JPEG IMAGE DISCRETE WAVELET TRANSFORM COMPRESSION USING MATLAB

Divya R. Jariwala[1], Heta S. Desai[2]

[1]Research Scholar (computer Science & Applications), Shri JJT University, Dist.-Churu, Vidhyanagari, Jhunjhunu, Rajasthan, India
[2]Assistant Professor, UCCC & SPBCBA & UACCAIT, Udhna- Navsari Road, Surat, Gujarat, India

ABSTRACT:

Image Enhancement technique is one of the most popular and crucial methods in image research. The goal of image enhancement is to enhance the visual appearance of an image, or to provide a better transform representation for future automated image processing. Image Enhancement methods which improve the clarity of images for human viewing, removing blurring and noise, increasing contrast, and revealing details are examples of enhancement operations. The enhancement technique differs from one field to another according to its objective. The effectiveness of the algorithm has been justified over some real images, and the performance of the algorithm has been compared with other common compression standards. We analyze image resolution enhancement technique based on the interpolation of the high-frequency sub bands acquired by discrete wavelet transform (DWT) and the input image. The proposed resolution enhancement technique uses DWT to break down the input image into different sub bands. Various image enhancement techniques are being used for developing an image, which includes gray scale manipulation, Binary image manipulation, RGB image manipulation and index image manipulation. This is implemented in software using MATLAB Wavelet Toolbox and 2D-DWT technique. The experiments and results are carried out on .jpeg format images. These results provide a good reference for application developers to choose a good wavelet compression system for their application.

Keywords— *Discrete Wavelet Transform (DWT), JPEG Compression, Image Compression, MATLAB*

I. INTRODUCTION

Compression is one of the major image processing techniques. It is one of the most useful and commercially successful technologies in the field of digital image processing. Image compression is the representation of an image in digital form with as few bits as possible while maintaining an acceptable level of image quality [1]. Increasingly images are acquired and stored digitally or various film digitizers are used to convert traditional raw images into digital format [5].The objective of image Resolution enhancement is to overcome the limitation of the image acquisition device or ill posed acquisition condition [2]. A Super Resolved image is useful for many fields. Resolution has been frequently referred as an important property of an image [2-3] [6]. The principal scope of enhancement is to process an image so that the result is more suitable than the original image for a specific application. Image enhancement is one of the most interesting and visually appealing areas of image processing [7].

Digital Image processing deals with processing of digital images. Digital images have digitized value of intensities. Image enhancement deals with enhancing images so that visual quality of image improves thus providing more information [8]. Image enhancement is the technique which is most widely required in the field of image processing to improve visualization of the features so that the surface feature can be accurately extracted. [4]. Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image [9]. Researcher used Matlab platform for compression of JPEG image using DWT.

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II. DISCRETE WAVELET TRANSFORM (DWT)

The Discrete Wavelet Transform (DWT), which is based on sub-band coding. In DWT, the signal to be analyzed is passed through filters with different cutoff frequencies at different scales. Wavelets can be realized by iteration of filters with rescaling. The resolution of the signal, which is the measure of the amount of detail information in the signal, is determined by the filtering operations, and the scale is determined by up-sampling and down-sampling. The DWT is computed by successive low-pass and high-pass filtering of the discrete time-domain signal. Images are treated as two dimensional signals, they change horizontally and vertically, thus 2D wavelet analysis must be used for images (Nanavati and Panigrahi, 2005). 2D wavelet analysis uses the same 'mother wavelets' but requires an additional step at each level of decomposition.

In 2D, the images are considered to be matrices with N rows and M columns. At every level of decomposition the horizontal data is filtered, and then the approximation and details produced from this are filtered on columns. At every level, four sub-images are obtained; the approximation, the vertical detail, the horizontal detail and the diagonal detail (Mahendra et al.) [10].The 2-D wavelet decomposition of an image is performed by applying the 1-D discrete wavelet transform (DWT) along the rows of the image first, and then the results are composed along the columns. This operation results in four decomposed sub band images referred to low-low (LL) low-high (LH), high-low (HL), and high-high (HH). The frequency components of those sub bands cover the full frequency [11].

