Noise Reduction in Digital Hologram using Contourlet Transform

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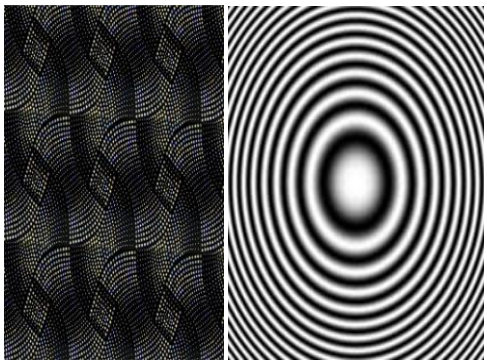
***Abstract*:- The main aim of this project is reducing noise in a hologram. Generally noise in hologram is very difficult to remove because an interference pattern is recorded on a digital camera during the digital processing. It is also present in reconstruction process which is affected by discrete quantizing levels. So we develop an algorithm using contourlet transform by changing the pixel values at different scales according to the requirements of each scale in the decomposition of the hologram.**

Keywords: Contourlet Transform, local thresholding, quantization, reconstruction.

INTRODUCTION:

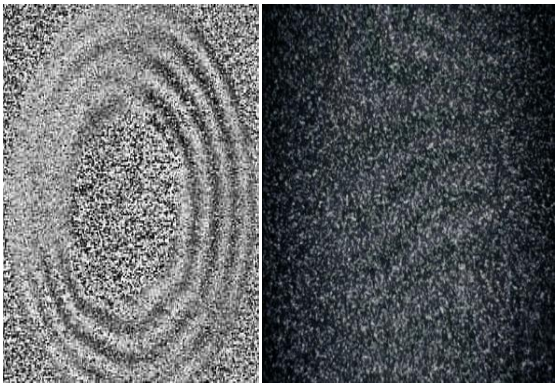
Digital hologram is an advanced technology that can replay 3D objects with full color and wide depth cues without using any glasses. However the reconstruction image from the hologram contains heavy obstacles due to white noise and speckle noise by reducing these noises we can use contourlet transform uses a double filter bank structure to get the smooth contours of images. In this double filter bank the laplacian pyramid (LP) is first used to capture the point discontinuities, and then a directional filter bank(DFB) is used to form those point discontinuities into linear structures. The Laplacian pyramid (LP) decomposition only produce one band pass imageina multidimensional signalprocessing that can avoid frequency scrambling. And directional filter bank (DFB) is only fit for high frequency since it will leak the low frequency of signals in its directional subbases. This is the reason to combine DFB with LP, which is multiscale decomposition and remove the low frequency.Therefore image signals pass through LP subbands to get band pass signals and pass those signals through DFB to capture the directional information of the image.

This double filter bank structure of combination of LP and DFB is also called as pyramid directional filter bank (PDFB), and this transform is approximate the orginal image by using basic contour,so it is also called discrete contourlet transform.

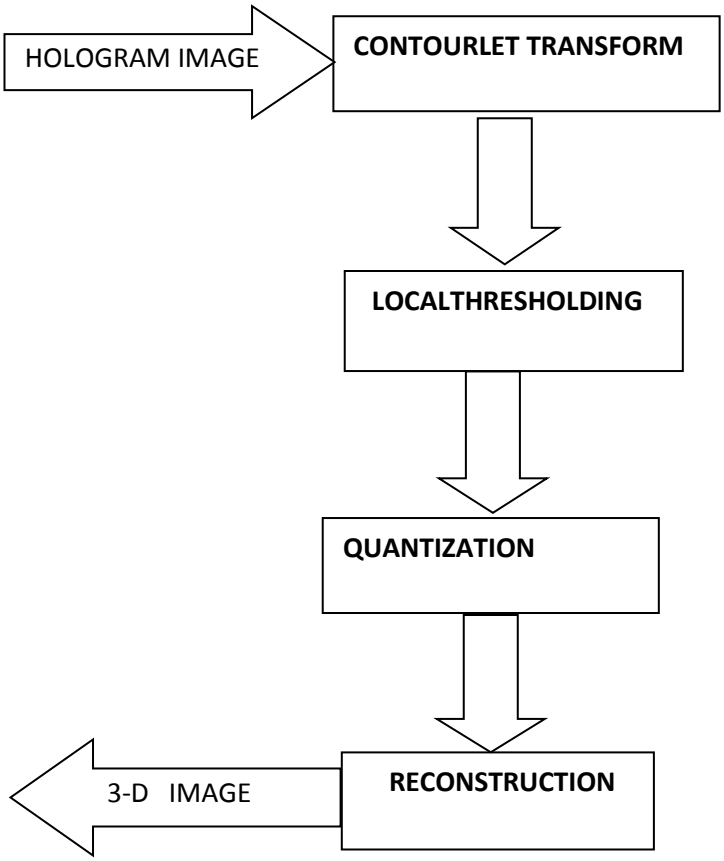


Noise occurs from three main sources:

