AbstractID: 14072 Title: Reduced Number of Signal Averages for Diffusion Imaging Using Compressed Sensing

Purpose:
Diffusion-weighted imaging is an important clinical tool in neurological and body MRI. However, low contrast to noise ratios (CNR) of parameter maps (e.g., fractional anisotropy (FA)), force numerous signal averages to achieve useful CNR. Diffusion Tensor Imaging (DTI) requires at least six diffusion directions, which can lead to extremely lengthy protocols. Here, we present a method for using Compressed Sensing (CS) processing to decrease the number of signal acquisitions needed to achieve a given CNR.

Method and Materials:
The CNR was calculated for the FA (Fractional Anisotropy) map of celery DTI data acquired on a 9.4T vertical Bruker BioSpec. The 2-D Fourier coefficients of FA map were first decomposed into multiple sets of incoherent subsamples by the application of complementary random masks with equal sampling ratios, such that all of the coefficients were used at least once. Data subsampling was performed in both directions. CS reconstruction was applied to each subset of Fourier coefficients to recover multiple fully sampled FA maps. Finally, the CS reconstructed FA maps were averaged (in Fourier space) to produce a less noisy FA map.

Results:
The CS processed FA maps mostly contained significantly less noise than unprocessed FA maps by both calculated CNR and visual inspection.

Conclusion:
We found that the CS processed FA maps mostly contained significantly less noise than unprocessed FA maps. However, our celery phantom datasets started out with high CNR, which does not reproduce in vivo noise conditions. Therefore, application of this method to a phantom dataset might not fully demonstrate the its capabilities, meaning that the method should be tested on more realistic MR data before any practical significance can be attached to these results.

Conflict of Interest (only if applicable):