PERFORMANCE IMPROVEMENT OF CURVELET TRANSFORM BASED IMAGE DENOISING USING GRADIENT DESCENT

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ABSTRACT

Image denoising is a very important preprocessing in many computer vision tasks. Removal of noise is an important step in the image restoration process, but denoising of image remains a challenging problem in recent research associate with image processing. Denoising is used to remove the noise from corrupted image, while retaining the edges and other detailed features as much as possible. This noise gets introduced during acquisition, transmission & reception and storage & retrieval processes. The major objective of this is how to remove noise present in image using non-linear technique such as curvelet transform and wavelet transform in image processing. In this I used Gradient Descent Algorithm gradient descent is useful for large signal. It works efficiently on large signal.We can apply the gradient descent algorithm to the Wiener filter in such a way that at each new step we can calculate a new set of filter coefficients. and these new set of filter coefficient makes filtering more efficient. Using the gradient descent method, we can approach a minimum error value in relatively few iterations.

Keywords:-*Curvelet Transform, Sub-Band Decomposition,FFT,Ridgelet Transorm,Wiener Filter, Gradient Descent Algorithm*

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1. INTRODUCTION:

Image denoising has a very rich history beginning from the mid-1970s[6].Digital images play an important role both in daily life applications such as satellite television, computer tomography as well as in areas of research and technology such as geographical information systems and astronomy. In reality, an image is mixed with certain amount of noise which decreases visual quality of image. Therefore, removal of noise in an image is a very common problem in recent research in image processing. An image gets corrupted with noise during acquisition or at transmission due to channel errors or in storage media due to faulty hardware. Removing noise from the noisy image is still a challenging problem for researchers. Noise may be classified as substitutive noise (impulsive noise: e.g., salt and pepper noise, random valued impulse noise, etc.), additive noise (e.g., additive white gaussian noise) and multiplicative noise [1].

2. BACKGROUND:

Curvelet Transform is an extension of wavelet Transform. Curvelet transform is a multi-scale geometric wavelet transforms, can represent edges and curves singularities much more efficiently than traditional wavelet.The Curvelet Transform is a multi scale mathematical transform which provides a new multi-resolution representation with several that are superior to existing representations such as wavelets and steerable pyramids. The Curvelet Transform has been widely used for image denoising because curvelet reconstructions exhibit higher perceptual quality than wavelet based reconstructions, offering visually sharper images and in particular higher quality recovery of edges.

2.1 Curvelet Transform involves the following Steps:

Removal of noise is an important in the i mage processing.Figure.1 shows the basic model for denoising of image. In the implementation of these methods, first the noisy image is decomposed by wavelet transform than apply sub-decomposition. After this apply FFT .After this, by using apply wiener filter to decomposed images. Finally denoised image is obtained by using ridgelet transform.

