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DESIGN OF A TOOL FOR IMPROVING EFFICIENCY OF SPECKLE NOISE FROM IMAGES – A REVIEW

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ABSTRACT

A computerized image is a bidimensional image with a limited set of digital values, called pixels (or picture elements). Because of certain elements such as the system's physical attributes, picture capturing instruments etc, noise gets developed in the images. There are various sorts of noise, out of which speckle noise – a type of multiplicative noise, is very hard to extract and remove. Many devices to draw out speckled noise from pictures have been made. To de-speckle the picture, several factors are considered that show the aggregate of speckled noise removed from the picture. This paper discusses speckle noise, methods used to de-speckle a digital image and the defects in de-speckling models which lead to problem formulation.

KEYWORDS :

INTRODUCTION

An image is defined as artifact or visual representation which is recorded by visual perceptions and then further digitized to convert it in the form which can be stored in the computer memory or some type of storage media such as hard disk. After the image has been digitized, it can further be operated by various image processing operations. The image gets degraded by undesired material or particles or electric signals and to improve image's quality they must be removed. These unwanted particles make up the noise. Appearance of the noise in the images can be in the form of dots and this is due to the signals getting corrupted by the noise. Removing the noise from the images can be defined as denoising. These are different type noises which can get incorporated in the image, such as impulse noise, gaussian noise, additive white gaussian noise (awgn), shot noise, quantization noise, anisotropic noise, and multiplicative noise. Out of all these, multiplicative noise is most difficult to remove. Multiplicative noise can be defined as unwanted random signal that gets multiplied into some relevant signal during capture, transmission, or other processing. Speckle noise is an example of multiplicative noise which is commonly present in SAR(Synthetic Aperture Radar) images.

This paper describes speckle noise ,various techniques used in despeckling an image, flaws in image despeckling models which lead to problem formulation.

SPECKLE NOISE

Speckle noise is a granular form of 'noise' that is known for degrading the quality of the active radar and synthetic aperture radar (SAR) images. It is a multiplicative noise, which makes the visual evaluation in ultrasound imaging quite difficult. Speckle noise suppression is a vast field as lot of people are working on techniques to reduce it without tampering the original image to a great extent. The coherent processing of backscattered signals coming from multiple distributed targets, results in speckle noise. The edges and fine details of the image are affected by the presence of speckle noise, resulting in limiting the contrast resolution of the image as well.

DESPECKLING

Denoising is a general term given to the removal of all sorts of noises from an image. For speckle noise removal, despeckling is the technique used specifically. Based upon different mathematical models of the phenomenon several different methods are used to eliminate speckle noise. One such method is multiple-look processing (a.k.a. multi-look processing), averaging out the speckle noise by taking several "looks" at a target in a single radar sweep. Another way is by using adaptive and non-adaptive filters. Adaptive speckle filtering is better at preserving edges and detail in high-texture areas (such as forests or urban areas). Non-adaptive filtering requires less computational power and has more simple implementation as well. There are two types of non-adaptive speckle filtering: one is based on the mean and the other is based on the median (within a rectangular area of pixels in the image). The second form preserves edges more efficiently while eliminating noise spikes, than the first one. Various types of adaptive speckle filter like the Lee filter, the Frost filter are described below.

Common Speckle Filters: There are two major classifications of speckle reduction filters, viz. transform domain multiscale filters and single-scale spatial filters. The spatial filter improves quality of an image by smoothing it; that is, it decreases the intensity variation between adjacent pixels. Commonly used filters are

Lee Filter: It is based on multiple-look processing (a.k.a. multi-look processing) in which averaging out the speckle noise is done by taking several "looks" at a target in a single radar sweep. Lee filter is a window-based approach and depends upon the variance. The main disadvantage of Lee filter is that it ignores the speckle noise in the areas closest to edges and lines.

