Low Resolution Image Enhancement Of Aerial Images Using Scikit Tools

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Abstract-Digital Aerial image pre-processing is an operation with images at the lowest level of abstraction. The aim of image pre-processing is an improvement of the image data that minimizes distortions and enhances some image features which will be important for further processing in different applications like object detection and localization. In this paper, a procedure to polish up image contrast of aerial images, is proposed, in which transformation is performed with a combination of universal and local conversion functions. It conserves the intensity and fine facts of the input image. Several procedures suggested in this paper preprocess poorly concentrated images by composing several consecutive independent processing phases to nullify noise, enrich contrast & enhance the image. It also minimizes the effect of blur and noise. Finally output of each stage is compared by using PSNR parameters. Proposed methodology is also used in preprocessing filtration, edge detection and image enhancement to improve image qualities.

Keywords-Contrast Enhancement,Contrast Stretching,Gaussian Blur,Image Preprocessing Filtering, Image Enhancement, Image Rectifications,Edge Detection.

1.INTRODUCTION

Digital image is an image composed of picture elements, also known as pixels, each with finite, discrete quantities of numeric representation for its intensity or gray level that is an output from its two-dimensional functions .There are various categories of images like real-world images, aerial or satellite images.

Aerial images are images of the Earth taken from the air and from space show landforms, vegetation, and resources. Aerial and satellite images, known as remotely sensed images, permit accurate mapping of land cover and make landscape features understandable on regional, continental, and even global scales.

Aerial images have low resolution, because these images are captured from a very long distance, so they contain high noise and distortion because of atmospheric barriers. After capturing the image, some radiometric and geometric corrections are carried out on it but they are not sufficient for all the applications. It is very important to enhance the restored image before using it.

1.1 Image Preprocessing

Image Processing is a technique to perform some important operations on an image, in order to get an enhanced high quality image or to extract most useful information from that image. In this processing input is an aerial image and output will be an image or characteristics associated with that image.

Image pre-processing is the term used for operations on images at the lowest level of abstraction. These operations do not increase image information content but they decrease it if entropy is an information measure [1, 2]. The aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some image features relevant for further processing and analysis tasks. Image preprocessing uses redundancy in images.

1.2 Contrast Enhancement

Contrast enhancement is frequently referred to as one of the most important issues in image processing. Contrast is created by the difference in luminance reflected from two adjacent surfaces. In visual perception, contrast is determined by the difference in the color and brightness of an object with other objects. Our visual system is more sensitive to contrast than absolute luminance; therefore, we can perceive the world similarly regardless of the considerable changes in illumination conditions. If the contrast of an image is highly concentrated on a specific range, the information may be lost in those areas which are excessively and uniformly concentrated. The problem is to optimize the contrast of an image in order to represent all the information in the input image. There have been several techniques to

overcome this issue, such as general histogram equalization (GHE) and local histogram equalization (LHE). Image pre-processing methods can be classified into categories according to the size of the pixel neighborhood that is used for the calculation of new pixel brightness.

1.3 Factor for Image Preprocessing

We will focus on two factors for image preprocessing i.e.

1.3.1. Image Enhancement:

This provides more effective display of data for visual interpretation. An example of this is to edit the shades in an image. It is used to assist with distinction of different objects

1.3.2. Image Rectification and Restoration:

Image Rectification and Restoration can be used to correct geometric distortions, eliminate noise or to remove blurring in an image.

2. PROPOSED METHOD

The Image enhancement process is needed in all image processing applications. The images from satellites are also needed to be upgraded both in terms of resolution and edges so that the quality of the improved image looks enhanced than the original image.

There are numbers of techniques used recently, to increase the image quality in various applications. Each methodology shows different results. The images acquired from DWT and IDWT procedure have low PSNR and are not sharp. Hasan and Gholamreza enclosed the Discrete & stationary wavelet decomposition method based on interpolation of high frequency sub band images resulting from DWT. The Image enhancement process is needed in all image processing applications. The images from either satellites or real world images are also needed to be improved both in terms of resolution and edges so that the quality of the improved image looks enhanced than the original image. In image processing Complex Wavelet Transform (CWT) is utilized which gives two complex-valued sub-band images of low frequency and six complex valued sub-band images of high frequency of original image.MSE and PSNR of the super resolved image also improved.