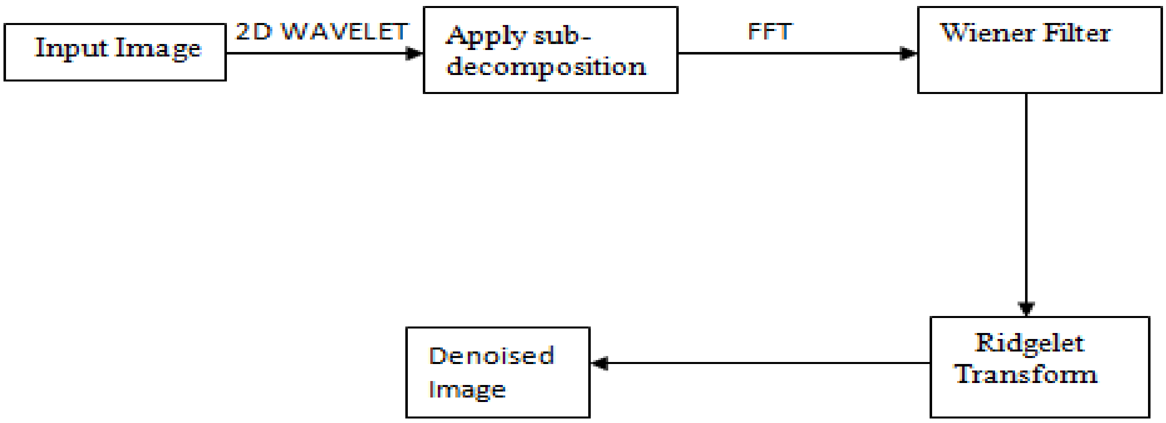


Fig.1: Curvelet Transform Process

2.2 Gradient Descent Algorithm:

An image gradient is a directional change in the intensity or color in an image. Image gradients may be used to extract information from images. Gradient Descent is useful for large signal. It works efficiently on large signal.We can apply the gradient descent algorithm to the Wiener filter in such a way that at each new step we can calculate a new set of filter coefficients. and these new set of filter coefficient makes filtering more efficient. Using the gradient descent method, we can approach a minimum error value in relatively few iterations .There are different types of filters are availble.Filters are classied as a mean filter,median filter,wiener filter. We used a Wiener Filter.

2.3 Wiener Filter:

Wiener filters are a class of optimum linear filters. It provides linear estimation of a desired signal sequence from another related sequence. The wiener filter provides a solution of signal estimation problem for stationary signals. It also provides successful results in removing noise from photographic image. The design of the filter is distinct. It is based on statistical approach. The filter is optimal in the sense of MMSE [5].

2.4 Sub-Band Decomposition:

Any form of transform coding that breaks a signal into a number of different frequency bands. So we used a 2D wavelet transforms.

2.5 Image Noise:

Noise in an image is the result of errors in the image acquisition process that result in pixel values that do not reflect the true intensities of real picture. The presence of noise gives an image a grainy, rough, mottled or snowy appearance. The magnitude of image noise can vary from almost gradual specks on a digital photograph to optical and radio astronomical images that are completely noise [5]. Various types of noises present in an image are as follows:

- Gaussian noise
- Salt and pepper noise
- Speckle noise

A. Gaussian Noise:
Gaussian noise is a statistical noise. It is evenly distributed over the signal.It is a major part of 'read noise' of an image sensor i.e. of the constant noise level in dark areas of the image. The probability density function (PDF) of Gaussian noise is equal to that of the normal distribution, also known as Gaussian distribution. It is usually used as additive white noise to give additive white Gaussian noise (AWGN) [5].

B. Salt and Pepper Noise:
Fat-tail distributed or impulsive noise is sometimes called salt and pepper noise or spike noise. An image containing salt and pepper noise will have dark pixels (black dots or pepper) in bright region and bright pixels (white dots or salt) in dark region .An effective method to remove this type of noise involves the use of median filter, morphological filter or a contra harmonic median filter [5].

C. Speckle Noise:
Speckle noise is a granular noise that inherently exists in and degrades the quality of the active radar and synthetic aperture radar (SAR) images. Speckle is a random, deterministic, interference pattern in an image formed with coherent radiation of a medium containing many sub-resolution scatterers. Speckle noise is eliminated using adaptive and non-adaptive filters [5].

3.PROPOSED WORK:

In this method, to denoise the image following steps follows:

Step 1.First select a noisy image.

Step 2.The next step will be to apply a sub-band decomposition to decompose the noisy image into four sub images:LL,HL,LH,HH.

Step 3.After this apply FFT and normalization.

Step 4.For image smoothing, apply a ridgelet transform.. then apply a wiener filter.

Step 5.Finally apply a gradient descent algorithm.

