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# A Wavelet Based Enhancement Technique for Aerial Imagery

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***Abstract:*** **A wavelet based intense range compression algorithm was introduced to recover the visual components of aerial images captured in non-uniform circumstances. In this paper the algorithm is used to enhance the aerial images for better human visualisation. Aerial images are normally used for land use planning, environmental studies, conveyancing, archaeology, security tasks and other purposes. The outcome obtained by applying the algorithm to aerial images show high image value with all the required components. This process can further be modified and applied to video streaming.**

***Keywords:*** **Aerial Images, Wavelet, Image Enhancement, Transforms.**

## 1. INTRODUCTION

Aerial images are the images of the ground which are captured from raised position [2], which gives us the view of what the place looks like. When these images are being captured from an aircraft or a satellite, due to the weather conditions like fog, clouds and heavy rain there is a disturbance or noise caused in the image. To eliminate the disturbances caused we use the wavelet based dynamic range compression algorithm [1].

Wavelet is a function which is used for compressing an image and a waveform whose value on an average is zero. There are other types of transforms which can be used but a wavelet transform provides more information about the data and the dynamic range compression conserving the intensity, contrast and tonal interpretation of an image. A wavelet compressed coefficients can be obtained by,

$$\bar{a}_{J,k,l} = \left[\frac{\sinh(4.6248 a'_{J,k,l} - 2.3124) + 5}{10}\right]^r$$

A wavelet also recovers the vertical components, horizontal components and the diagonal components from the restored image. It can apparently generate new frequency components [3] and due to this the image looks more attractive.

This process is classified into three:

i. Histogram Adjustment
ii. Wavelet Based Dynamic Range Compression and Contrast Enhancement
iii. Color Restoration

The advantages are:

- With histogram adjustment we can explain the image intensity.
- The compression method will reduce the memory occupied by the image.
- Enhancement of aerial images is done easily.

## 2. IMAGE ENHANCEMENT TECHNIQUES

Improving the quality and features of an image or a video by using a computer program is called as [3] enhancement of an image. It is commonly used for computer graphics. It is classified into two categories

1. Spatial Domain
2. Frequency Domain

The spatial Domain type directly depends on the pixels of the image and it is mathematically represented as, G(x,y)=T[F(x,y)]

The enhancement of an image depends on the gray level of the image and it is referred to as point processing. The enhanced image is obtained by the difference between all the pairs of equivalent pixels [5].

Histogram equalization is one of the important techniques for image enhancement which is used to improve the visual quality of the image. It can either be applied on a part of an image or the full image.

In the frequency domain method the Fourier transform of the image will be enhanced and will be multiplied by the filter and the inverse transform will be considered as the enhanced image.

The main aim of image enhancement is to remove the noises and disturbances caused by the camera and give a smooth image. It also gives the fine details of an image.

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## 3. SYSTEM ARCHITECTURE

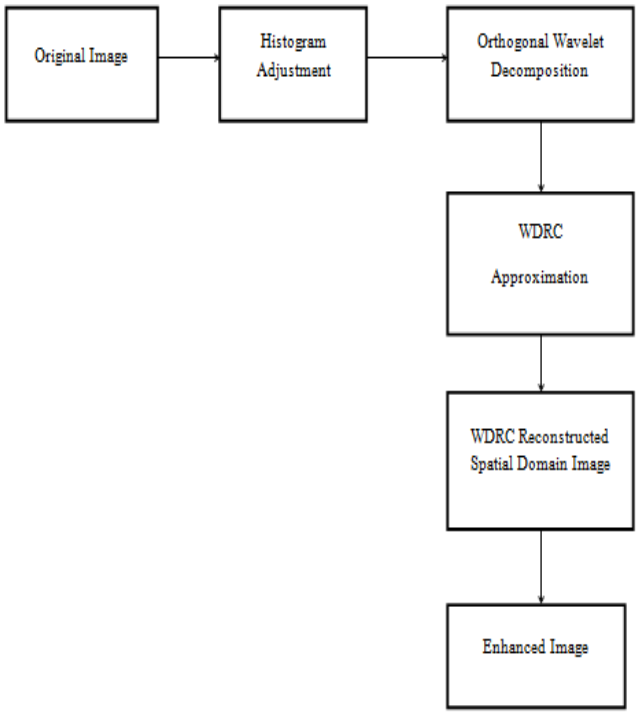


Fig:1. Block Diagram

An aerial image is taken and it is given as an input. The given image will undergo histogram adjustments. After the histogram equalization of the image it undergoes orthogonal wavelet decomposition [4]where the vertical, horizontal, diagonal components of the image are retrieved. Next the image will go through WDRC approximation where the gray images are improved. After this it undergoes WDRC spatial domain where the image is reconstructed. After all the improvements we get the final enhanced image where we can find the difference between the original image and enhanced image.

## 4. SOFTWARE HANDLING TOOLS

We are using the MATLAB software for the above process. In the MATLAB we are using the wavelet toolbox which provides functions to analyze signals and images. It also includes algorithms for continuous and discrete transforms. It can also be extended for different types of wavelets. It also allows us to study about the frequency components of the signal and how they vary with time[6]. It is also used for detection of errors and discontinuities which are not visible in the raw data. It can be used to remove the noises and compress the size of the information by maintaining the quality of the image.

