Chapter 79
The Combination of Adaptive Filters to Improve the Quality of Medical Images in New Wavelet Domain

Nguyen Thanh Binh
Ho Chi Minh City University of Technology, Vietnam

Vo Thi Hong Tuyet
Ho Chi Minh City Open University, Vietnam

ABSTRACT

Most of medical images not only have noise but also have blur. This problem reduces the quality of images and influences diagnostic process of medical specialists because a small detail in a medical image is very useful for treatment process. This chapter explores the new generation wavelets, which provides the basic framework for the development of adaptive techniques to improve the quality of medical images. The process of the method for improving medical images includes: decompose of medical images in nonsubsampled contourlet domain and calculate the coefficients of Bayesian thresholding combined with Lucy Richard to reconstruct the medical images. For demonstrating the superiority of the method, the results of the proposed method are compared with the results of the other methods in new generation wavelet domain.

INTRODUCTION

Nowadays, enhancing the quality of medical images becomes a popular topic. There are many factors to affect the quality of medical images such as machine specification, surroundings, etc. Medical images are useful for doctor's treatment. The life of patients depends on the image-based diagnosis. Medical images are taken from many types of technical equipment, such as: X-ray images, ultrasound images, ultrasound - color Doppler, endoscopic image (digestive endoscopy, endoscopic urology, etc), images computerized tomography Scanner (CT image), magnetic resonance imaging (MRI), etc. Each image type

DOI: 10.4018/978-1-5225-0571-6.ch079

gives the information about each different disease, and this information is necessary for the consultation of health professionals. Only the small detail, such as: tumor or unusual point, is the key to detect the disease early and increases the patient's survival chances.

Most of medical images not only have noise but also have blur. This problem reduces the quality of images and causes difficulty for diagnosis. So, denoising and deblurring are necessary for the enhanced medical image processing such as classification, segmentation, etc. The goal of denoising is to extrude noise details from the low quality images. This process is very difficult because it must not only increase the quality of images but also keep edge features. Noise in medical images always leads to the undesirable appearance, but the noise can cover and reduce or lose the visibility of certain features within the image. In many cases, the images are also blur and noise which are combined to each other. Therefore, this problem is harder than denoising. Recently the models of noise in medical images have been proposed by (Gravel, 2004; Ashish, 2005). Practically, the noise in majority of medical images can be represented as some combination of Gaussian additive noise, speckle and impulsive noise.

Wavelet is widely used for denoising, but it suffers from shift, rotation sensitivity and poor in directionality. To improve this drawback, the new generation wavelet transforms such as the ridgelets, curvelets, contourlet transform and nonsubsampled contourlet transform have been proposed. The nonsubsampled contourlet transform (NSCT) is useful for denoising and deblurring because the NSCT comprises two parts: a nonsubsampled pyramid structure which gives multi-scale property and a Nonsubsampled Directional Filter Bank (NSDFB) structure that brings directional property. Both of them are shift - invariant due to nonsubsampled filter banks. This chapter explores the new generation wavelets, which provides the basic framework for the development of adaptive techniques to improve the quality of medical images. The process of the method for improving medical image includes: decompose of medical images in nonsubsampled contourlet domain and calculate the coefficients of Bayesian thresholding combined with Lucy Richard to reconstruct the medical images. For demonstrating the superiority of the method, the results of the proposed method compared with the other methods in new generation wavelet domain such as contourlet, ridgelet, curvelet domain. For performance measure, the authors have used Peak Signal to Noise Ratio (PSNR) and Mean Square Error (MSE) and it has shown that the results of the present method are better than those of the other methods. The contributions of the chapter are:

1. The advantages of new wavelet generation are almost unexplored area, are explored and applied them to solve problems in the image analysis such as: image denoising and image deblurring.
2. The features of new X-let multiscale transforms such as curvelet, ridgelet, contourlet transform, nonsubsampled contourlet transform are also shown.
3. A method for increasing the quality of medical images based on the combination of adaptive filters in new wavelet generation is shown.

RELATED WORK

In the past, there were many methods which were proposed for denoising medical images by Discrete Wavelet Transform (DWT) (Strang, 1989; Tim, 1992; Marcin, 2001). DWT has three serious disadvantages: shift sensitivity, poor directionality and lack of phase information. Several methods have provided solutions for decreasing these disadvantages using new generation wavelet such as: curvelet transform