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# REVIEW ARTICLE

## REVIEW PAPER ON ENHANCING COLOR IMAGES BY USING VARIOUS FUSION METHODS

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## ABSTRACT

One of the fundamental challenges in the field of image processing and computer vision is image denoising, where the underlying goal is to estimate the original image by suppressing noise from a noise-contaminated version of the image. Image denoising plays an important role in a wide range of applications such as image restoration, visual tracking, image registration, image segmentation, and image classification for strong performance. The fast development of digital image processing leads to the growth of feature extraction of images which leads to the development of Image fusion. PCA and Discrete Wavelet Transform plays a vital role in image fusion since it minimizes structural distortions among the various others transforms. Now, after fusion basic problem in image processing is to suppress the noise in corrupted image by using image resolution enhancement and denoising using MDBUTMF filter for color images to suppress the noise and and get good color contrast.

***Key words:*** DWT, MDBUTMF, IDWT, SWT. Transform Fusion.

## INTRODUCTION

Digital images play an important role both in daily life applications such as satellite television, magnetic resonance imaging, computer tomography as well as in areas of research and technology such as geographical information systems and astronomy. Data sets collected by image sensors are generally contaminated by noise. Imperfect instruments, problems with the data acquisition process, and interfering natural phenomena can all degrade the data of interest. Furthermore, noise can be introduced by transmission errors and compression. Thus, denoising is often a necessary and the first step to be taken before the images data is analyzed. It is necessary to apply an efficient denoising technique to compensate for such data corruption. Image denoising still remains a challenge for researchers because noise removal introduces artifacts and causes blurring of the images. This paper describes different methodologies for noise reduction (or denoising) giving an insight as to which algorithm should be used to find the most reliable estimate of the original image data given its degraded version. Noise modeling in images is greatly affected by capturing instruments, data transmission media, image quantization and discrete sources of radiation. Different algorithms are used depending on the noise model. Most of the natural images are assumed to have additive random noise which is modeled as a Gaussian. Speckle noise is observed in ultrasound images whereas rich in noises affects MRI images.
One of the fundamental challenges in the field of image processing and computer vision is image denoising, where the underlying goal is to estimate the original image by suppressing noise from a noise-contaminated version of the image.

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Image noise may be caused by different intrinsic (i.e., sensor) and extrinsic (i.e., environment) conditions which are often not possible to avoid in practical situations. Therefore, image denoising plays an important role in a wide range of applications such as image restoration, visual tracking, image registration, image segmentation, and image classification, where obtaining the original image content is crucial for strong performance. While many algorithms have been proposed for the purpose of image denoising, the problem of image noise suppression remains an open challenge, especially in situations where the images are acquired under poor conditions where the noise level is very high.

**Review of Literature**

Pravin R. Dabhi at el. [8], author worked on satellite images which as many applications such as in meteorology, oceanography, fishing, agriculture, biodiversity conservation, forestry, landscape, geology, cartography, regional planning, education, intelligence and warfare. Images can be in visible colors and in other spectra. There are also elevation maps, usually made by radar images. Low resolution is the major drawback in these kinds of images. The resolution of satellite images varies depending on the instrument used and the altitude of the satellite's orbit. In order to exploit the information and to analyze the image the resolution of the image has to be enhanced. Various image processing techniques exist for resolution enhancement. The latest being application of wavelet techniques for resolution enhancement. In this, a comparison of two main wavelet techniques i.e. DWT & SWT are studied based on the image quality metrics and a new image quality enhancement technique had been worked based on wavelet fusion algorithm. The computation results of the image enhancement and image quality metrics of the proposed technique is compared with existing techniques. It is proved that the proposed technique have higher resolution enhancement capability than existing techniques. Mirajkar Pradnya (2013) defined Image fusion as the process of combining two or more different images into a new single image retaining important features from each image with extended information content. There are two approaches to image fusion, namely Spatial Fusion and Transform fusion. In this paper, we propose an image fusion approach based on Stationary Wavelet Transform (SWT). Stationary Wavelet Transform (SWT) is firstly applied with the original image to get the edge image information both in level 1 and level 2. Next, both edge images are fused to get a complete edge image using Spatial Frequency Measurement, which is compared with a few simple fusion Methods. Siva Kumar *et al*. (2013) proposed an image resolution enhancement technique based on interpolation of the high frequency subband images obtained by discrete wavelet transform (DWT) and the input image. The edges are enhanced by introducing an intermediate stage by using stationary wavelet transform (SWT). DWT is applied in order to decompose an input image into different subbands. Then the high frequency subbands as well as the input image are interpolated. The estimated high frequency subbands are being modified by using high frequency subband obtained through SWT. Then all these subbands are combined to generate a new high resolution image by using inverse DWT (IDWT).

