Wuhan University
State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing

Geophysical Image enhancement by fusion of multispectral image and panchromatic image

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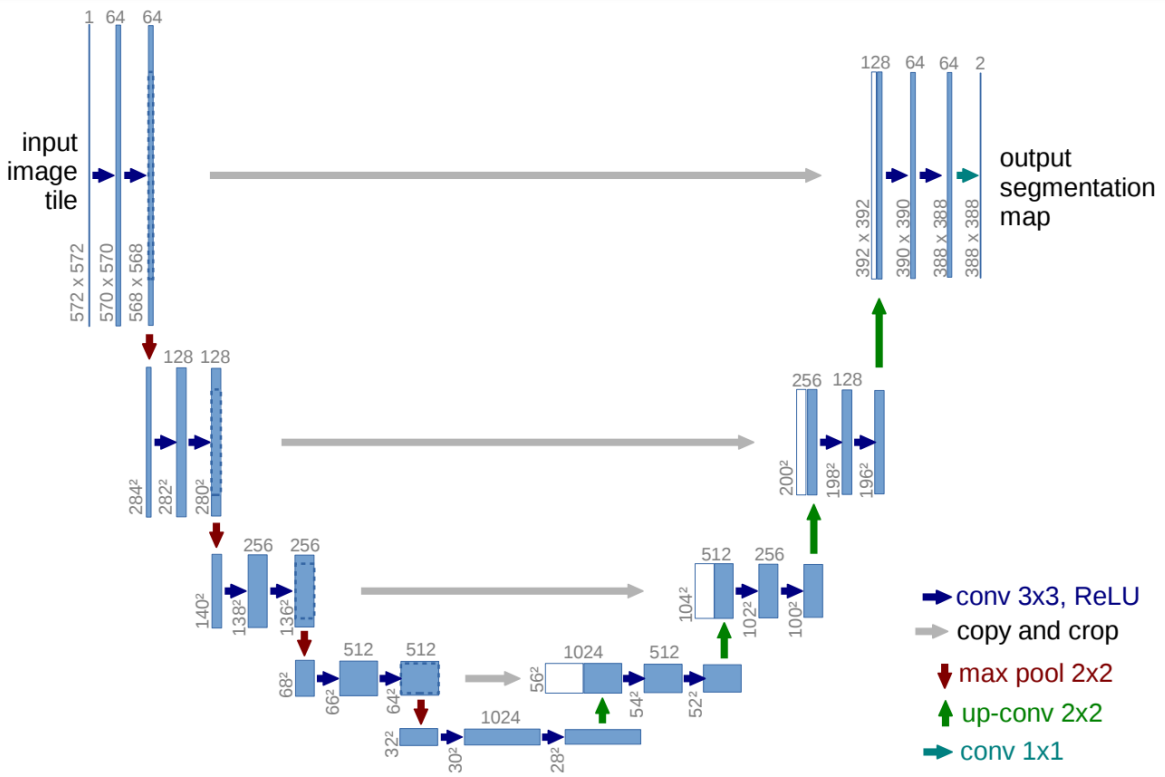
CONTENTS:

1 INTRODUCTION, PREVIOUS STUDIES & PROBLEM

- It is very hard for Deep learning models such as CNN-convolution neural network to extract features from low resolution satellite images.
- High-resolution images are very expensive for most of the companies to afford this indispensable dataset.
- The reason behind is that CNN-model has three layers in neurons(several functions)- such as: (Convolution layer, activation function and pooling layer) , CL responsible for feature detection.
- It uses like-wise multiplication to identify each feature on the pixel level. If algorithms applied and Fusing images with distinct edges angles (data fusion and scene modelling)