In this work, Researchers are proposing an image resolution enhancement technique which generates sharper high resolution image. The high-frequency sub band images are interpolated using interpolation. In parallel, the input image is also interpolated separately. [12]

III. JPEG COMPRESSION

JPEG (Joint Picture Expert Group) standard is one of the most popular and comprehensive still frame compression standards. The ever expanding multimedia and internet applications necessitated further expansion in technologies in the field of still image compression. [16]. in the sequential or the baseline system, the input and output data precision is limited to 8 bits. As each 8 X 8 blocks or sub image is faced, its 64 pixels are level-shifted by subtracting the quantity 2K -1. Thereafter, the transform of the block is computed, quantized as per the quantized optimization equation and recorded, using zigzag pattern to form a 1-D sequence of quantized coefficients [15].

The image is first divided into 8 by 8 blocks of pixels. For the description of the process, let us take that the color of each pixel as represented by a three-dimensional vector (R,G,B) consisting of its red, green, and blue components. A significant amount of correlation exists between these components. Thus, the three quantities are typically less correlated than the components (R, G, B). Further, the human eye is more sensitive to luminance than chrominance, which can support us to neglect larger changes in the chrominance without affecting image perception [17]. Since this transformation is invertible, we will be able to recover the (R,G,B) vector. [13]. The Encoding or Compression Phase is usually lossless and uses standard compression techniques. [14].

IV. METHODOLOGY

This section illustrates the proposed compression technique with pruning proposal based on discrete wavelet transform (DWT). The proposed technique first decomposes an image into coefficients called sub-bands and then the resulting coefficients are compared with a threshold. Coefficients below the threshold are set to zero. The compression features of a given wavelet basis are primarily linked to the relative scarceness of the wavelet domain representation for the signal. [18].

A. Matlab as Tool

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, Fortran and Python. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing abilities. [19]. Common usage of the MATLAB application involves using the Command Window as an interactive mathematical shell or executing text files containing MATLAB code. [20].

B. Image Compression Using DWT

Wavelets are also playing a significant role in many image processing applications. The 2-D wavelet decomposition of an image is performed by applying the 1-D discrete wavelet transform (DWT) along the rows of the image first, and then the results are decomposed along the columns. [21] Wavelet Transform has become an important method for image compression. Wavelet based coding provides sub spatial improvement in picture quality at high compression ratios mainly due to better energy compaction property of wavelet transforms. Wavelet transform partitions a signal into a set of functions called wavelets. Wave-lets are obtained from a single prototype wavelet called mother wavelet by dilations and shifting. The wavelet transform is computed separately for different segments of the time-domain signal at different frequencies [22]. The 2-D wavelet decomposition of an image is performed by applying the 1-D discrete wavelet transform (DWT) along the rows of the image first, and then the results are decomposed along the columns. This operation results in four decomposed sub-band images referred to low-low (LL), low-high (LH), high-low (HL), and high-high (HH).The frequency components of those sub-bands cover the full frequency spectrum of the original image [8].

Wavelets are functions that are concentrated in time as well as in frequency around a certain point. We know that we can have both high frequency resolution and poor time resolution OR poor frequency resolution and good temporal resolution. The Wavelet transform is designed in way that we get good frequency resolution for low frequency components and high temporal resolution for high frequency components. We start with a mother wavelet such as "Daubechies". The signal is then translated into shifted and scaled version of this mother wavelet. According to our wavelet analysis can be used to divide information of image into approximation and detail sub-signal. The approximation sub-signal shows general trend of pixel value and three detail sub-signal on horizontal, vertical and diagonal signal details. If these details are too small then they can be set to zero without significant change in the image. Hence filtering and compression can be achieved.

V. Result and Analysis

According to Nyquist sampling this change in frequency range means that only half of original samples need to be kept in order to perfectly reconstruct the signal.

[CA, CH, CV, CD]=DWT2(x, "Wname") (1)

Researcher used this MATLAB function for applying 2D DWT image compression. CA represents Approximation Coefficient Matrix. CH, CV and CD represents Detailed Coefficient Matrix obtains by a wavelet decomposition of the input matrix X. Wname is a string containing the wavelet name.

