A Study of De-Speckle Method Using Speckle Reducing Anisotropic Diffusion for Ultrasound Image Enhancement

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1 Introduction
A diagnosis for diseases by using an ultrasound images is difficult to determine that the tissue is good or not good. For this reason, the reduction of speckle is important to check the disease. In this paper, the purpose is to reduce speckle noise in ultrasound images. We preprocessed the images by using speckle reducing anisotropic diffusion (SRAD) which is the edge-sensitive diffusion for speckled images. It is important to decide the homogeneous area of speckle scale function to get the better result. Section II shows the proposed method to determine the homogeneous area. Experimental results and concludes are summarized in Section III.

2 Proposed Method
Based on conventional SRAD, we propose the method to decide the homogeneous area by using a feature of homogeneous area in speckle image.

2.1 SRAD for Preprocessing
SRAD has been proposed as a useful method for ultrasound image enhancement. The diffusion coefficient function is used as in the conventional SRAD. The SRAD diffusion coefficient incorporates local speckle statistics and is found via

\[ c(q) = \frac{1}{1 + [q^2 - q_0^2(t)][q_0^2(t)]} \]

Here, \( q \) is the instantaneous coefficient of variation (ICOV) and \( q_0(t) \) is the speckle scale function.

\[ q_0(t) = \frac{\text{var}[z(t)]}{\overline{z}(t)} \]

where the parameters \( \text{var}[z(t)] \) and \( \overline{z}(t) \) are the intensity variance and mean over a homogeneous area at \( t \). Determining the homogeneous area in speckle image has an effect on the result image.

2.1 Decision of Homogeneous Area
A feature of homogeneous area of speckle image is homogeneous about intensity of gray scale to 255 from 0. We proposed to calculate the variance to know the distribution condition of the intensity in homogeneous area. Of all the variance, we focus the minimum value. Standard deviation value could also be used to know the distribution condition of homogeneous area whereas variance is better than standard deviation at judgment of distribution. We decide the size of homogeneous area 40 x 40.

image at this size when we simulate the SRAD using checkerbox of matlab. We could also get the distinct image using bigger size than 40 x 40. However, a decrease level is almost same at graph of speckle scale function. We divide by 40 columns to calculate the each mean, and means is used to calculate the variance. At the same reason, we divide by 40 rows, the minimum value of the total of two variance is used to decide the homogeneous area. We use the peak signal to noise ratio (PSNR), signal to mean square error (SMSE) and edge preservation (EP) as the evaluation method of the result images.

3 Results and Conclusions
Figure 1 is the test image and the preprocessed image by proposed method. Table 1 shows the result of the evaluation. We know that proposed method is better than other methods at edge preservation and similarity of image.

In this paper, We used the conventional SRAD based on variance parameter to reduce the speckle noise. And we compared with another image as evaluation. As a result, we confirmed efficiency of proposed method at edge preservation and speckle reduction.

References