Generally noise comes from three main sources first it is related, to the optical components, which make multiple interference fringes on the recording plane Secondly, it comes from the process of set up of the experiment. Because the hologram setup requires a low concentration of the particles which create a spotted diffraction pattern in the CCD camera. With many particles, several diffraction patterns are superimposed and make speckle noise that disturbs the reconstruction of the particle object. Therefore, speckle noise and white noise will appear when the phase or intensity of the object beam and reference beam is different. Thirdly, digital holograms are captured using a physical system as opposed to an idealized system in computer-generated holography, so there is a lot of wrong information included in the hologram.



Block Diagram:



EXPLANATION:

DATA HOLOGRAM:
Here the hologram image is taken as input.
CONTOURLET TRANSFORM:
Hologram data pass through a transformation to series of coefficients.

LOCAL THRESHOLDING:

Thresholding is a process of converting a grayscale input image to a bi-level image.

QUANTIZATION:

In this process the image is quantised by changing the pixel values.

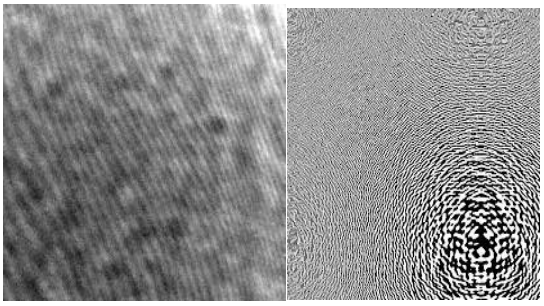
RECONSTRUCTION:

In this process get back the original image by using reconstruction.

WHITE NOISE:

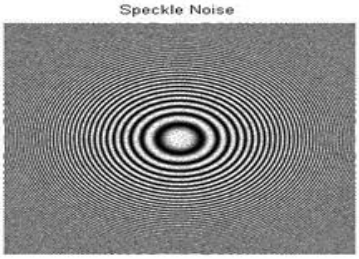
White noises containing many frequencies with equal intensities. In discrete time, white noise is a discrete signal whose samples are regarded as a sequence of serially uncorrelated random variables with zero mean and finite variance a single realization of white noise is a random shock. Depending on the context, one may also require that the samples be independent and have the same probability distribution In particular, if each sample has a normal is said to be Gaussian white noise.

The samples of a white noise signal may be sequential in time, or arranged along one or more spatial dimensions. In digital image processing, the pixels of a white noise image are typically arranged in distribution with zero mean, the signal a rectangular grid, and are assumed to be independent random variables with uniform probability distribution over some interval. The concept can be defined also for signals spread over more complicated domains, such as a sphere.



SPECKLE NOISE:

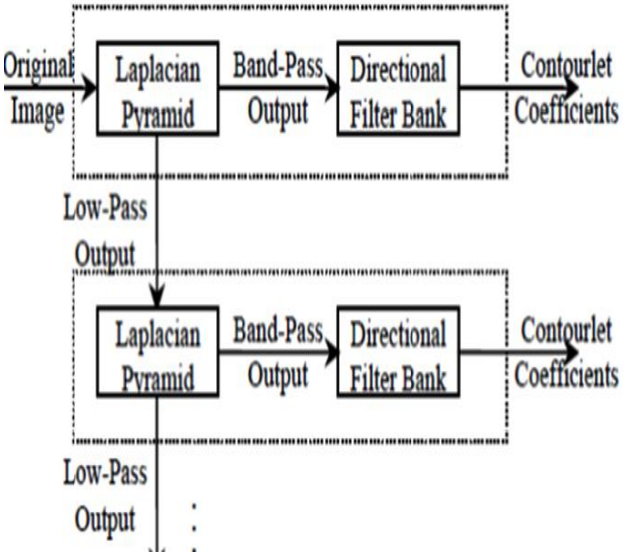
A speckle noise is an intensity pattern produced by the mutual interference of a set of wave fronts. Speckle patterns typically occur in diffuse reflections of monochromatic light such as laser light. Such reflections may occur on materials such as paper, white paint, rough surfaces, or in media with a large number of scattering particles in space.The speckle effect is a result of the interference of many waves of the same frequency, having different phases and amplitudes, which add together to give resultant wave whose amplitude, and therefore intensity, varies randomly.When an image is formed of a rough surface which is illuminated by a coherent light (e.g. a laser beam), a speckle pattern is observed in the image plane; this is called a “subjective speckle pattern” .It is called "subjective" because the detailed structure of the speckle pattern depends on the viewing system parameters; for instance, if the size of the lens aperture changes, the size of the speckles change. If the position of the imaging system is altered the pattern will gradually change and will eventually be unrelated to the original speckle pattern.