We have used 2-D discrete wavelet transform to divide the image into four sub-bands, namely LL, LH, HL and HH bands using with mother wavelet shown on figure 3. Researchers used jpeg file format for applying 2D discrete wavelet transform on the left top side it represent Approximate Image (LL), Left Bottom side it represent Vertical Detail (LH), Right Top side it represent Horizontal Detail (HL) and Right Bottom it represent Diagonal Detail (HH). This image is a color image of 1024×768 pixel, Horizontal and Vertical resolution is 96 dots per inch and Bit depth is 24.

A. Histogram

A histogram is an approach to graphically perform the sharing of data in a data set. Each data mark is placed into a bin based on its value. The histogram is a plot of the number of data marks in each bin. Histograms are useful in representing the spread of data from repeated experiments and for determining the probability of given analysis. This image is converted into gray scale image and generated histogram for different LL, LH, HL and HH sub bands of images which shown in figure 5, figure 6, figure 7 and figure 8. Figure 4 depicts histogram of original gray scale image.

VI. Conclusion and Future Scope

In this paper, we propose an approach for image compression in which uses DWT in spatial domain data which efficiently compress the size but it includes noise in the image. Researcher has proposed a resolution enhancement technique based on interpolation of high-frequency sub band images obtained by DWT and input image. Most of the techniques are useful for altering the gray level values of individual pixels and hence the overall contrast of the entire image. But they usually enhance the whole image in a uniform manner which in many cases produces undesirable results. There are various techniques available which produce highly balanced and visually appealing results for a diversity of images with different qualities of contrast and edge information and it will produce satisfactory result. In future, it will improve low bit-rate compression performance, lossless and lossy compression and continuous-tone and bi-level compression. The combined use of wavelet transforms gives the promising applications in image, mine detection, etc. The application of m-band wavelet transforms may give the more accurate results, in which processing time is not a constraint.

Appendix

Appendixes, if needed, appear before the acknowledgment.

Acknowledgment

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments. Avoid expressions such as "One of us (S.B.A.) would like to thank ... ." Instead, write "S.B.A. thanks ... ." This work was supported in part by the U.S. Department of Commerce under Grant BS123456 (sponsor and financial support acknowledgment goes here).

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https://www.youtube.com/watch?v=dSi9mLaa-WE.

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The second paragraph uses the pronoun of the person (he or she) and not the author's last name. It lists military and work experience, including summer and fellowship jobs. Job titles are capitalized. The current job must have a location; previous positions may be listed without one. Information concerning previous publications may be included. Try not to list more than three books or published articles. The format for listing publishers of a book within the biography is: title of book (city, state: publisher name, year) similar to a reference. Current and previous research interests ends the paragraph.

