СЕКЦИЯ «БИОИНФОРМАТИКА»

RADIOGRAPHY IMAGE ENHANCEMENT USING CONTOURLET TRANSFORM

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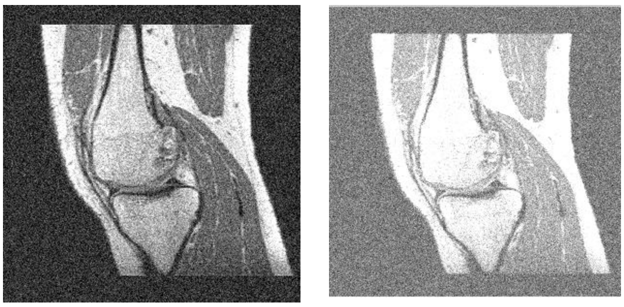
Denoising of Medical Image represents one of the fundamental challenges in the field of biological image processing in computer vision. X-RAY, CT scan and MRI imaging is the widest used image acquisition technique. Image denoising goal is to enhance the original MRI image by suppressing noise from a noise-contaminated version of the image. In this paper, a denoising algorithm using Contourlet transform with blocking method was proposed to improve the quality of MRI images.

Key words: MRI; Blocking; Block thresholding; Contourlet.

Introduction. The image enhancement system aims to improve the image of the various body tissue structures on the MRI film or screen and reducing radiation exposure to patients and workers. Denoising images is an important technique for image processing analysis. In this work, Additive Noise Model (AWGN) is used [1, 2], for experimental requirements, noise signal gets added to the original signal (Image) to produce a corrupted noisy signal [3, 4, 5]. The additive noise model follows the following rule:

$$W(x,y) = s(x,y) + n(x,y) \quad (1)$$

Where, $s(x,y)$ is the original image intensity and $n(x,y)$ denotes the noise introduced to produce the corrupted signal $W(x,y)$ at (x,y) pixel boundary. Figure (1) shows the normal noise distribution over the transmission channel [6].



(a) (b)

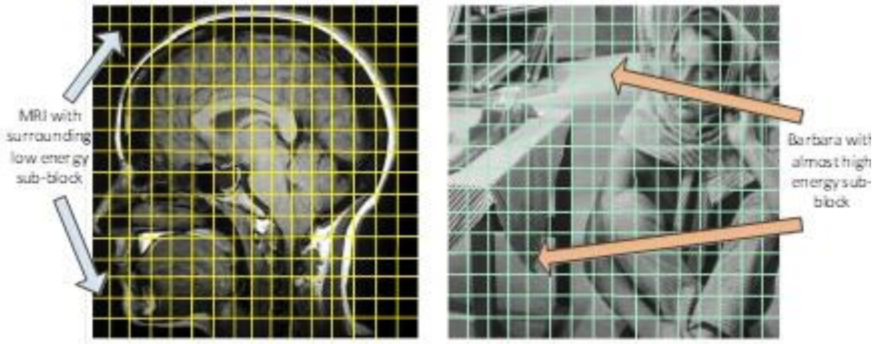
Fig. 1. Examples of the normal noise distribution over the transmission channel. (a) Noisy image of (AWGN) with mean μ = 0.5, variance σ^2 = 0.05; (b) noisy image of (AWGN) with mean μ = 1.5, variance σ^2= 0.5

The probability density of the normal distribution is:

$$PG(z) = \frac{1}{\sqrt{2\pi\sigma}} e^{-(z-\mu)^2/2\sigma^2}, \quad (2)$$

where: μ is the mean or expectation of the distribution, σ is the standard deviation, σ^2 is the variance

The Proposed Method (CTB). Blocking Algorithm has been used in the proposed system, instead of using the hole image. For overall image size, (512x512) pixels, it can use the block size of (32x32) pixel size, it means that the hole image will divide into (16x16) or 256 sub-image (block), as shown in figure 2.



(a) (b)

Fig. 2. Image blocking. (a) MRI image; (b) Barbara image

From the figure 2. It can be observed that the surrounding blocks, in figure 2(a) has lower energy (more darkness) if compared with same coordinates located in 2(b), It means that, it should estimate the variance of noise value. The variance of noise is calculated by:

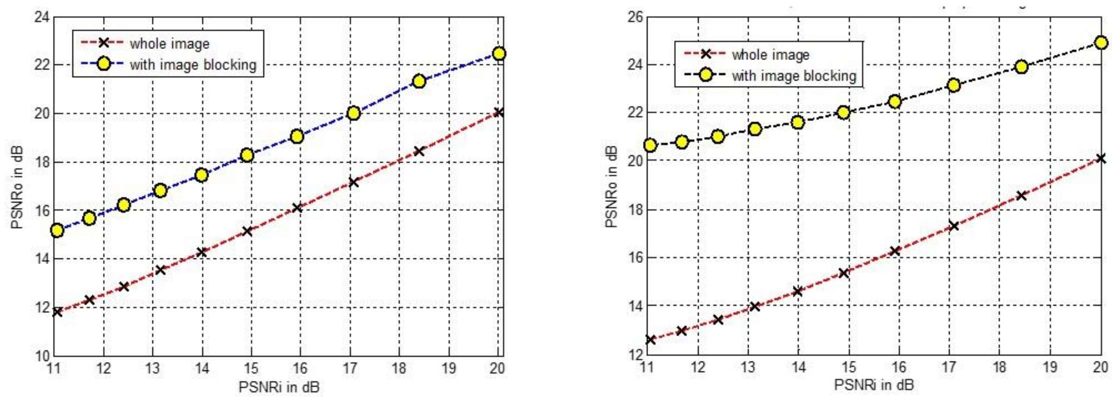
$$\sigma_x^2 = \left\{\frac{med(K_{i,j})}{C}\right\}^2, \quad (2)$$

where *K*, is the contourlet coefficients of the image, C, constant calculated by normalized mean value of individual block, the threshold value used for extracting contourlet coefficients is calculated by [7].

$$Th = \frac{3}{4} M \left(\frac{\sigma_x^2}{\sigma_d}\right) \quad (3)$$

Where *M*= the number of pixels in each individual block (x*y), σ_d is the standered deviation of noisy source image [8].

Results. From the figures (3-a) and (3-b) it's clear by comparing the results using (blocking algorithm), got advantage of 3 dB PSNRin to PSNRout difference with wavelet, and about 10 dB with contourlet preprocessing for AWGN removal.



a b

Fig 3. (a) wavelet denoising for AWGN; (b) contourlet denoising (both with blocking method)

Conclusion. Experimentally shown that the contourlet is outperforms denoising behavior better than the wavelet behavior in about 7 dB. Simulation results on medical MRI images showed that the proposed blocking method is more powerful in medical MRI images than in ordinary images. Also, the results showed that the denoising improvement depends on the block size and the less block size is, the more PSNR advantage is. This result will definitely improve the quality of medical images compared to wavelet preprocessing, as well as reduce exposure to radiation for patients by reducing radiation doses and exposure time.

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