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SPECKLE NOISE REMOVAL IN MEDICAL IMAGES USING CLUSTER BASED FILTER ALGORITHM

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Abstract

Medical images especially ultrasound images are easily prone to noises like specklenoise, which is multiplicative in nature. It degrades the image quality and contrast . Hence there is an need for speckle noise reduction. There has been many filters available for speckle noise reduction. In this paper we discuss about the speckle noise removal using cluster based filters. Clustering method is suitable for image segmentation and identification.

Introduction

Ultrasonography is otherwise called as Medical ultrasound. It is one of the application of ultrasound. The internal body of human organs images are created by the medical ultrasound. It many times aims at finding the cause of disease, or excluding genetics. Ultrasound produces ultrasound picture of the body using sound waves.An instrument which emits high frequency sound and tracks the echoes to determine the size, quality and shape of the soft organ and tissues is known as transducer. The test is conducted by specially trained ultrasound technicians or sonographers. After that ultrasound images will be interpreted by a radiologist or your doctor. The diagnosing and treating can be helped in certain condition by this technology. Speckle noise is otherwise known as multiplicative noise. Speckle is a granular distortion that naturally occurs in the medical ultrasound, synthetic aperture radar (SAR), and optical coherence tomography images active radar and deteriorates their accuracy.Speckle reduction consist of two types of filters linear filter and non linear filter. Linear filter is not used because it only smoothen the edge of the images and it minimize the speckle noise. But in non linear filter, the noise is fixed by median filter in the ultrasonic image and the mean value is get replaced by the corresponding pixel. Jain [1] proposed a speckle reduction algorithm based on a Wiener filter by converting from the multiplicative noise and into an additive noise.Kuan[1], Frost et al.[1], and Lee [1]filters are low pass filters and it is based on the local statistics with minimal square error. A new approach based on dictionary learning was suggested by Elad and Aharon. Using the noisy image blocks, they used K-Singular Value Decomposition (K-SVD) algorithm to create a global dictionary. By decomposing noisy blocks in the obtained dictionary using only a sparse coding algorithm, the tidy estimate of each de-noised block can be calculated [7]. Local grouping or similar block clustering can also be seen as doing some kind of image blocks clustering as significant factors in the performance of some approaches, including dictionary learning based de-noising methods. K-SVD, for instance, is a generalization of clustering algorithms for K-means. The clustering or grouping therefore has a crude role in the de-noising image [8].

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ExistingSystem

Mean filter: It is a type of linear filter and it is otherwise known as averaging filter. In this filter each and every value of image consists of pixels. The each pixels is get changed by the standard of all grey level neighboring pixel. The image will be burred and smoothed by the effect of the filter. It act as a low-pass filter and optimal for gaussian noise.

Median filter: It is the type of non linear digital filter. It removes the noise from an image. The image will be burred less and preserve the edges. The mathematical model is shown in equation.

$f \wedge (x, y) = median\{g(s,t), where s,t \in Sxy\}$

Frost filter: This technique is a strategy that has also been used to achieve an appropriate balance between edge protection and segmentation[7]. The balance is achieved by applying an exponentially dampened kernel that adapts based on different regions by making common use of local statistics such as the variance and mean of the adjacent window produced at each pixel.

$DN = \sum nxnK\alpha e -\alpha|t|$

The α can be formulated as follows

$$\alpha = (\frac{4}{n\sigma^2})(\frac{\sigma^2}{\Gamma 2})$$

Lee filter: This technique is based on deliberately reducing the mean-square error (MSE) on the weighted average of the generated subregions at each pixel location. While, the relationship between the Lee filter's enhancement and a region's variance is generally inversely proportional to one another[7]. This certainly means that the process of enhancing is not accomplished when a region's variance is fully high, especially close to the edges. In comparison, Lee filter performs an efficient enhancement method to eliminate the noise from the low-variance regions, like flat regions or homogeneous regions.

$Img(i,j) = Im + W* (Cp - Im)$

Kuwahara filter (DsFkuwahara): It is the type of smoothing filter which is used for adaptive noise reduction. It is one dimensional filter working at a zone of 5×5 pixels. It searches for the homogeneous region on every side of the each pixel. The filter mainly used in medical imaging to increases the edges and for classifying the accuracy in various organs of human.