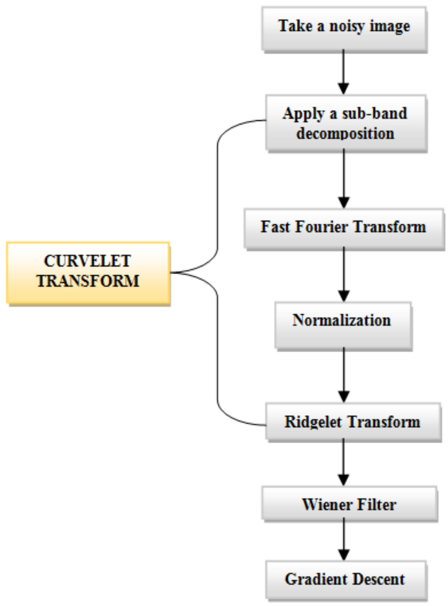


Fig.2: Proposed Work

4.LITRETATURE SURVEY:

In this survey study,[1] Represents based on wavelet domain. This paper shows that how to convert noisy image to denoised image. In this paper, we have evaluated and compared performances of modified denoising method and the local adaptive wavelet image denoising method. These methods are compared with other based on PSNR (Peak signal to noise ratio) between original image and noisy image and PSNR between original image and denoised image. Simulation and experiment results for an image demonstrate that RMSE of the local adaptive wavelet image denoising method is least as compare to modified denoising method and the PSNR of the local adaptive wavelet image denoising method is high than other method. Therefore, the image after denoising has a better visual effect. The performance of the local adaptive wavelet image denoising method is good and effective compared to modified denoising method in terms of PSNR between denoised image and original image.[2] Represents is to improve over existing compressive imaging algorithms in terms of both reconstruction error and runtime. For this error, compressive imaging algorithms that employ the approximate message passing (AMP) framework. AMP is an iterative signal reconstruction algorithm that performs scalar denoising at each iteration; in order for AMP to reconstruct the original input signal well, a good denoiser must be used. We apply two wavelet-based image denoisers within AMP. The first denoiser is the “amplitude-scale-invariant Bayes estimator” (ABE), and the second is an adaptive Wiener filter; we call our AMP-based algorithms for compressive imaging AMP-ABE and AMP-Wiener. Numerical results show that both AMP-ABE and AMP-Wiener significantly improve over the state of the art in terms of runtime. In terms of reconstruction quality AMP-Wiener offers lower mean-square error (MSE) than existing compressive imaging algorithms. In contrast, AMP-ABE has higher MSE, because ABE does not denoise as well as the adaptive Wiener filter. AMP-Wiener achieves the lowest reconstruction error among all competing algorithm. Comparing the denoising quality of ABE and the adaptive wiener filter as image denoisers in scalar channels, we have seen that AMP with a better denoiser produces better reconstruction quality for compressive imaging problems. [3] Represents Hyperspectral image denoising is an essential preprocess step to improve the performance of subsequent applicationS.HSI,there is much global and local redundancy and correlation in spatial/spectral dimensions. This paper show the performance of proposed algorithm(Spa+Lr for short) on simulated and real noisy HSI and video block-matching and 3-D filtering (VBM3D) method, which is an extension of the block-matching and 3D filtering method for single-image denoising to the multichannel image case. But the experimental results demonstrate that our denoising method can achieve competitive performance than other state-of-the-art methods. So the denoising performance may decrease when noise is strong. HSI denoising method can achieve competitive performance than other methods. Denoising performance may decrease when noise is strong. Here concentrate on removing noise for HSI under strong noise. [4] Represents Image denoising methods can be grouped into two categories: model-based methods and learning-based methods. Most denoising methods reconstruct the clean image by exploiting some image and noise prior models, and belong to the first category. Learning-based methods attempt to learn a mapping function from the noisy image to the clean image. This paper shows PSNR and SSIM results of GHP,B-GHP and S-GHP, GHP WITH THE ESTIMATED GRADIENT HISTOGRAM(GHP-E),WITH THE GROUND TRUTH GRADIENT HISTOGRAM(GHP-G), SAPCA-BM3D, LSSC and NCSR.GHP leads to similar PSNR/SSIM measures to the state-of-the-art denoising methods such as SAPCABM3D,LSSC and NCSR; however, it leads to more natural and visually pleasant denoising results by better preserving the image texture areas. One limitation of GHP is that it cannot be directly applied to non-additive noise removal, such as multiplicative Poisson noise and signal-dependent noise. So I study in this paper, different types of methods are available for removing noise and it's PSNR values also are different. GHP is cannot be directly applied to non-additive noise removal, such as multiplicative Poisson noise be interesting and valuable to study more general models and algorithms for non-additive noise removal with texture enhancement.[5] Represents a various filters and wavelet transform for image de-noising. It deals with comparison of two approaches i.e. filtering approach and wavelet based approach accounting Peak Signal to Noise Ratio and Root Mean Square Error as performance parameters. This paper proves that Wavelet Transform method is very effective for all types of noise.[6] Represents In this method similar image patches are grouped together from a noisy image into Three-dimensional (3-D) stack. From three dimensional stack, higher order singular Value Decomposition(HOSVD) coefficients are computed, then invert HOSVD transform is applied to produce the filter output. In the noisy images if the group of patches are similar then we do not denoise independently in the three dimensional stack. HOSVD can obtain the fine textures.