Statistic Kuan Filter: The Kuan filter is better than Lee filter as it does not make an approximation on the noise variance within filter window. It just simplifies to convert the multiplicative noise model into additive linear form. However, it depends on the ENL from an image to determine a weighting function W.

Frost filter: Frost Filter is an Adaptive filter that comprises the local image statistics in the filtering process assuming a negative distribution for noise. The main constraint of frost filter is that the parameters are adjusted according to variance in each area. The smoothing will occur if the variance is low.

LITERATURE SURVEY

Work done in the field of despeckling the image using different proposed filtering techniques are given below :

"A hybrid filter for image despeckling with wavelet-based denoising and spatial filtering", (Adib akl, Charles Yaacoub [1]2013)

The authors proposed a model which produced better PSNR,

COC and ENL values in comparison with earlier models such as Lee, Frost and Kuan filters individually. This filter is a hybrid of wavelet denoising filter and Kuan filter, which resulted in a gain with respect to speckle noise filters as well as simple denoising methods used earlier.

"A new denoising method of SAR images in curvelet domain", (Yuan Gao and Zhengyao Bai 2008)

The authors proposed a new method of speckle reduction of SAR images in curvelet domain. In this method, curvelet transform is integrated with wavelet filtering. The new method consists of five parts: preprocessing, curvelet transform (CT), curvelet coefficients processing and two inverse transforms. In the preprocessing step, Homomorphic transform is applied to convert multiplicative noise in SAR images to an additive noise which is suitable to be dealt with curvelet. After curvelet transform, curvelet coefficients are thresholded by using soft and hard thresholding functions with improved rules. In hard thresholding rule, noise variations are obtained by using noise parameter estimation. In soft thresholding rule, a classic soft thresholding function and thresholding rule used in wavelet domain is combined with curvelet. Finally, inverse CT and exponential transform are employed to reconstruct denoising image. It can be seen that the method presented in the paper is an effective one

"Speckle Noise Reduction in Ultrasound Images by Wavelet Thresholding Based on Weighted Variance", (S.Sudha et al 2009)

The author in their paper proposed a wavelet-based Thresholding scheme for noise reduction in ultrasound images. Comparison of the results obtained by the proposed method with the results achieved from the other speckle noise reduction techniques demonstrate its higher performance for speckle reduction in terms of peak signal to noise ratio. Pierrick Coupe et al 2009 in their paper "*Nonlocal Means-Based Speckle Filtering for Ultrasound Images*" proposed a Bayesian thresholding and NL-means filter in Ultrasound images Quantitative results on synthetic images show the performances of the proposed method compared to well-established methods. Results on real Images shows that the proposed method gives better preserve accurately edges and structural details of the image.

"Performance evaluation of various speckle noise reduction filters on Medical images" (Raman Maini and Himanshu Aggarwal 2009)

They proposed and compared five different speckle reduction filters quantitatively using simulated imageries. The results have been presented by filtered images, statistical tables and diagrams. Filtering is one of the common methods which are used to reduce the speckle noises. Finally, the best filter has been recommended based on the statistical and experimental results in terms of PSNR.

"SAR Speckle Reduction Based on Nonlocal Means Method" (Bibo Lu 2010)

He proposed a novel SAR speckle reduction method base on nonlocal means (NLM) filter. NLM is applied to remove additive noise after taking the logarithm of the original speckle noise. The proposed method can preserve edges and protect more fine details. Results on real speckle SAR images are given and have also compared our method with some related methods.

PROBLEM FORMULATION

The image quality parameters like PSNR, COC and ENL of prevailing models such as Lee, Frost and Kuan are lower in comparison to the hybrid model proposed by *Adib Akl and Charles Yaacoub[1],* which is based on Kuan filter and wavelet denoising filter. This paper proposes to create a tool which will improve the capability of removing speckled noise which is based on wavelet transform process. This proposed model will be more efficient and more effective in removing the speckled noise from the noisy image with improved results in quality parameters as well.

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