Kuan filter: In 1987, it was proposed by Kuan, Nathan and Kurlander. The filter is mainly used for smoothening the speckle noised image. The image gets smoothened without removing the edges of the image. This filter first convert the multiplicative noise model to a signal- dependent additive noise model after that it decreases the mean square error. For Kuan filter, equation of weighted function is,

$$W = \frac{1 - \frac{cu}{ci}}{1 + cu}$$

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Wiener filter: The other name of wiener filter is Least Mean Square. It has the ability to restore images when corrupted or blurred. By comparing preferred noiseless image, it decreases noise from image. Wiener filter works based on local image variance calculation. Therefore, if the local image variance is lesser than the smoothing is performed higher while local image variance is higher, than smoothing is lesser. The wiener filter goes towards the result in better. More computing time is required for the Wiener filter.

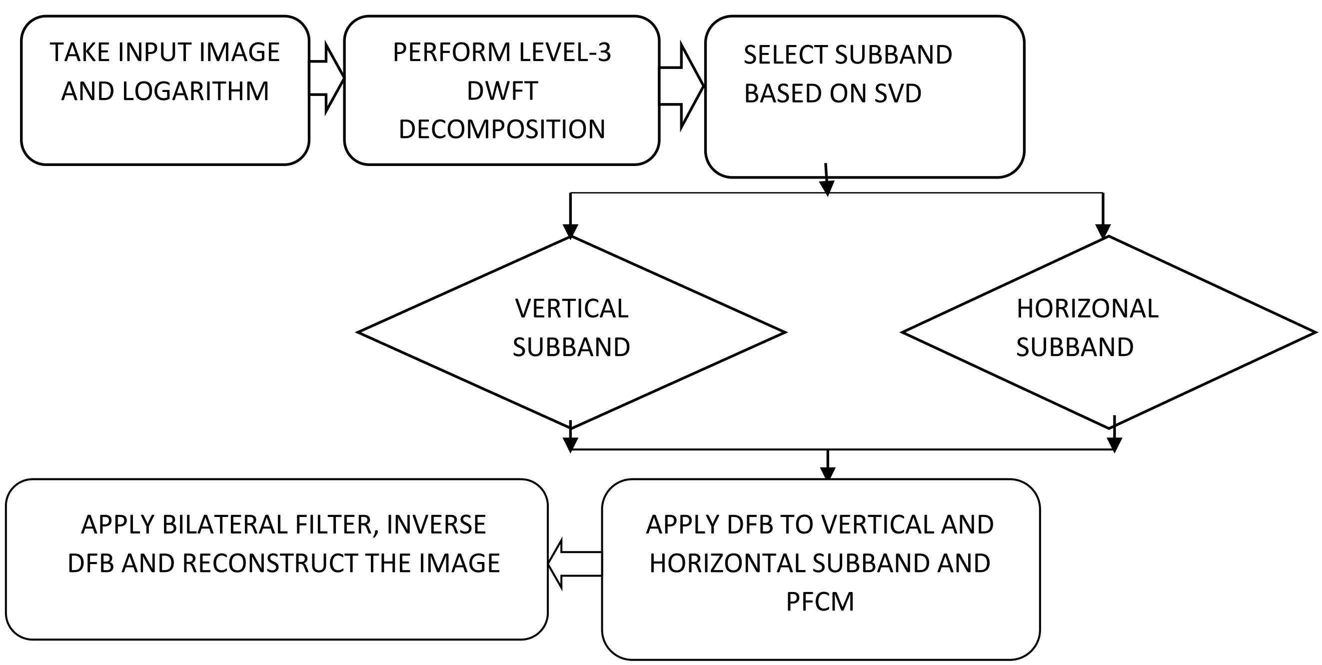
Clustering techniques

Fuzzy c-means clustering: In 1981, Bezdek improved the performance of fuzzy c means clustering. It is otherwise called as soft clustering. FCM is slightly differing from the normal K-means clustering. In FCM, M is used to calculate the position of the centriod. The C that direct the hyper parameter. Hyper parameter that specify how many number of clusters are required for formation of data point. The Fuzzy c-means is seen as an constant optimization method with a stable structure that delivers good results for data overlap.