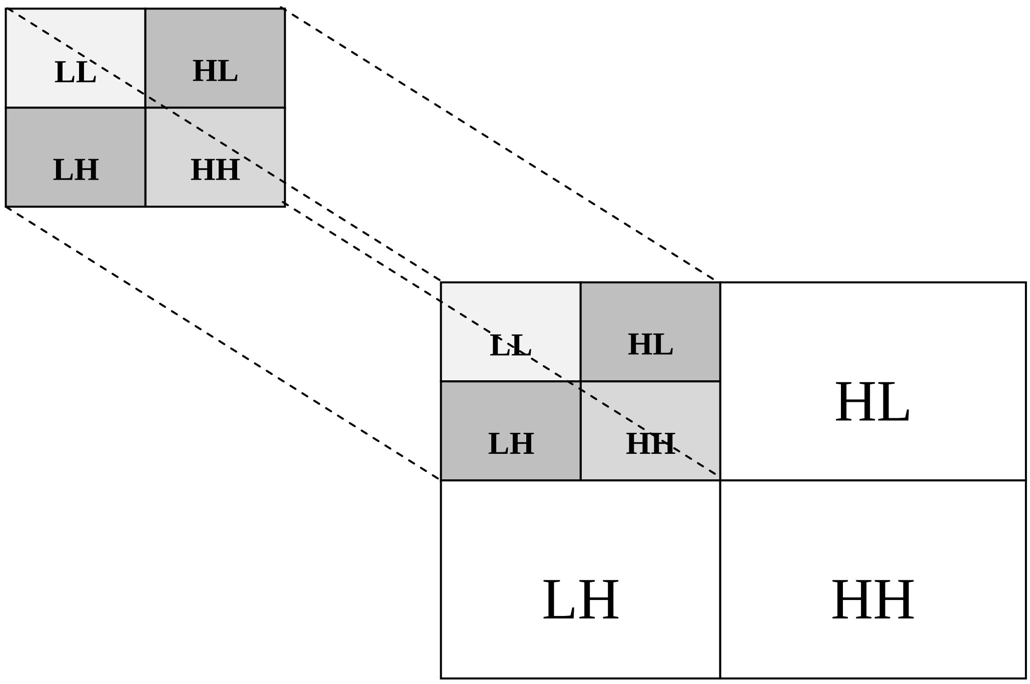
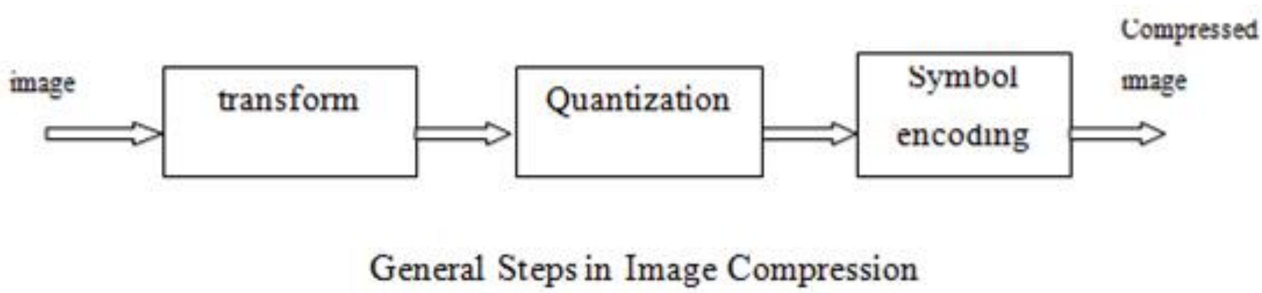