Image embellishment procedures are applied for the modification of band intensities and lessening the noise which cover substantial information, about contrast-based feature extraction from satellite images of high resolution. Wavelet transform, Fourier decomposition, and discrete cosine transform, are alternative approaches that belong to the frequency-domain techniques. Intricate diffusion methods similar to normalized shock filters for the improvement of image and a ramp maintaining de-noising process were utilized.

Transform and interpolation methods are utilized together for image embellishment. Transform techniques are applied to improve the edges of an image. Edges of any image can also be improved by effectively using wavelet transform techniques, but as it is not suitable with directional element, Curvelet transform is used here for edge improvement. Image resolution is moreover an important constraint for enrichment of images; this can be carried out by means of interpolation in which the number of pixels in an image is increased. In this method we perform image enrichment with three main phases that is preprocessing filtration, Edge detection using Gaussian smoothing and image enhancement algorithm. Proposed methodology is represented with the help of architecture figure 2.1 Proposed methodology architecture.

Step1 : Dataset preparation

For Dataset preparation, we take a dataset from Dota aerial image dataset. The images in DOTA-v1.0 dataset are mainly collected from Google Earth, some are taken by satellite JL-1, the others are taken by satellite GF-2 of the China Centre for Resources Satellite Data and Application. Dataset contains more than 80 images taken from the above website and then all are converted into the same size, same data type and same resolution.

Step 2 :Preprocessing Filters

Here, for preprocessing we are applying Wiener algorithm, Lucy-Rechardson algorithm, Unsupervised Wiener-Hunt deconvolution and median algorithm for preprocessing filtration . Then output of all filters is compared on MSE and PSNR parameters. Finally, Unsupervised Wiener-Hunt deconvolution filter is selected as a preprocessing filter for the input image. As in an averaging filter, each output pixel is set to an average of the pixel values in the vicinity of the Corresponding input pixel. However, with median filtering, by calculating the median of the neighborhood pixels, an output pixel value is determined, rather than the mean.

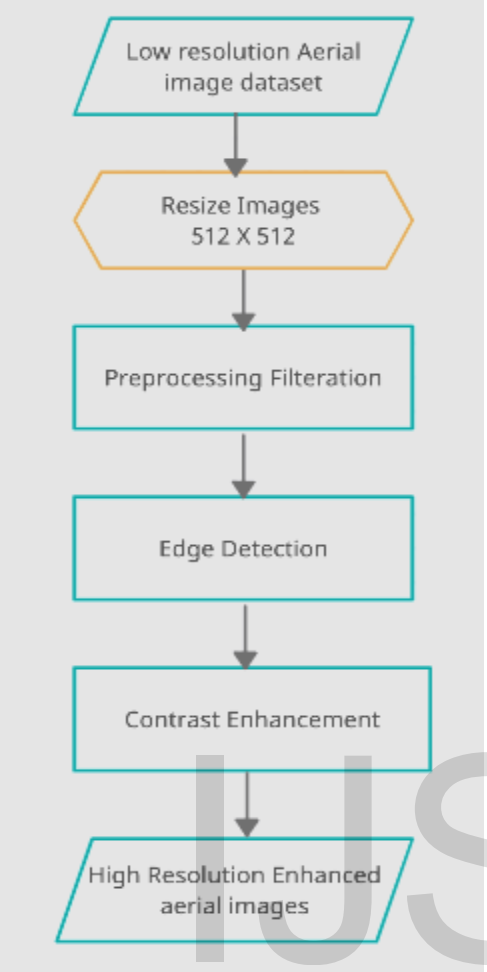


Figure 2.1 Proposed methodology Architecture

Step 3 : Edge Detection

We do this using Gaussian blur which is also known as Gaussian smoothing is the result of blurring an image by Gaussian function[22] .The visual effect of this blurring technique is a smooth blur resembling that viewing the image through a translucent screen, distinctly different from the bokeh effect produced by an out-of-focus lens or the shadow of an object. Gaussian smoothing is also used as a preprocessing stage in computer vision algorithms in order to enhance image structures at different scales.

Step 4 : Contrast Enhancement

In the process of contrast enhancement, the output of edge detection apply for next step processing ,pixels with lower pixel value than a specific value are displayed as black, whereas the pixels having higher pixel value are displayed as white, and pixels having pixel value in between these two values are displayed as tint of gray.

The outcome of this process is a linear mapping of a subset of pixel values to the full range of grays from black to white, creating an image of higher contrast. For best output different upper and lower limits are analyzed.

The contrast stretching algorithm is used by stretching the range of the color values to use all possible values to enhance the contrast. For preserving the accurate color proportion when the contrast stretching algorithm is used, similar scaling is applied for stretching all channels.