The quantitative and visual results are showing the superiority of the proposed technique over the conventional and state-of-art image resolution enhancement techniques. Kanagaraj Kannan *et al*. (2010) introduced the fast development of digital image processing leads to the growth of feature extraction of images which leads to the development of Image fusion. The process of combining two different images into a new single image by retaining salient features from each image with extended information content is known as Image fusion. Two approaches to image fusion are Spatial Fusion and Transform fusion. Discrete Wavelet Transform plays a vital role in image fusion since it minimizes structural distortions among the various other transforms. Lack of shift invariance, poor directional selectivity and the absence of phase information are the drawbacks of Discrete Wavelet Transform. These drawbacks are overcome by Stationary Wavelet Transform and Dual Tree Complex Wavelet Transform. This paper describes the optimal decomposition level of Discrete, Stationary and Dual Tree Complex wavelet transform required for better pixel based fusion of multi focused images in terms of Root Mean Square Error, Peak Signal to Noise Ratio and Quality Index Jeen Marseline *et al*. (2013), proposed under water environments are dynamic and complex, and obtaining a clear picture of the obstacles and movements of objects in this environment is difficult. The disturbances caused by various factors affect the image quality which leads to incorrect analysis. Sonar image quality can be assessed in terms of quality parameters like contrast, illumination variation and Noise. A non-parametric statistical wavelet denoising method is proposed in this paper. The proposed method incorporates the edge coefficients and non-edge coefficients as it picks up the homogeneous neighbor of non-edge coefficients and estimates the noise-free coefficients and outperforms the traditional approach. Haweez Showkat *et al*. (2014) presented a Robust Video watermarking become a challenge for researchers as it is used to sustain the copyrights of the owner. Most of the developed watermarking algorithm based on frequency domain because this approach provides better results as compare to spatial domain approach. In this paper we proposed a Graphical User Interface (GUI) based SVD-DWT Video Watermarking using Fused Images and Low-Middle frequency bands. In this work, two watermark images are used in fused manner using wavelet fusion. The basic approach used in this work is to utilize the benefits of Singular Value Decomposition (SVD) and Discrete Wavelet Transform (DWT). For embedding watermark Low and Middle frequency bands are used as they provide more robustness against geometric attacks such as cropping, rotation etc. The performance of the proposed algorithm has been evaluated using two parameters such as Peak Signal to Noise Ration (PSNR) and Correlation Coefficient (CC) under various noise attacks like Gaussian and Salt and Pepper Noise attacks, geometric attacks – rotation and cropping. The simulation results shows that proposed method has better results as compared to SVD-DWT hybridization, DWT and SVD approaches [4]. Amar Tej (2015) pre-processing techniques hire filtration and resolution enhancement to remove noise and have good resolution is the main quality parameters in medical images. So as to preserve the edges and contour information of the medical images, an improved image enhancement technique and the efficient denoising is required. Here, concentrate on the average filtering, median filtering, wiener filtering and wavelet denoising for image denoising and an interpolation based Discrete and stationary Wavelet Transform technique for resolution enhancement is calculated on the base of some performance parameters such as PSNR which provides efficient denoising and resolution enhancement for image pre-processing. Ashishgoud Purushotham, *et al* (2015), result of fusion is a new image which is more suitable for human and machine perception. Pixel level image fusion using wavelets and principal component analysis have implemented and worked on different performance metrics with and without reference image which concluded that image fusion using wavelets with higher level of decomposition showed better performance in some metrics and in other metrics PCA showed better performance. DWT in all parameters performs better than the PCA fusion algorithm so finally we can conclude that DWT is performs better than PCA.

**Fusıon Technıques**

As we know Image fusion is the process of matching two images so that corresponding coordinate points in the two images correspond to the same physical region of the scene being imaged or Produce a single image from a set of input images. It aims to reduce amount of data, retain important information.

**Various techniques of fusion are**

**1. High pass filtering technique**: High-pass filter fusion method a method that make the high frequency components of high-resolution panchromatic image superimposed on low resolution multispectral image, to obtain the enhanced spatial resolution multispectral image. The formula is as follows:

$F_k(i,j)=M_k(i,j)+HPH(i,j)$ (1)

In the formula, $F_k(i,j)$ is the fusion value of the band K pixel (i,j), $M_k(i,j)$ the value of multi-special of band k pixel (i,j), HPH(i.j) show the high frequency information of the high resolution image.

2. **IHS transform based image fusion:** this technique follows the standard procedure with three bands based on RGB true color space.

3. **PCA based image fusion:** this is similar to IHS method but using arbitrary number of bands used. The input of low resolution modulation intensity is first transferred into the same number of uncorrelated principal components. There can be as many possible principal components as there are variables. It can be viewed as a rotation of the existing axes to new positions in the space defined by the original variables. In this new rotation, there will be no correlation between the new variables defined by the rotation. The PCA is widely used for dimensionality reduction and data analysis. The PCA is computed using the Eigen values and eigenvectors of the covariance matrix of the multi-spectral image bands. Thus the first principal component corresponds to the direction of the highest Eigen values or maximum variance. The second principal component corresponds to the second maximum variance and so on. Last step is to inverse the PCA transform.