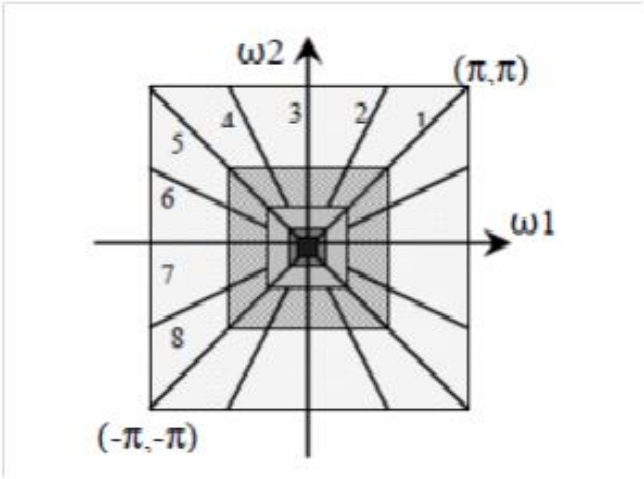


CONTOURLET TRANSFORM:

Contourlets form a multiresolution directional tight frame designed to efficiently approximate images made of smooth regions separated by smooth boundaries. The Contourlet transform has a fast implementation based on a Laplacian Pyramid decomposition followed by directional filterbanks applied on each bandpass subband. The Contourlet transform has properties of multiresolution, localization, directionality, critical sampling and anisotropy. Its basic functions are multiscale and multidimensional. The contours of original images, which are the dominant features in natural images, can be captured effectively with a few coefficients by using Contourlet transform.

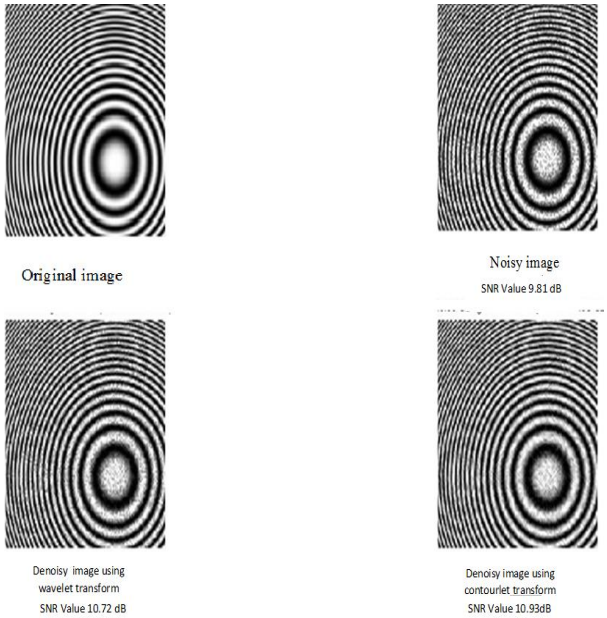
Block Diagram of Contourlet Transform:





ALOGARITHM:

Step:1
Noisy Hologram image is taken a input.
Step:2
Hologram data pass through the contourlet transform to form series of coefficients.
Step:3
Each pixel in an image if VT>T all pixel values are group together by using local thresholding.
Step:4
These coefficients are continuous to be quantized to remove the noise**.**
Step:5
Finally, we can get back original image by using reconstruction process.
Results:



CONCULSION:

In this paper, we have proposed a method for noise-reducing created during hologram reconstruction using contourlet transform and a smooth filter. From the result of experiments for this algorithm, it showed that the noise-reducing of our proposed method is better than a quantization method.

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