Paper	PSNR Variance=20	PSNR Variance=30
Image Denoising using the Higher Order Singular Value Decomposition	32.015	30.079

5.IMPLEMENTATION AND RESULTS:

Let's consider following work flow algorithm for mentioned system.

Step1 :- Take a noisy Image.

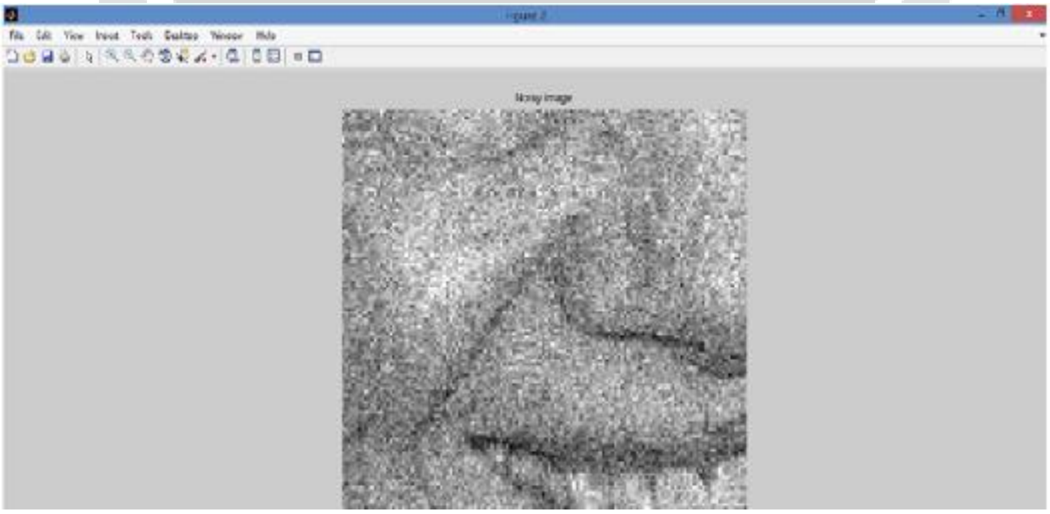


Fig – 1: Noisy Image

Step 2:-Apply a Noisy Coefficients.