Fig. 1. Decomposition using mother Wavelet in DWT



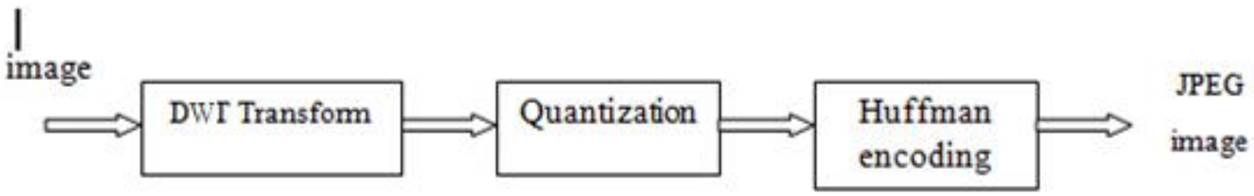


Fig 2. Process flow of JPEG Image compression

Fig 3. Process of Applying Discrete Wavelet Transform (DWT) on image

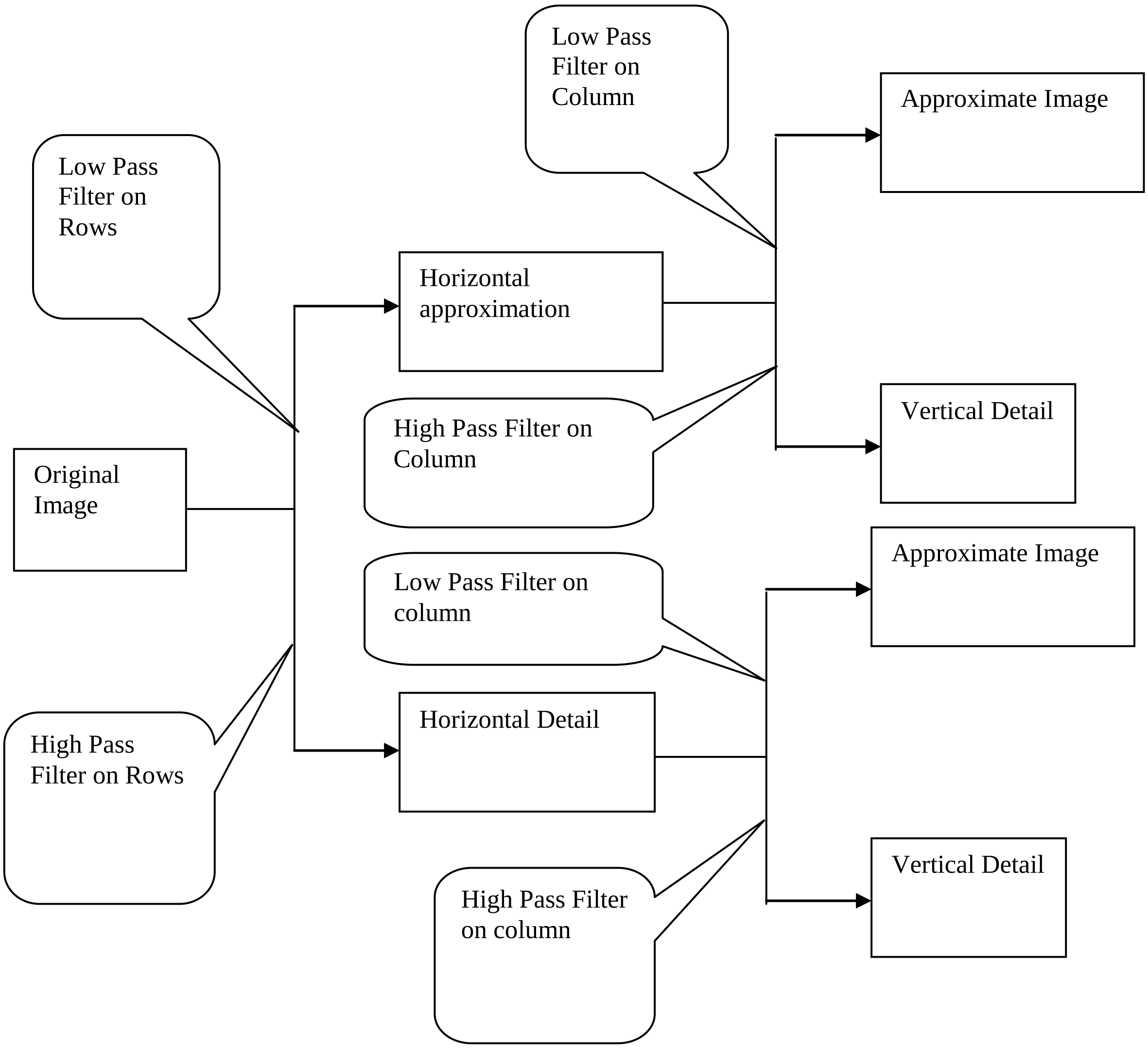


Fig 4. LL, LH, HL and HH sub bands of image obtained by using 2D DW

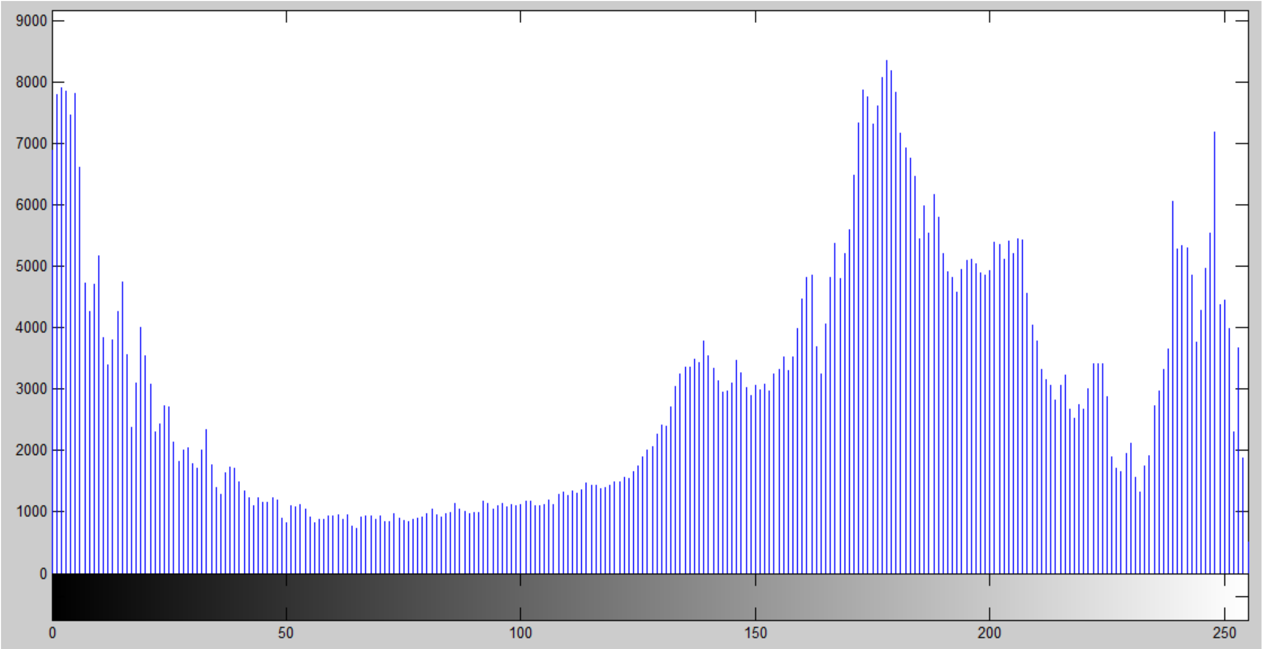