2 PREVIOUS STUDIES & PROBLEM

- Image fusion extracts the information from several images of a given scene to obtain a final image which has is even better for human visual perception and become more useful for additional vision processing.(Mamta Sharma, 2016)
- Fusing high resolution on panchromatic image (PI) and multispectral images(MI) or real world images is important for better vision.
- There are various methods of image fusion(IF) and some techniques of image fusion such as IHS, PCA, DWT, Laplacian pyramids, Gradient Pyramids, DCT, SF.
- Several digital IF algorithms have been developed in a number of applications.
- Susheela D,. 2013 paper's focuses on the fusion of high spatial resolution PAN images and low spatial resolution MS images to improve the visual quality of urban features.
- Nine pixel-based fusion techniques are discussed: Principal Component Analysis (PCA), multiplicative, Brovey transformation, wavelet analysis, subtractive, High Pass Filtering (HPF), modified IHS, Ehlers, and hyperspherical color space.
- The evaluation of the fused images is based on visual comparison, correlation coefficients, and histogram statistics.
- All fusion techniques result in changes to the statistical parameters of the original images.
- The study aims to identify the most effective fusion technique for enhancing the visual quality and resolution of urban features in the merged images.
- The main objective of the fusion techniques is to enhance the resolution and visual appearance of the original MS images.

3 DATASET

(a) Low resolutions MS image

(b) High resolution PN image

Multispectral (MS) and Panchromatic (PAN) images are commonly used in remote sensing applications:: Source ESA-GeoEYE1

The multispectral (MS) (a)image possesses several spectral bands and contains abundant spectral information.

The panchromatic (PAN) (b) image provides a high spatial resolution. It is composed of only one band.

4 Algorithm Adaptation

- The fusion image has been widely applied to image interpretation and pre-processing of various applications such urban planning, road, environ mgt.

Brovery algorithm

The Brovey transformation is based on spectral modeling and was developed to increase the visual contrast in the high and low ends of the data's histogram.

Brovey fuses the PAN and MS images as following:

$$F_i = \frac{PAN}{M} MS_i$$

$$F_i = \frac{PAN}{\frac{1}{N}\sum_{i=1}^{N} MS_i} MS_i$$

M is a linear combination of MS images

It uses a method that multiplies each re-sampled, multispectral pixel by the ratio of the corresponding panchromatic pixel intensity to the sum of all the multispectral intensities.

It assumes that the spectral range spanned by the panchromatic image is the same as that covered by the multispectral channels.

The spatial details in the MS image are inferior to those in the PAN image.

4 Algorithm Adaptation

In the Brovey transformation, the general equation uses red, green, and blue (RGB) and the panchromatic bands as inputs to output new red, green, and blue bands, for example:

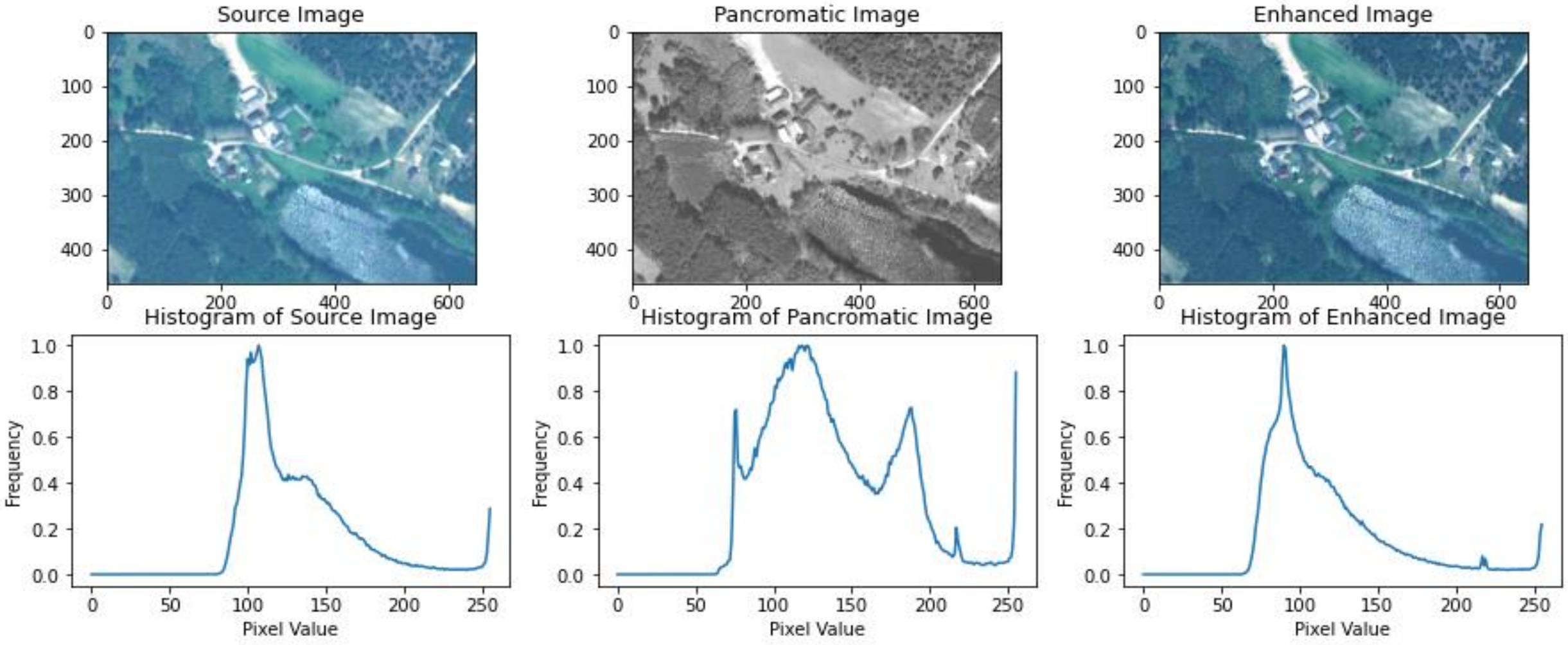
Red_out = Red_in / [(blue_in + green_in + red_in) * Pan]