In Min-Max Contrast Stretching for each pixel:

pixel = ((pixel – min) / (max – min))*255

Where min and max are the maximum and minimum pixel values in the image. Sometimes, when Min-Max is performed, the tail ends of the histogram becomes long resulting in no improvement in the image quality In the first step the red and green channels are balanced to be the blue channel slightly, by stretching the histogram to both sides to get a well-spread histogram.

PSNR is well-defined simply via the mean squared error (MSE). If the pixels are characterized by using 8 bits per sample, it is 255, and m, n is the number of rows and columns of input image respectively. Higher value of PSNR shows good results. and it can be simply determined that PSNR values for median filter are higher in all cases so median filter should be opted as a preprocessing filter for input satellite images.. Finally output of each lower and upper bond is tested on the basis of their PSNR values.

3. Result And Discussion

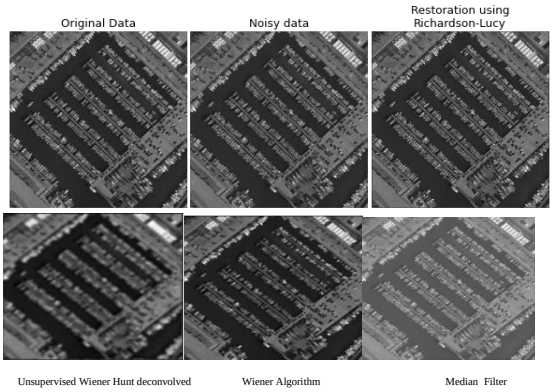
3.1. Preprocessing Filtration Result

In this section, an experimental process of we show that the comparative result analysis study for the image enhancement of DOTA aerial images to enhance image quality is performed. This process of image enrichment of various aerial images is done by using proposed method.

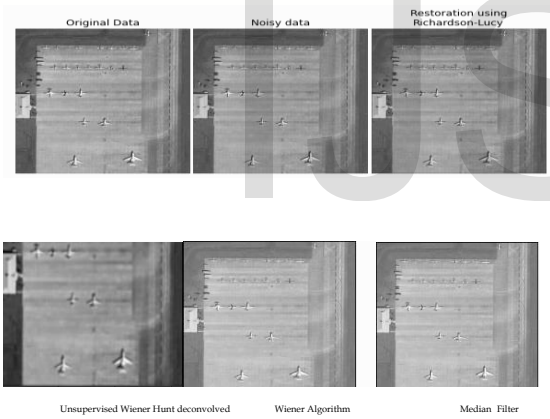
Scikit-image is an image processing Python package that works with NumPy arrays which is a collection of algorithms for image processing. Libraries of scikit-image are used in preprocessing filtration .

From scipy.signal for performing import convolve2d for Lucy-Richardson and winner algorithm. OpenCV (Open Source Computer Vision Library) ,PIL,Skimage.metrics are the libraries are used in implementation of proposed methodology.Matplotlib libraries are used for displaying images and visualization result.

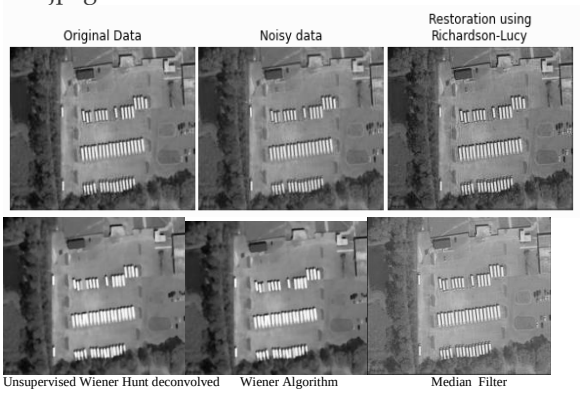
P1.jpeg :



P2.jpeg:



P12.jpeg



3.1.2 Table I

Comparison of Preprocessing: Output of preprocessing filters is compared on the basis of PSNR values between input image and enhanced image presented in Table I.