## 5. RESULTS

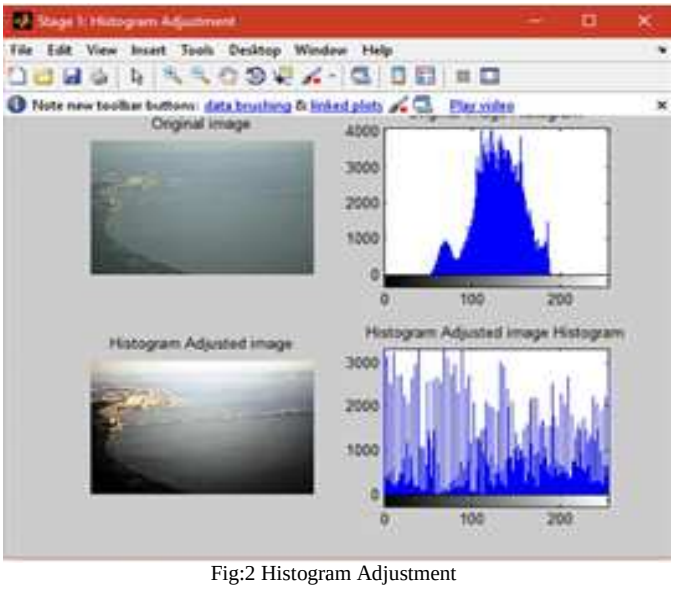


Fig:2 Histogram Adjustment

The above image shows the original image and it's histogram representation. It also shows the histogram adjusted image and it's histogram representation.

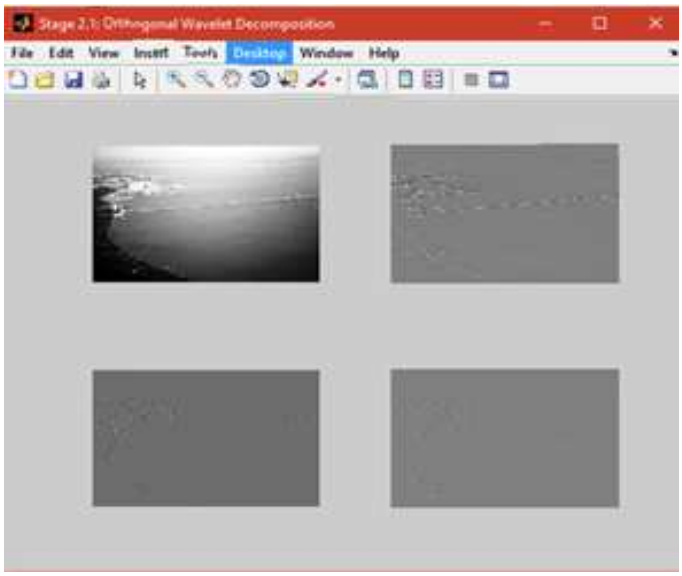


Fig:3 Orthogonal Wavelet Decomposition

The above image shows the orthogonal wavelet decomposition of the image which gives the horizontal, vertical and diagonal components of the image.

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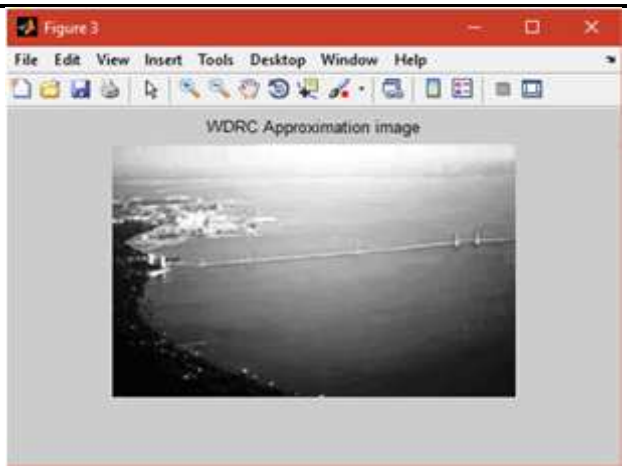


Fig:4 WDRC Approximation

The above image is the wavelet dynamic range compression of the original image. It gives a partial coloring to the gray images.

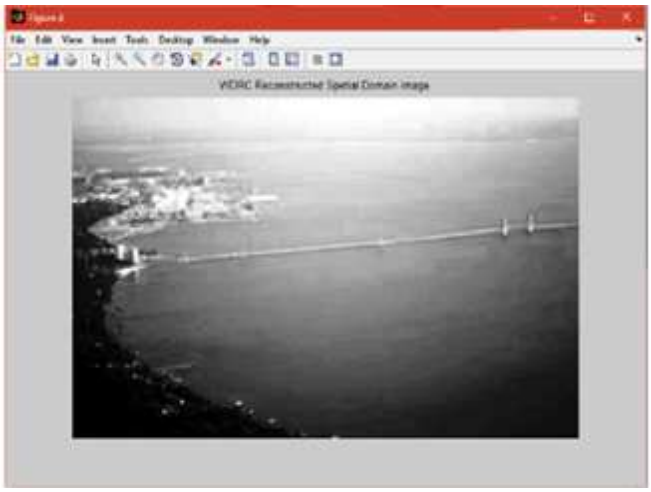

Fig:5 WDRC Reconstructed Image

This image gives the WDRC reconstructed spatial domain image of the histogram equalized image.

Fig: 6 Final Result

The above image gives the final result where the original image has some disturbances in it and when it goes through wavelet transform we get an enhanced image which is higher quality than the original image.

## COCNLUSION

In this paper we have seen how an aerial image which had disturbances in it has been changed to a clear enhanced image without any disturbances using the wavelet transform. The outcomes obtained of the aerial images show high image quality with strong robustness and enhancement in the visibility of the image. With this we can also say that, the above algorithm can be used for video streaming which can be useful in different aspects.

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