AbstractID: 5243 Title: 3D Wavelet Packet Denoising of Arterial Spin Labeled MR Perfusion Images

Purpose:
To develop a 3D denoising approach based on wavelet packet decomposition for denoising MRI brain perfusion weighted images acquired with Flow-sensitive Alternating Inversion Recovery (FAIR) arterial spin labeling technique.

Method and Materials:
A 3D multi-resolution wavelet packet decomposition approach was developed that takes advantage of both spatial and temporal correlation between multiple consecutive slice selective and non-selective inversion recovery images acquired with FAIR technique. Single shot spin-echo EPI-FAIR imaging was performed on 5 healthy volunteers on a 1.5T GE scanner using FAIR inversion time of 1200ms. Other imaging parameters were 64x64 matrix, TE/TR=20/2000ms, and 20 image pairs.
To find the best wavelet base, different bases with different levels of decomposition were tested. Then using the best filter and 2D wavelet transform each image was first decomposed and then for each image a threshold was estimated for noise coefficients and wavelet coefficients below that threshold were removed and the image was reconstructed from the remaining coefficients (Spatial denoising). Then these images were fed into the second step of processing in which each pixel's time course along all of the selective and nonselective images was considered as an one-dimensional signal and decomposed again using wavelet packets and denoised based on a separate threshold estimated for each signal (Temporal denoising). Then each image was reconstructed again.

Results:
Among different wavelet packets that were tested Coiflet wavelet packet with 5 vanishing moments, 4 level of decomposition with Shannon entropy and soft SURE threshold (for smoothness and preservation of the edges) criteria resulted the best performance in terms of PSNR and minimal distortion after reconstruction. The mean PSNR of the denoised images was 22.29 ± 4.2.

Conclusion:
Denoising based on our proposed method in general significantly improves the acquired FAIR perfusion-weighted images. This improvement is associated with blurring of the edges in the image.