Figure 4: Histogram of Original Image

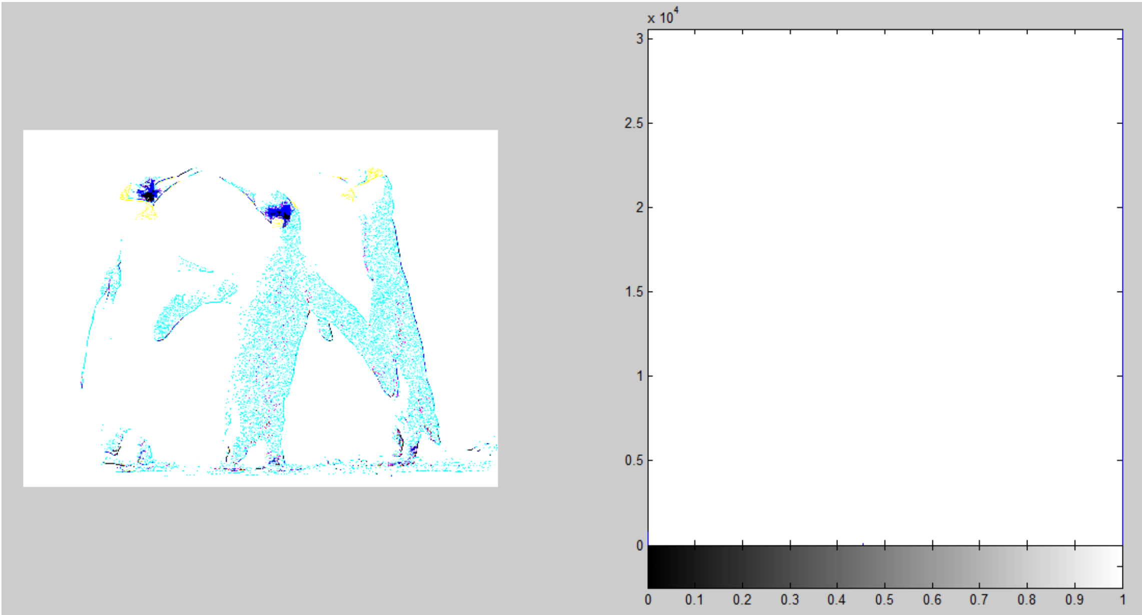


Figure 5: Approximate Histogram for LL

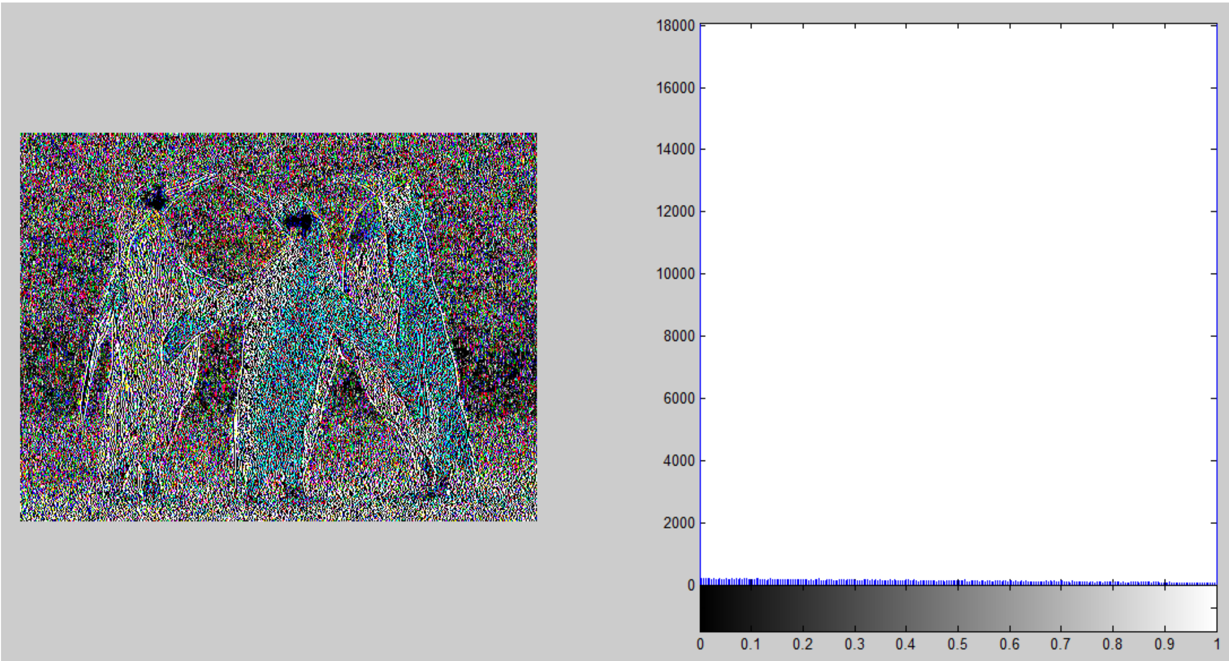


Figure 6: Vertical Detail Histogram for LH

