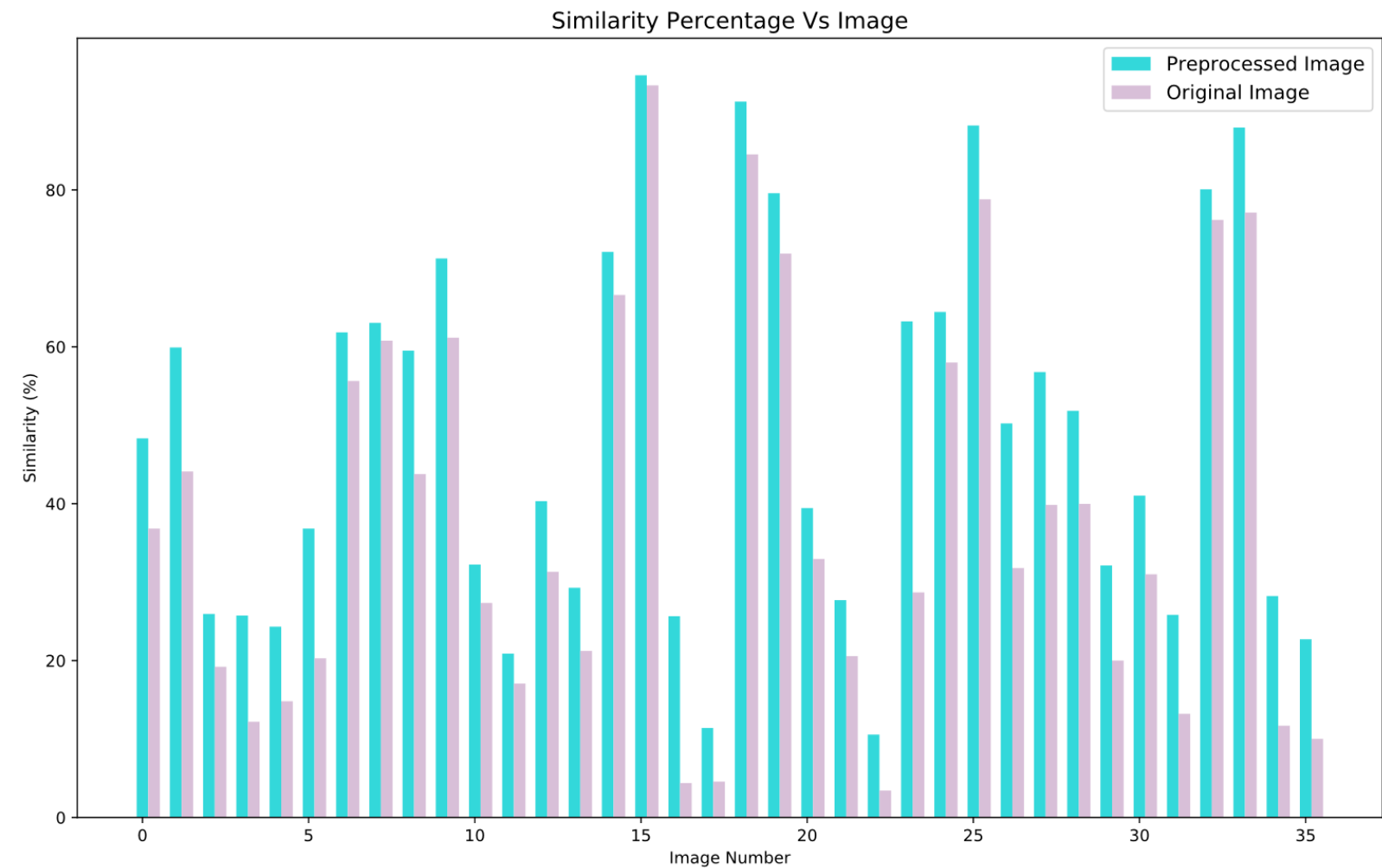


Original Image



*Fuzzy Histogram
Hyperbolization Image*

PROJECT RESULTS



Preprocessing leads to more similar images compared to “ground truths” in all cases of th36 images

Average improvement of **27.87%** for the 36 images

For the entire dataset:

Average improvement of **34.20%**

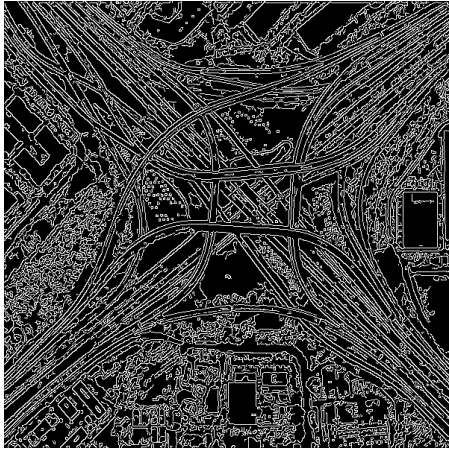
41/908 images became worse

PROJECT RESULTS: EXAMPLES

Original Image



Original Canny



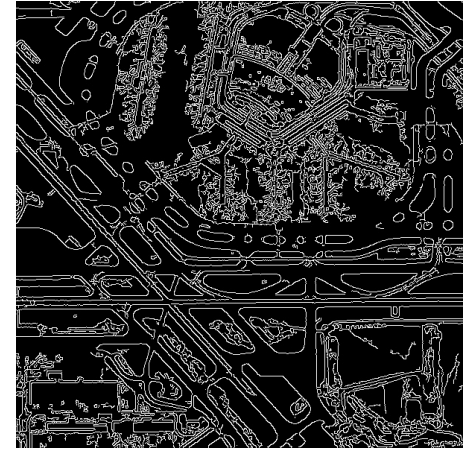
Preprocessed Canny



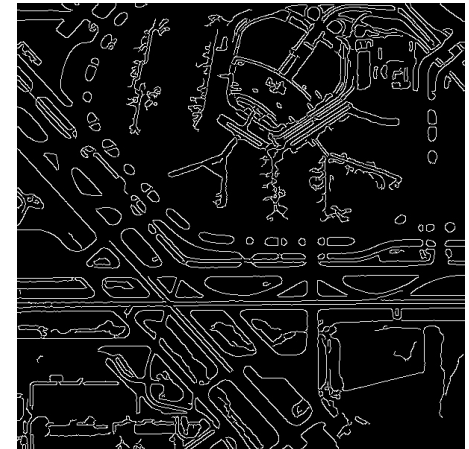
Original Image



Original Canny



Preprocessed Canny

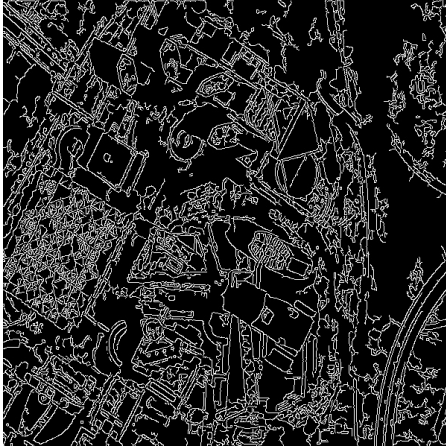


PROJECT RESULTS: EXAMPLES

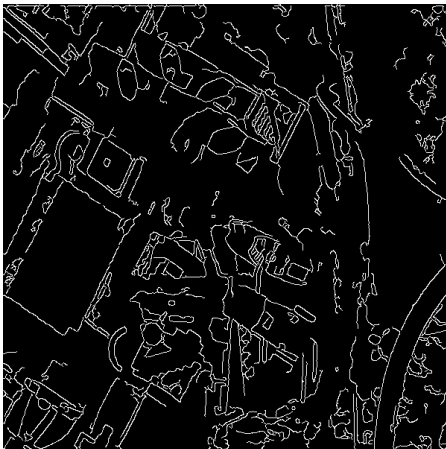
Original Image



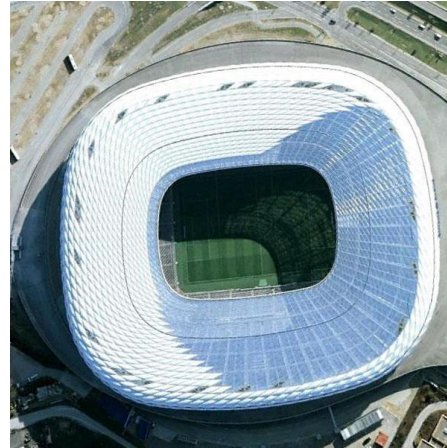
Original Canny



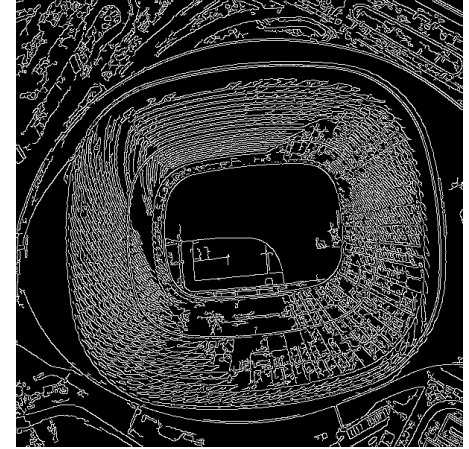
Preprocessed Canny



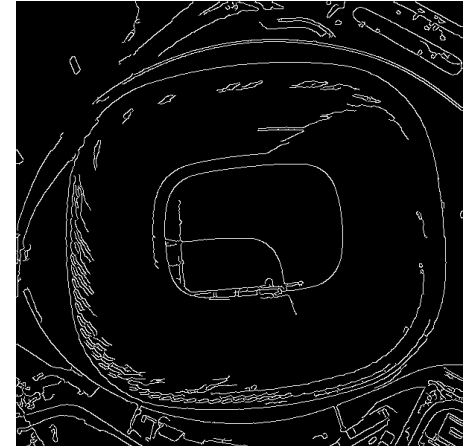
Original Image



Original Canny



Preprocessed Canny



PROJECT RESULTS: CONCLUSION

- **Goal:** *Prove that increasing image resolution is not the only way to extract more meaningful information from an image*
- **Result:** *Preprocessing does in fact improve the performance of classical computer vision techniques such as Canny edge detection by a significant margin with regards to satellite imagery*



THANK YOU

Questions?