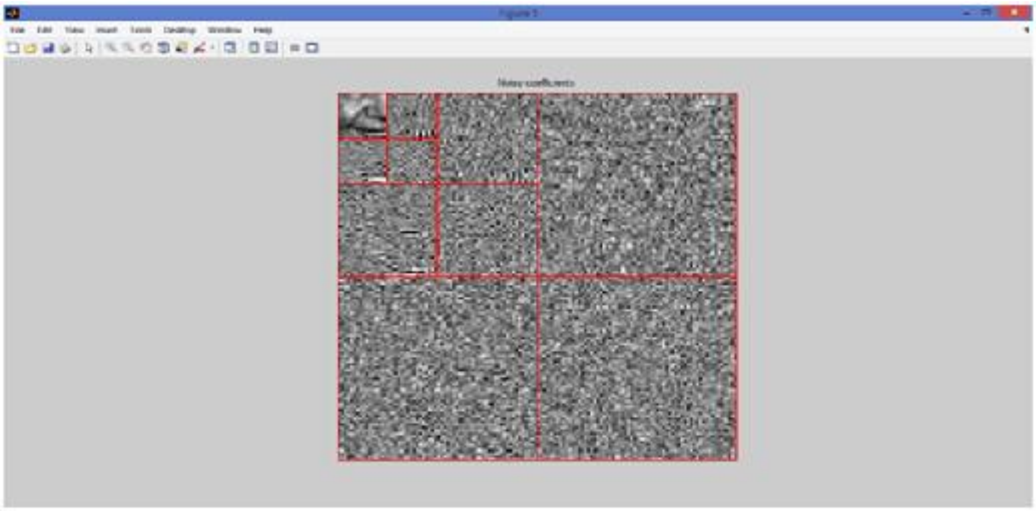


Fig – 2:Noisy Coefficients

Step 3:-Apply a Thresholded coefficients.