However, by using weights and the near-infrared band (when available), the adjusted equation for each band becomes

DNF = (P - IW * I) / (RW * R + GW * G + BW * B)
Red_out = R * DNF
Green_out = G * DNF
Blue_out = B * DNF
Infrared_out = I * DNF

P = panchromatic image
R = red band
G = green band
B = blue band
I = near infrared
W = weight

5 Results and Discussion



The histograms of 2 images & output

5 Results and Discussion

Source Image:

Standard Deviation: 66.24
Mean: 164.64
Quartiles: [117. 155. 255.]

Panchromatic Image:

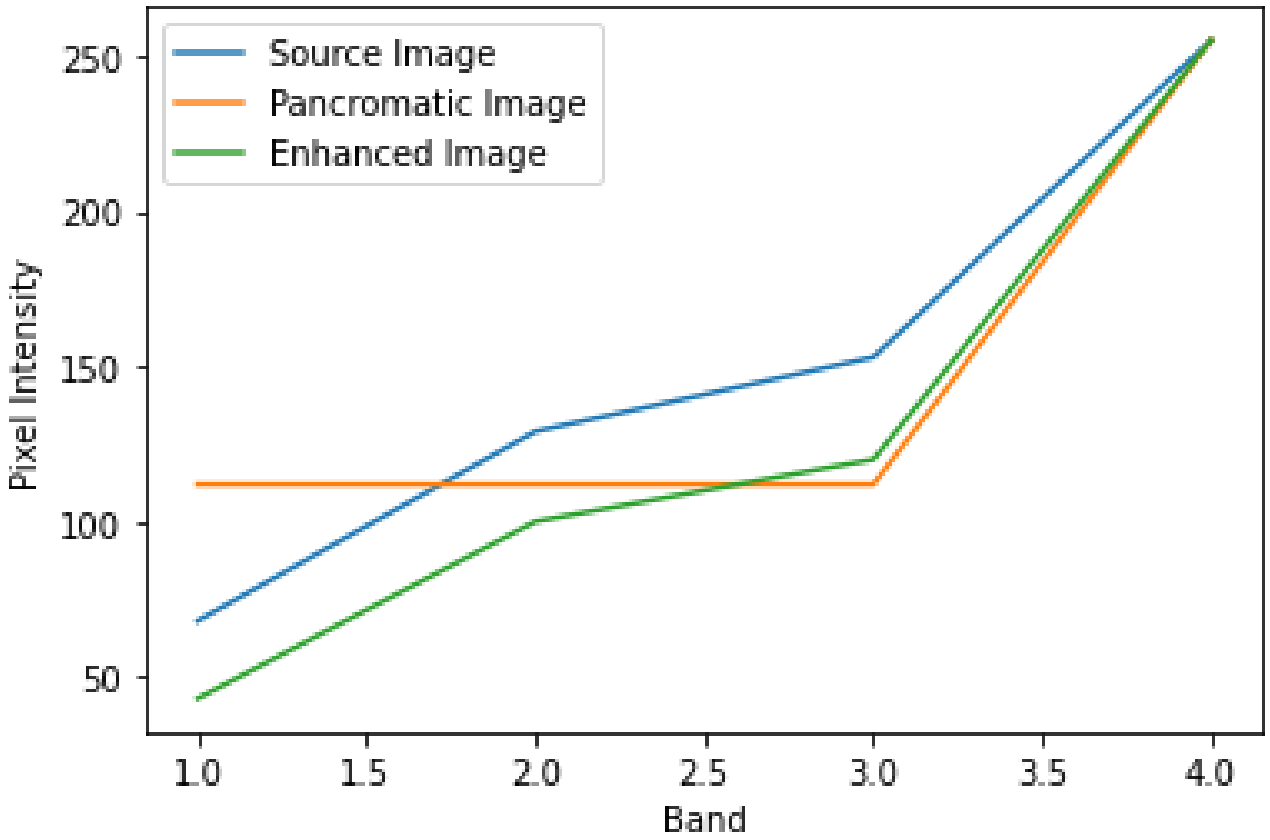
Standard Deviation: 61.87
Mean: 167.13
Quartiles: [115. 151. 255.]