4. **Wavelet transforms image fusion:** here represents any arbitrary function x(t) as a superposition of a set of such wavelets or basis function- mother wavelet by dilation or contractions (scaling) and translation (shifts). Using multi-resolution analysis, the multispectral and the panchromatic images were decomposed into an orthogonal wavelet representation at a coarser resolution, which consisted of low frequency approximation image and a set of high frequency detail images. The detail images from the high resolution panchromatic image are incorporated into the decomposed multispectral images at a level the resolution of the ground cover matches and the inverse transform is taken.

5. **Stationary Wavelet transforms image fusion:** here represents is a wavelet transform algorithm designed to overcome the lack of translation-invariance of the discrete wavelet transform (DWT). Translation-invariance is achieved by removing the down samplers and up samplers in the DWT and up sampling the filter coefficients by a factor of $2^{(j-1)}$ in the $j^{th}$ level of the algorithm. The SWT is an inherently redundant scheme as the output of each level of SWT contains the same number of samples as the input – so for a decomposition of N levels there is a redundancy of N in the wavelet coefficients. Here holes which refers to inserting zeros in the filters.

**Denosıng Model**

Image denoising plays an important role in a wide range of applications such as image restoration, visual tracking, image registration, image segmentation, and image classification, where obtaining the original image content is crucial for strong performance. While many algorithms have been proposed for the purpose of image denoising, the problem of image noise suppression remains an open challenge, especially in situations where the images are acquired under poor conditions where the noise level is very high**.** Different methodologies for noise reduction are given to us that insights into the methods to determine which method will provide the reliable and approximate estimate of original image given its degraded version. Image de-noising done by filtering. Linear filters result is not better because they destroy the fine details and lines and also blur the sharp edges. Bilateral filter recently used for de-noise the images. Its work effectively with high frequency areas but it fails to work at low frequency; it fails to remove salt and pepper noise and gives low performance to remove speckle noise. The Discrete Wavelet Transform (DWT) of image signals produces a non redundant image representation, which provides better spatial and spectral localization of image formation, compared with other multi scale representations such as Gaussian and Laplacian pyramid. MDBUTMF is modified decision based unsymmetrical median filter. To remove any type of noise this function copies the function of median filter except works only on noisy pixels. The processing pixel is checked whether it is noisy or noisy free. That is, if the processing pixel lies between maximum and minimum gray level values then it is noise free pixel, it is left unchanged. If the processing pixel takes the maximum or minimum gray level then it is noisy pixel which is processed by MDBUTMF.

**Enhancement Technıques**

Image resolution enhancement is a technique that helps to obtained high-resolution images from low-resolution images. It is needed to achieve a good effect of vision, in an improved effective image resolution, required for a good quality of images where it is required to adjust in a better size of image. So some histrogram equaliztion techniques are:

1. **Histogram Equalization (HE):** A histogram is a graphical representation of the distribution of data. An image histogram is a graphical representation of the number of pixels in an image as a function of their intensity. The histogram equalization technique is used to stretch the histogram of the given image. Greater is the histogram stretch greater is the contrast of the image.

2. **Brightness Preserving Bi-Histogram Equalization (BBHE):** BBHE divides the image histogram into two parts. In this method, the separation intensity is presented by the input mean brightness value, which is the average intensity of all pixels that construct the input image. After this separation process, these two histograms are independently equalized.

3. **Recursively Separated and Weighted Histogram Equalization (RSWHE):** The RSWHE segments the input histogram into two or more sub histogram recursively based on the mean or median as used in RMSHE and RSIHE, then apply the weighting process based on normalized power low function to modify the each sub-histogram. And then perform histogram equalization to each weighted output sub-histogram independently.

**Conclusıon and Future Work**

In a summary, the different techniques are studied of image fusion methods which are used to generate high resolution image that attempts to preserve the spectral characteristics of the original data. The selection of the fusion method for an application depends largely on the dataset. For image fusion methods, spatial enhancement and spectral preservation are all critical issues. In this paper, a new image fusion method is introduced. The fusion outcome is regarded as a linear combination of the input panchromatic and multispectral images. The DWT\ fusion method presents the best result for both visual and quantitative evaluations. The spatial and spectral changes help in comparative study of various fusion techniques. It has been proved that PCA fusion technique preserves more spectral information as compared with multiplicative. Apart from this, the Discrete Wavelet transform yielded better results when compared with the PCA, IHS and SWT image fusion techniques, however, some fusion methods produce blocking artifacts or noise in the fused images. The comparative analysis was carried out between the PCA, IHS, SWT, High-pass filter and DWT. Denoising for enhancement or removal of unwanted noise from fused images is also compared using MDBUTMF then an enhancement technique such as Histogram equalization is applied on above denoised imaged. Future scope is here that we can combine the fusion techniques to get out good contrast and high resolution images.

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