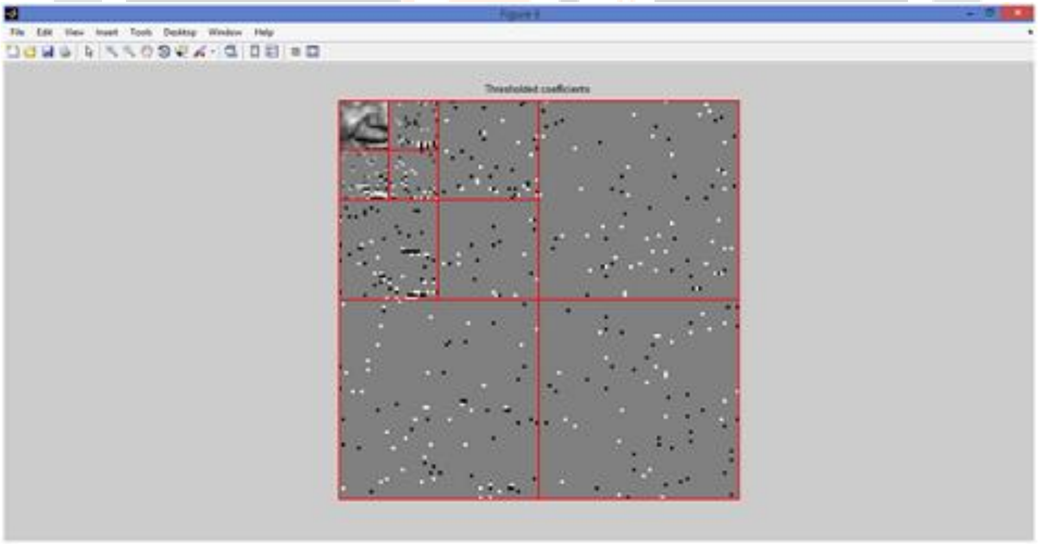


Fig – 3:Thresholded Coefficients

Step 4:-Finally we get Denoised Image

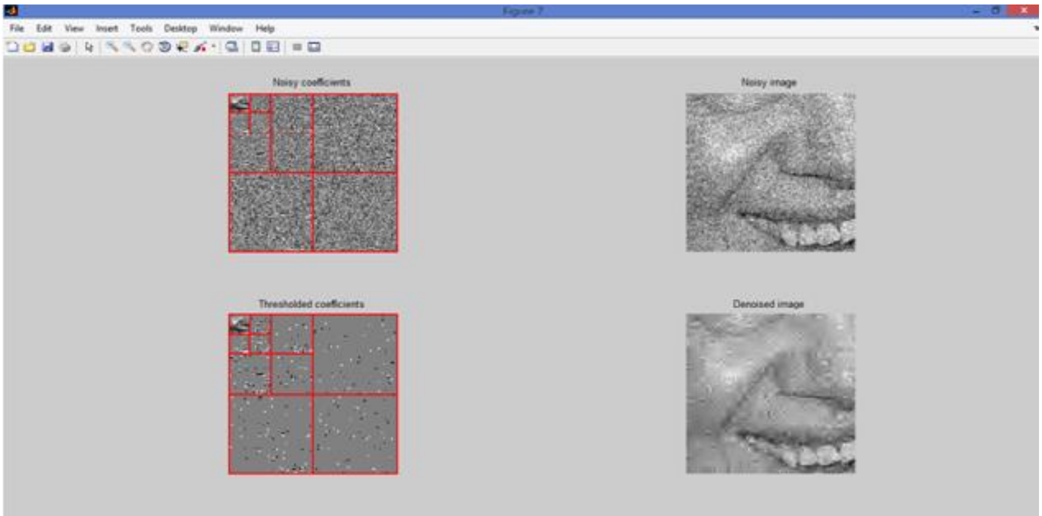


Fig – 4:Denoised Image

Step 5:-After apply a Wavelet Transform, we get a PSNR value.

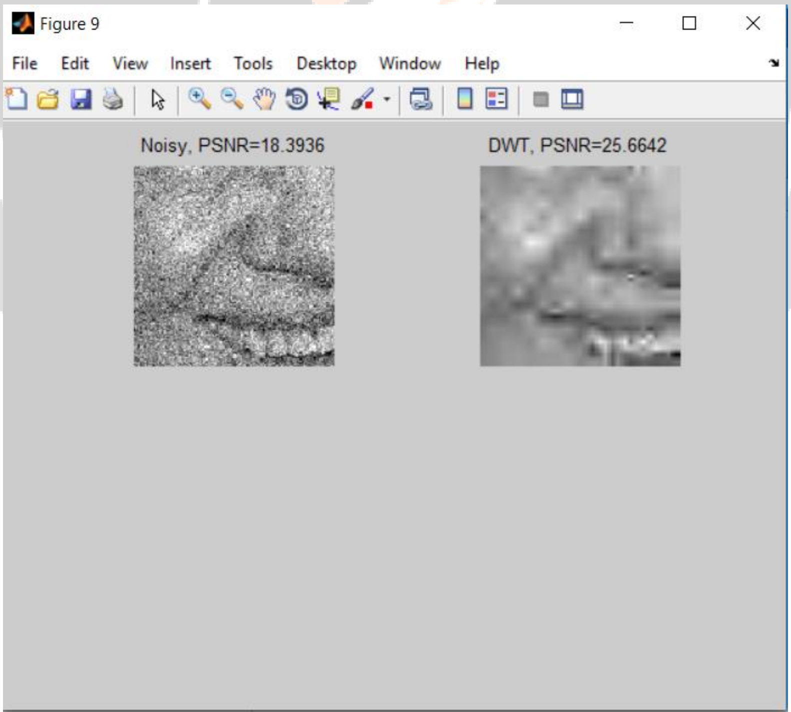


Fig – 5:Wavelet Transform Result with PSNR value

Step 6:-After wavelet Transform, apply a Ridgelet Transform

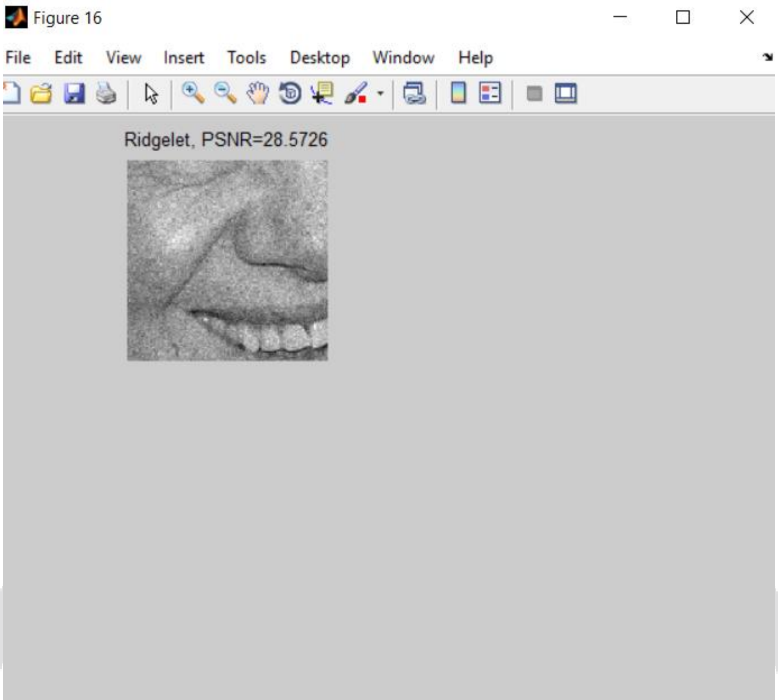


Fig – 6:Ridgelet Transform Result with PSNR value

Step 7:- Apply a Curvelet Transform.Get a PSNR value. Better performance comparison to wavelet and ridgelet transform.