Enhanced Image:

Standard Deviation: 72.00
Mean: 152.68
Quartiles: [99. 136. 255.]

Spectral Profiles

Compare the spectral profiles of the source, Panchromatic and enhanced images to identify any differences in the spectral response. Look for shifts, changes in shape, or improved contrast in the enhanced profile compared to the source.

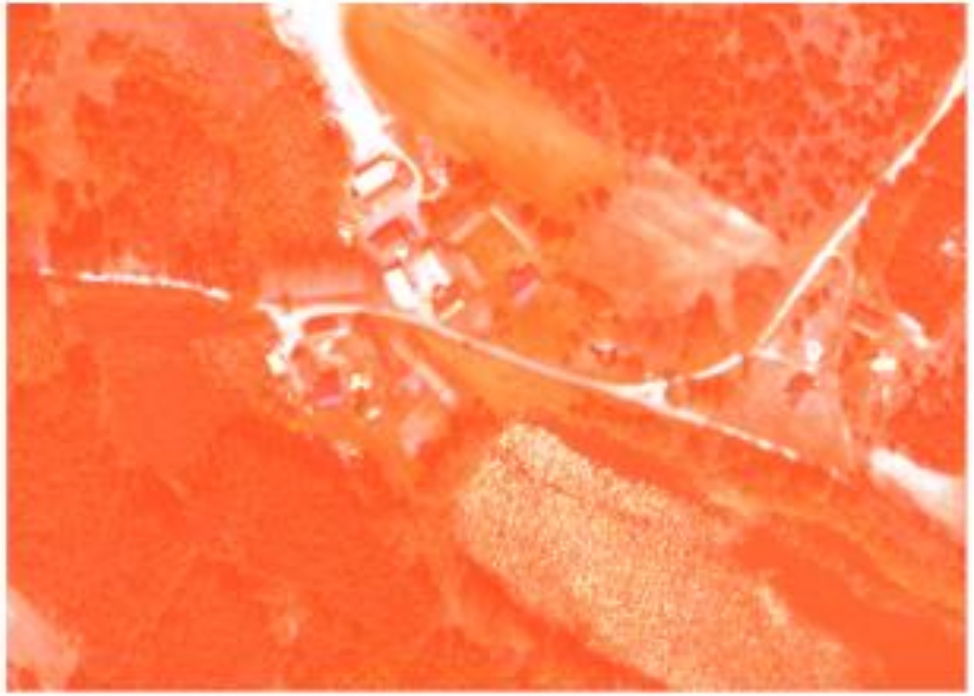


