Visualization of venous vessels by Phase Weighted Image

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Purpose The purpose of this study was to investigate and visualize the vasculature of venous system in the normal human brain with the phase weighted image reconstruction.

Introduction Visualization of venues vasculature system of human brain proved to be an important in diseases diagnosis or in path-physiology of certain lesions. Phase mask weighted reconstruction technique appears to be useful in visualization of small venues structure [1-2]. This technique exploits the fact that paramagnetic deoxyhemoglobin caused by the local magnetic fields inhomogeneity, resulting both T2* and a phase difference between the venous vassal and its surrounding [3-4]. Result of image reconstruction depends on numbers of parameters such as vessel orientation and also homodyne filter size, phase mask weighting function and number of multiplication. A newly developed application can handle setting of such parameters on individual slice or group of slices. Venus vessel can be viewed either as minimum intensity projection (mIP) of phase mask weighted images or 2D phase difference map overlaid on the MR image slices in color scale, which is called phase-weighted image (PWI). These images can used to visualize the venous vessel in 2D.

Method Normal healthy volunteer axial MR data on a 3T MR scanner (Signa Excite, GE Healthcare) was used in this research. T2* weighted image with velocity compensated gradient echo sequence using the scan parameter of TR=42ms, TE=30ms FOV=24X24cm^2, and matrix size =512X512. After the standard image reconstruction, real, imaginary and magnitude are generated. An application, running on Windows OS with standard specification of Intel based PC, load these images and create phase difference and phase-mask weighted images [1]. With proper setting of filter size, better results of venues vessel reconstruction, phase mask filter shape, number of multipliers and brain segmentation can be achieved. A parameter table was defined and each slice was set to the best-fitted parameter with the index in the parameter table for post-processing. Standard mIP was generated from phase mask weighted images with user defined slice range. Phase difference image, which depicts the phase change in venues vessel and its surround are mapped into color scale where the zero indicate no color and, as the phase change increases or decreases, the color changes to red and blue respectively. The colored image was overlaid on the corresponding image slides. Figure 1 shows the PWI reconstruction application where the user can define the range of image slide to view the venography with setting of image processing parameters on individual slices. Selected image slide range can also be seen on the center sagittal interpolated slice. The phase change was mapped as color map with the range of $-\pi$ to $+\pi$, overlaid on MR image slice as shown in Figure 2.

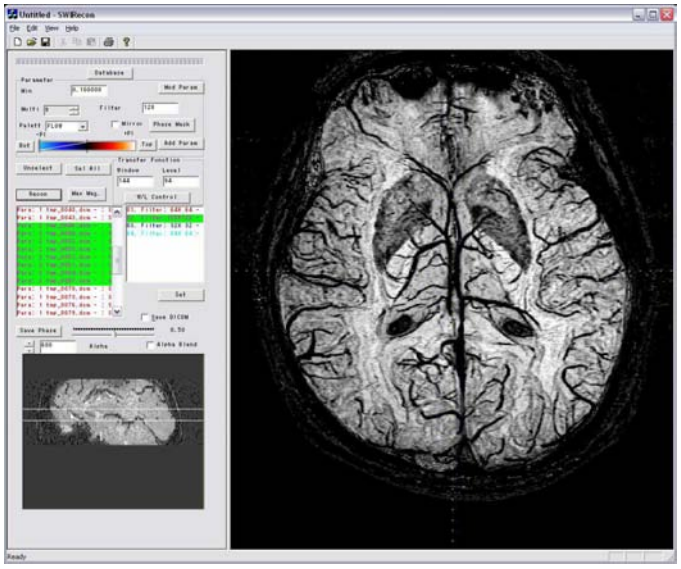

Figure 1. Windows OS based phase weighted image reconstruction application. Left side panel contains the recon parameter and right side panel shows mIP over specified slice range.

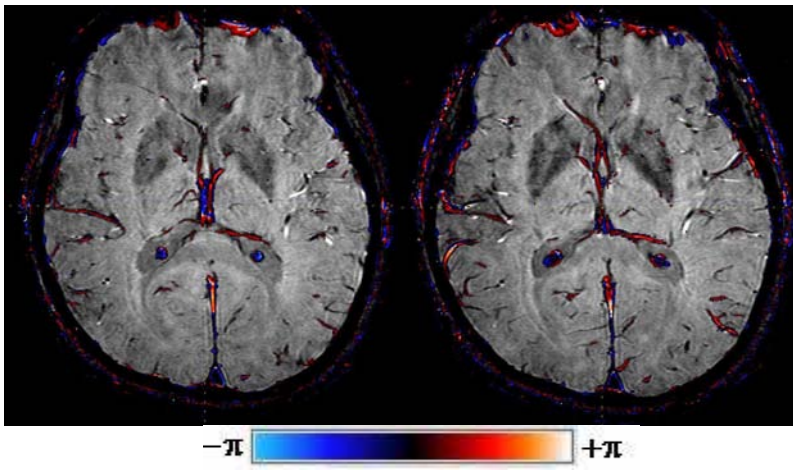

Figure 2. Phase weighted Image: Phase difference is mapped in to color scale and overlapped in the two sequential 2D axial MR image slices.

Result & Discussion These preliminary results indicate that phase difference due to the field inhomogeneity in the venues vessel overlaid the magnitude image as color map improved the visualization and scanning process in slice-by-slice manner. Furthermore, mIP of the phase mask weighted image with variable parameter setting improved visualization of vessel structure.

References

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