A Hybrid and Adaptive Non-Local Means Wavelet based MRI Denoising Method with Bilateral Filter Enhancement

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Abstract

Magnetic Resonance Imaging is one of the most advanced and effective medical diagnosis methods, however the raw image data is normally corrupted by random noise from the measurement process which reduces the accuracy and reliability of the results. Denoising methods are often used to increase the Signal-to-Noise Ratio (SNR) and improve image clarity. In this paper an adaptive Non-Local Means filter is developed in which bilateral filter is used to pre-enhance the images and then multi resolution wavelet domain is used to remove coefficients that contain more noise than signal.

In the past different methods have been used to denoise MRI images but many have not taken into consideration the Rician nature of noise distribution therefore they have not been very effective. Adaptation in this case is based on frequency and spatial information obtained from the noisy image. Knowledge of level of noise is used in an optimization procedure to minimize a Rician based likelihood function and by use of square signal intensity bias is also discarded. The method is implemented in Matlab and MRI images with different level of artificial noise are
denoised using the algorithm. Measures of performance values are PSNR, 37.12dB, MSE, 15.23, UQI, 0.985, SSIM, 0.894, EPI,0.69 for a 10% noisy image. These and also visual inspection show that there is significant improvement from results obtained using stand alone methods such as Gaussian smoothing, Wiener filter, NLM filter, bilateral filter and wavelet thresholding.

References


Index Terms

Computer Science
Image Processing

Keywords

MRI, Rician noise, wavelet, combinational, NLM, bilateral filter, resolution