Judging model

➢ **visualizing the False Color Composition :**

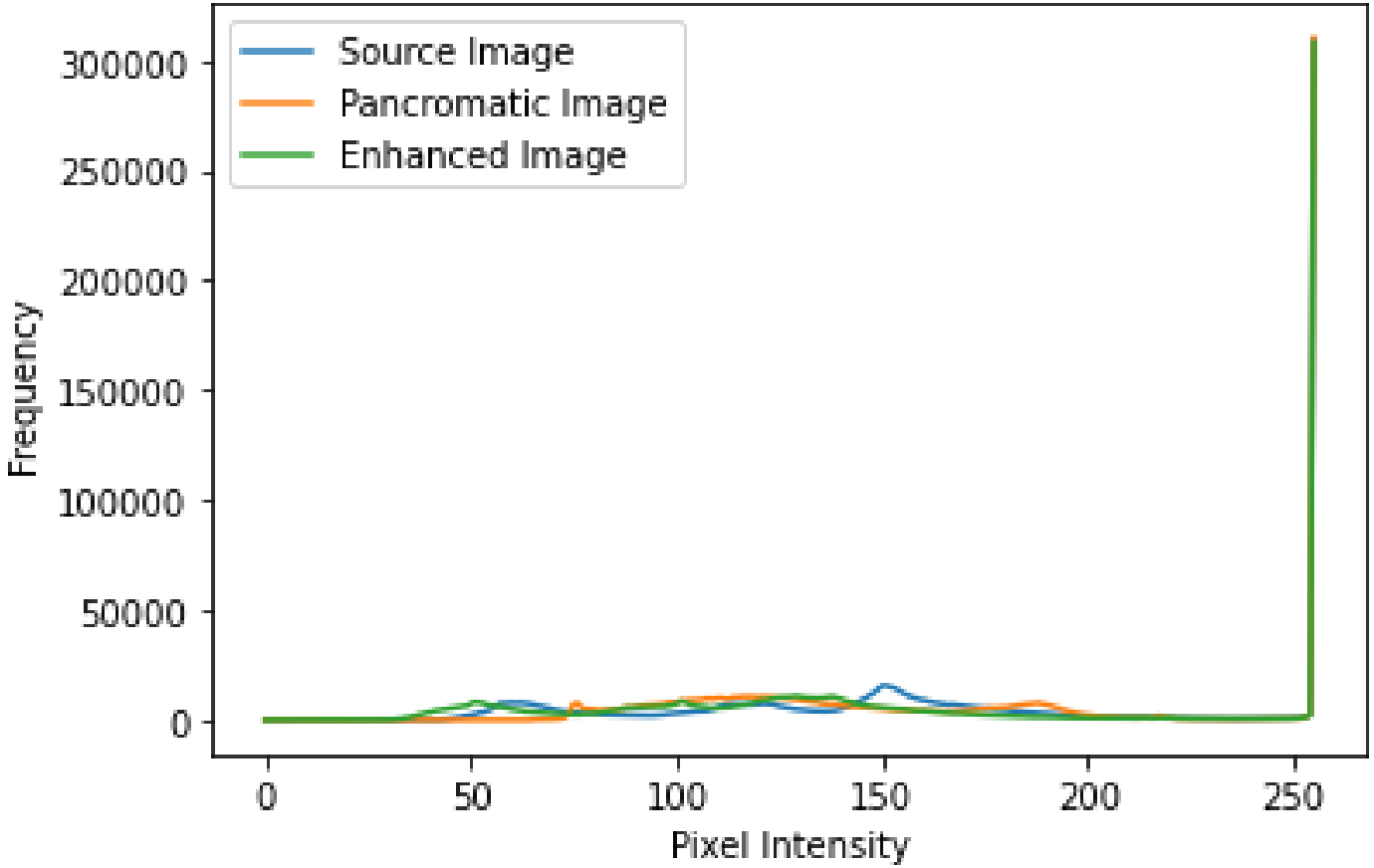
Observe the false color composite to visually assess if the enhancements have improved the visualization of features or patterns. Look for increased clarity, better discrimination of different classes, or improved interpretation compared to the source image.

