

Chapter 8

Non-Subsampled Contourlet Transform-Based Effective Denoising of Medical Images: Denoising of Medical Images Using Contourlet

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ABSTRACT

Noise removal in medical images remains a challenge for the researchers because noise removal introduces artifacts and blurring of the image. Developing medical image denoising algorithm is a difficult operation because a tradeoff between noise reduction and the preservation of actual features of image has to be made in a way that enhances and preserves the diagnostically relevant image content. A special member of the emerging family of multiscale geometric transforms is the contourlet transform which effectively captures the image edges and contours. This overcomes the limitations of the existing method of denoising using wavelet and curvelet. But due to down sampling and up sampling, the contourlet transform is shift-variant. However, shift-invariance is desirable in image analysis applications such as edge detection, contour characterization, and image enhancement. In this chapter, nonsubsampled contourlet transform (shift-invariance transform)-based denoising is presented which more effectively represents edges than contourlet transform.

DOI: 10.4018/978-1-5225-5876-7.ch008

INTRODUCTION

The extraction of features and object recognition of medical images acquired by various imaging modalities plays an essential role in extracting information for diagnosing various diseases. The presence of noise not only produces undesirable visual quality, but also lowers the visibility of low contrast objects. Medical images are usually of low contrast and they are subject to complex type of noise in its acquisition and transmission. All medical images are corrupted by visual noise. The presence of noise gives an image a mottled, grainy, textured, or snowy appearance. This noise can be either image dependent or image independent. It comes from a variety of sources. The diagnosis process would become complex if the image is contaminated with noise. Generally MRI images are affected by Additive White Gaussian Noise (AWGN) and ultrasonography images are affected by speckle noise during image acquisition. So noise removal in medical images plays an essential process for diagnosing the diseases properly (Chan, Law, & Siu, 2003; da Cunha et al., 2006).

In medical images, removal of noise is delicate and difficult task. Noise removal in medical images still remains as a challenge for the researchers because noise removal introduces artifacts and blurring of the image. Developing medical image denoising algorithm is a difficult operation because a tradeoff between noise reduction and preservation of actual features of image has to be made in a way that enhances and preserves the diagnostically relevant image content. A special member of the emerging family of multiscale geometric transform is contourlet transform (Do & Vetterli, 2002). The contourlet transform effectively captures the image edges and contours which are reconstructed using Laplacian pyramid and directional filter bank. This feature overcomes the limitations of the existing method of denoising using wavelet and curvelet. Thresholding is performed on the obtained contourlet coefficients, so that essential information in the image is preserved by removing the noise. But due to downsampling and upsampling, the contourlet transform is shift-variant. However, shift-invariance is desirable in image analysis applications such as edge detection, contour characterization, and image enhancement. This is a major drawback of the existing method which can be eliminated using nonsubsampled contourlet transform based denoising.

In this work, nonsubsampled contourlet transform (NSCT), which is a shift-invariant version of the contourlet transform is presented. The nonsubsampled contourlet transform is based on iterated nonsubsampled filter banks to obtain a shift-invariant directional multiresolution image representation.

The existing denoising algorithms, however tend to attenuate original signal features. In order to overcome this problem, the contourlet transform has been used to suppress noise in digital images. Contourlet based image denoising algorithms

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