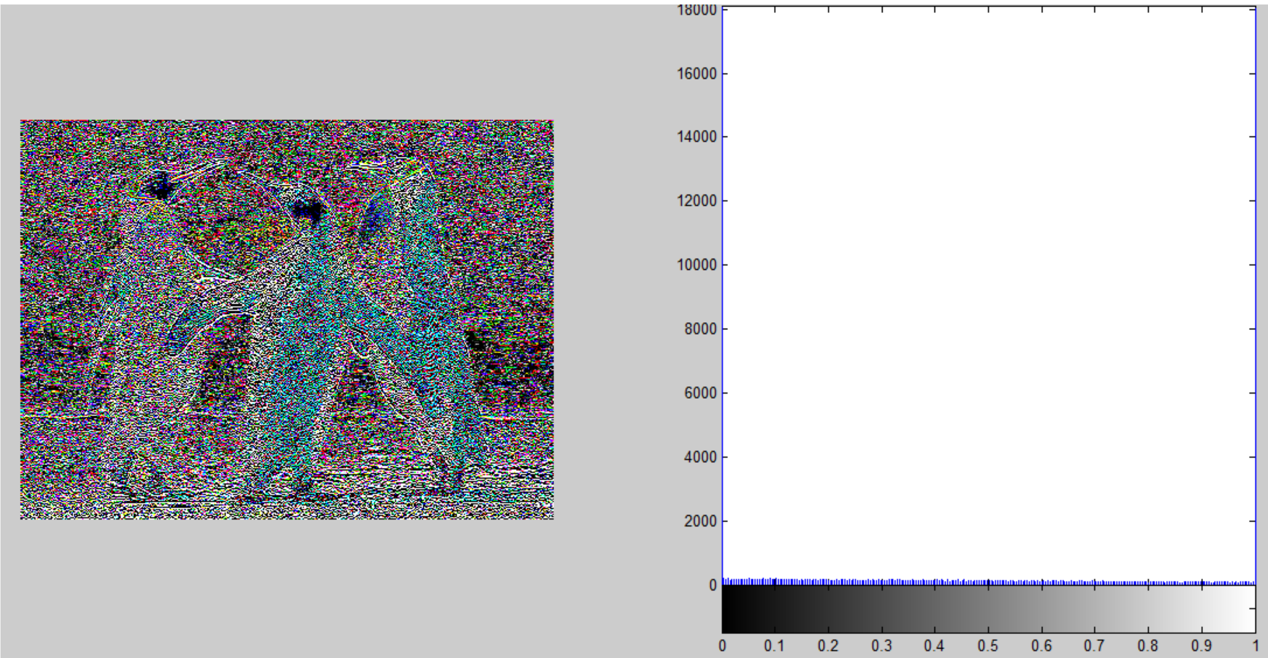


Figure 7: Horizontal Detail Histogram for HL

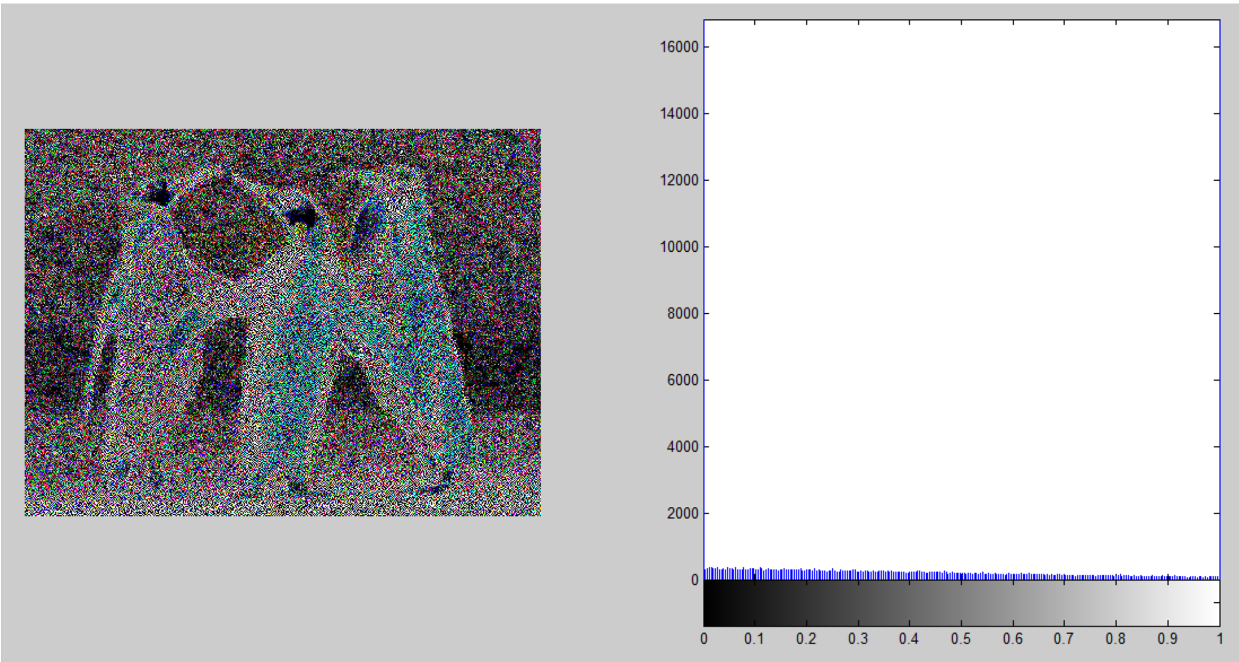


Figure 8: Diagonal Detail Histogram for HH