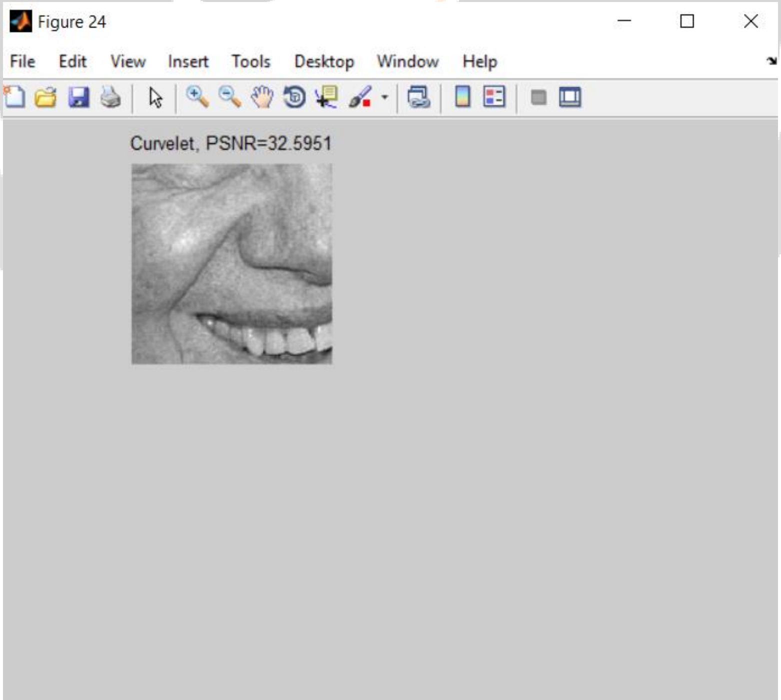


Fig – 7:Curvelet Transform Result with PSNR value

Step 8:- After apply curvelet,we apply a Gradient Descent.Get PSNR value.