Table I Output of preprocessing filters

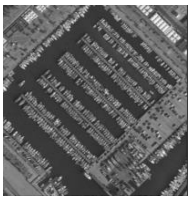
Images	**Median Filter**	**Unsupervised - Wiener-Hunt Algorithm**	**Wiener Algorithm**	**Lucy-Richardson Algorithm**
p1.jpeg	15.45	18.34	16.12	17.76
p2.jpeg	19.34	23.44	13.24	13.45
p3.jpeg	19.23	22.67	20.43	20.68
p12.jpeg	16.23	20.45	18.54	19.09
p13.jpeg	15.05	19.23	17.52	17.89
p17.jpeg	11.43	18.99	16.02	17.09
p18.jjeg	15.49	20.72	17.88	18.35
p19.jjeg	17.37	23.49	20.59	20.76
p78.jjeg	14.56	18.34	16.90	16.99
P23.jpeg	18.30	23.09	21.95	22.17
P24.jpeg	11.34	17.39	16.43	16.84

3.2. Edge Detection Result

PSNR value of unsupervised Wiener hunt Deconvolved is highest, therefore this one is used for edge detection sharpening and Gaussian blur using hstack. The Gaussian High Pass filter allows high frequency image information to pass through

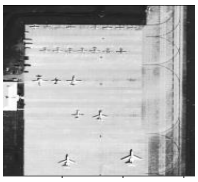
and blocks low frequency image information. The sharpening process works by first creating a slightly blurred version of the original image, the unsharp mask. This is subtracted away from the original to detect the presence of edges.

P1.jpeg

Sharpening ----------> Gaussian Filter

P2.jpeg

Sharpening ----------> Gaussian Filter

P12.jpeg


Sharpening ----------> Gaussian Filter

3.3. Contrast Enhancement Result

Result of Edge Detection is applied to normalization whose result is used for contrast enhancement. After comparing results, it is visible that Contrast Stretching Min-max algorithm give best result than CLAHE and GHE.

P1.jpeg

Global Histogram Equalization CLAHE Contrast Stretching

P2.jpeg

Global Histogram Equalization CLAHE Contrast Stretching

P12.jpeg

Global Histogram Equalization CLAHE Contrast Stretching

This is an enhanced result of DOTA aerial images for comparing with previous result which clearly increased PSNR then median preprocessing filtration. If compare among image enhancement algorithms it can be concluded that Contrast Stretching Algorithm give us good enhanced images then GHE, CLAHE.

3.3.3.Table II

Table II Output Contrast Enhancement Algorithm

Images	Contrast Stretching Algorithm	GHE	CLAHE
p1.jpeg	21.05	19.34	19.20
p2.jpeg	25.94	20.44	19.64
p3.jpeg	25.67	21.67	20.37
p12.jpeg	23.76	23.45	20.02
p13.jpeg	21.63	16.23	19.23
p17.jpeg	21.45	19.99	19.49

p18.jjeg	24.56	12.72	20.99
p19.jjeg	25.58	16.49	23.79
p78.jjeg	21.87	19.34	19.34
P23.jpeg	25.34	20.09	18.09
P24.jpeg	21.23	20.39	19.39

4. CONCLUSION

There are many different methods for image amendment to attain visually acceptable images. The techniques of Contrast enhancement are utilized broadly for betterment of visual quality of low contrast images. Here, after taking the image database, we have applied Wiener, Lucy-Rechard-son, Unsupervised-wiener hunt de-convolution algorithm and median filters. Then output of all filters is compared on MSE and PSNR parameters[17]. Finally, the median filter is selected as a preprocessing filter for the above input image. The PSNR values are far better for Unsupervised - wiener hunt deconvolution algorithm and it can be detected from Table I, so it is the best filter among all preprocessing filters for removal of noise from input image. Similarly from Table II it can be concluded that among algorithms, Contrast stretching algorithm is best. In low contrast and light distinction zones, none of the prevailing methods provide adequate outcomes. The technique suggested in this paper is very effective for image contrast enrichment through a plotting utility that advances the illumination and fine points of the input image and also reserves the complete image intensity and contrast stretching.

5. FUTURE SCOPE

Image processing technology extracts information from images and integrates it for a wide range of applications. Here, we've outlined the most prominent fields where image processing could bring significant benefits.

Advances in image processing and artificial intelligence will involve spoken commands, anticipating the information requirements of governments, translating languages, recognizing and tracking people and things, diagnosing medical conditions, performing surgery, reprogramming defects in human DNA, and automatic driving all forms of transport. With increasing power and sophistication of modern computing, the concept of computation can go beyond the present limits and in future, image processing technology will advance and the visual system of man can be replicated. The future trend in remote sensing will be towards improved sensors that record the same scene in many spectral channels. Graphics data is becoming increasingly important in image processing applications. The future image processing applications of satellite based imaging ranges from planetary exploration to surveillance application .

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