Possibilistic Fuzzy C-Means (PFCM): In 1997, Pal et al suggested the Possibilistic Fuzzy C-Mean. The noise reactivity defect in FCM is solved by PFCM. The model of FCM and PCM are expanded easily with the help of PFCM. The benefits of PFCM are that it lacks FCM's weakness in noise response, eliminating the PCM problem of coincident cluster

K-Means clustering: In 1967, it was proposed by James Mac Queen. It is called as unsupervised machine learning. There are two types of clustering they are, central and hierarchical. In this K-Means is a central clustering. A data collection is divided into a data group K in the clustering of K-means. K number of disjoint cluster is classified by given set of data. The algorithms of K-means consist of two distinct steps

Existing algorithm



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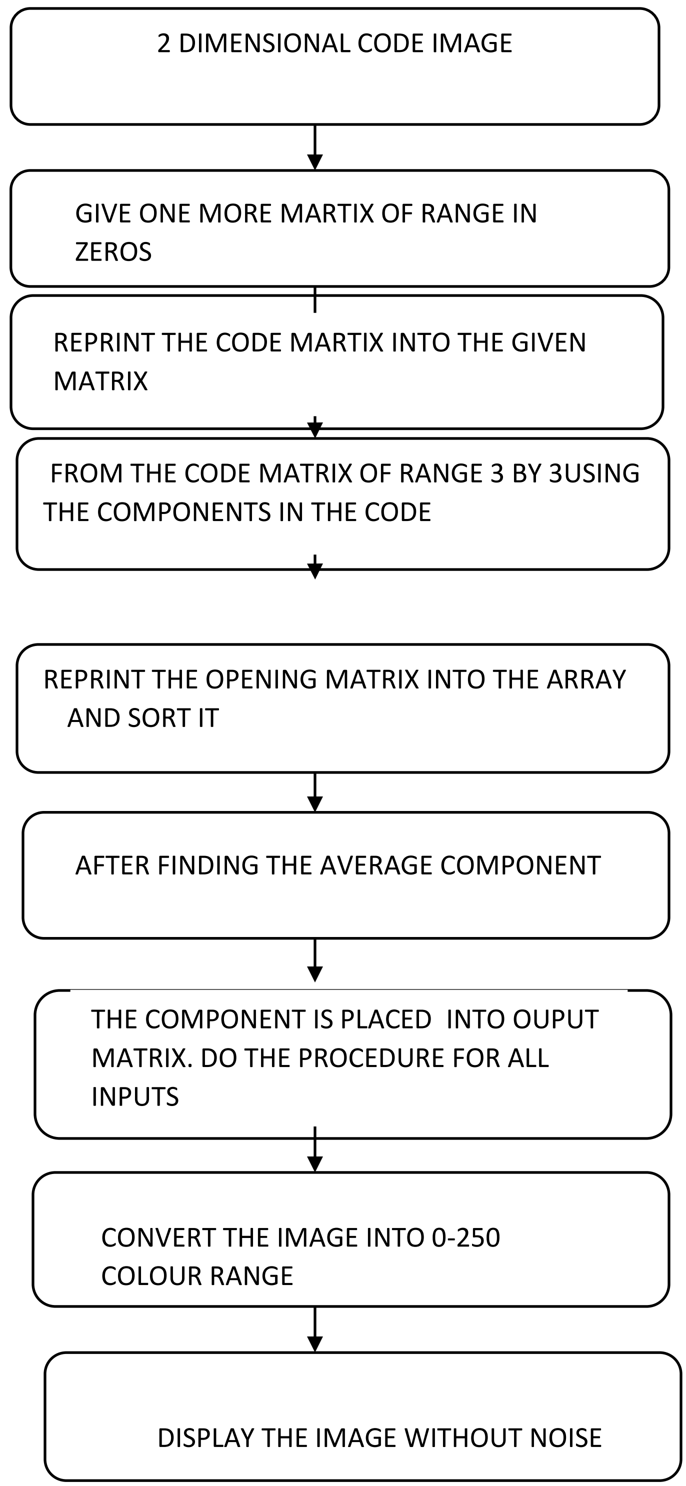
Proposed Algorithm



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Subtractive clustering: In 1994, it is proposed by chiu. Subtractive clustering is approximately code the information in the group of clusters.

$$P_n = P_n - P_1 e^{-4 x_n - x^2} r^2$$

One of the most widely used algorithms for clustering is clustering of k-means. It's easier and faster than hierarchical clustering computationally. And for a large number of element, it can also functionSame initial centroid value will result in same cluster size. So choosing the correct initial centroid is an essential task, too.

Conclusion

The work here explains about the speckle noise reduction in medical images using cluster based filters. It is more efficient than all other filters in preserving the important features of image. The quality of the image is enhanced by the clustering based filter, since clustering based is good at image segmentation, classification and identification.

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