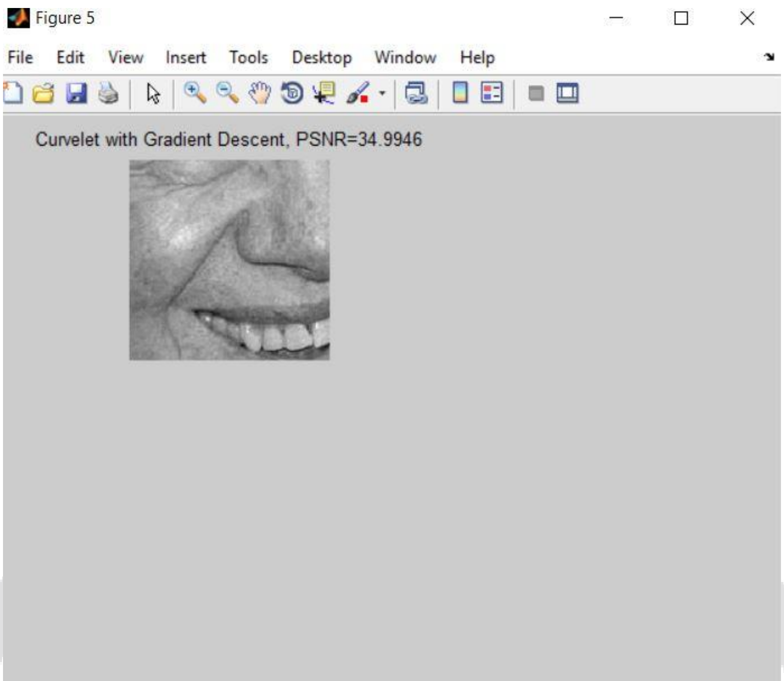
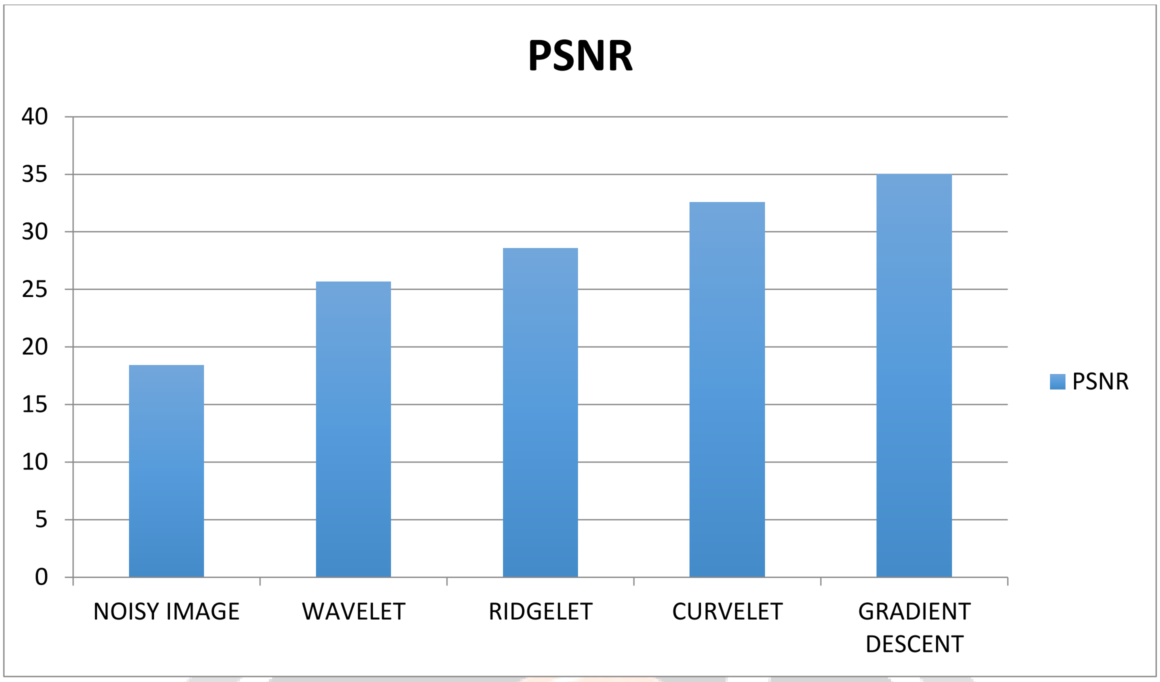


Fig – 8:Curvelet Transform with Gradient Descent Result with PSNR value

COMPARISON TABLE OF PSNR VALUES

	PSNR
Noisy Image	**18.3936**
Wavelet Transform	**25.6642**
Ridgelet Transform	**28.5726**
Curvelet Transform	**32.5951**
Curvelet Transform with Gradient Descent	**34.9946**

Table 1 Comparison table of PSNR values



Comparison Graph of PSNR Values

This graph is plotted for PSNR values resulting from different Transforms.After apply Curvelet Transform then apply curvelet transform with Gradient Descent.This graph shows that Gradient Descent is more efficient in removing noise than other transforms.

6.CONCLUSION:

In curvelet transform many techniques are used. Curvelet Transform is an extension of wavelet transfom.The fundamental quantity of curvelet transform is that it can easily and fastly converged for high frequency components. We have used sub band decomposition and fast fourier transform and also found that curvelet transform gives better PSNR than wavelet and Ridgelet Transform.In image if the PSNR value is increase so the noise in the image is decrease. For improvement the result than PSNR we will apply gradient descent algorithm with wiener filter. Denoising techniques are increasing day by day to improve the mean square error and the peak signal to noise ratio of the images without sacrificing the quality of the image.

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