False Color



Panchromatic Composite

5 Results and Discussion

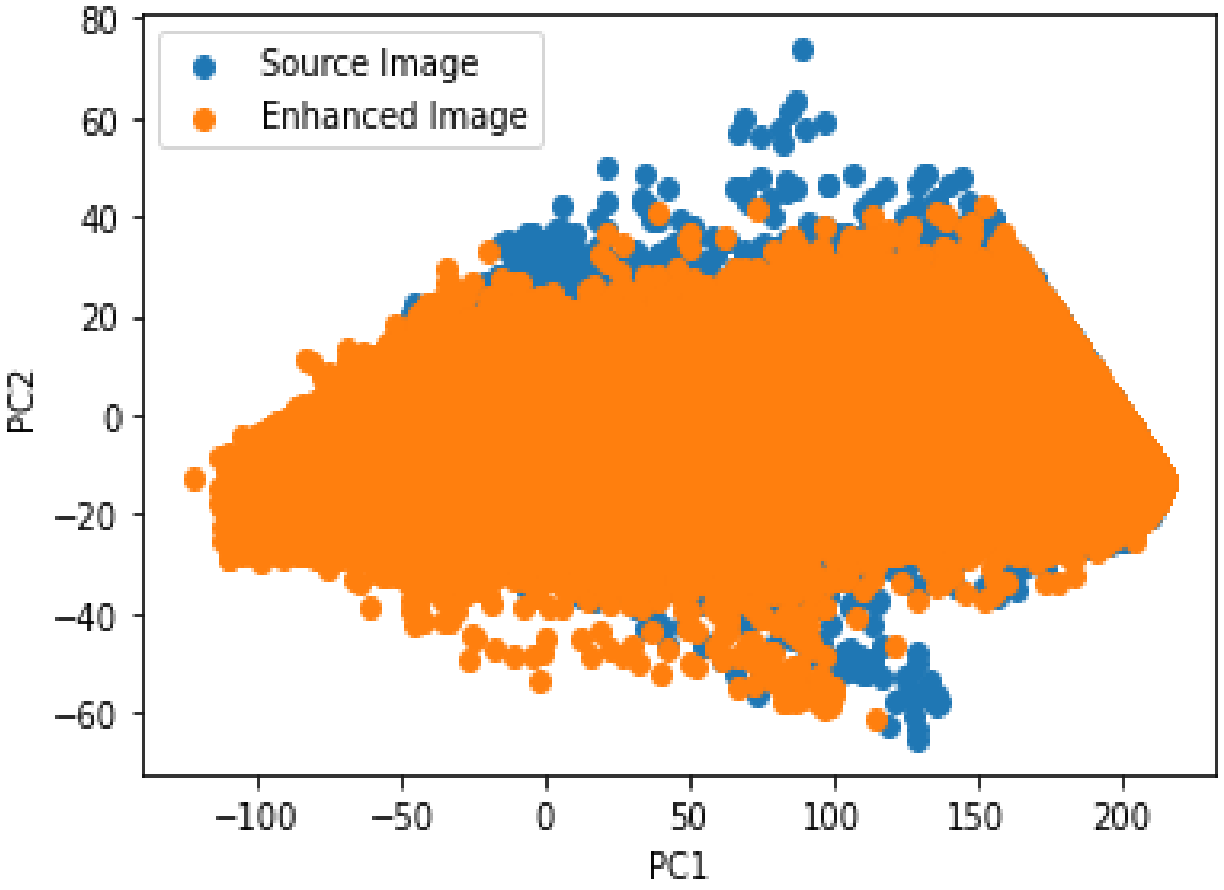


Analyze the histograms to compare the distribution of pixel intensities in the source and enhanced images. Look for any shifts, changes in the shape of the histograms, or differences in the distribution of values. These differences can indicate improvements introduced by the enhancement process.

Feature Extraction

- Assess the visualization of the extracted features using PCA. Look for improved separability of different classes or patterns in the enhanced image compared to the source image.

- If the enhanced image exhibits better clustering or more distinct groupings, it indicates potential improvements for feature extraction tasks.



Conclusion

The task demonstrated how we can leverage brovery algorithm to enhance low resolution open dataset to moderate resolution

The algorithm has revealed to bridge the gap that most small geospatial and institution faces in their work.

References

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3. Jat, K., Garg.k, Dahiya,S.,2016. A comparative study of various pixel-based image fusion techniques as applied to an urban environment.


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谢谢
dziękuję
tusind tak
molte grazie
ありがとう
obrigado
merci
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