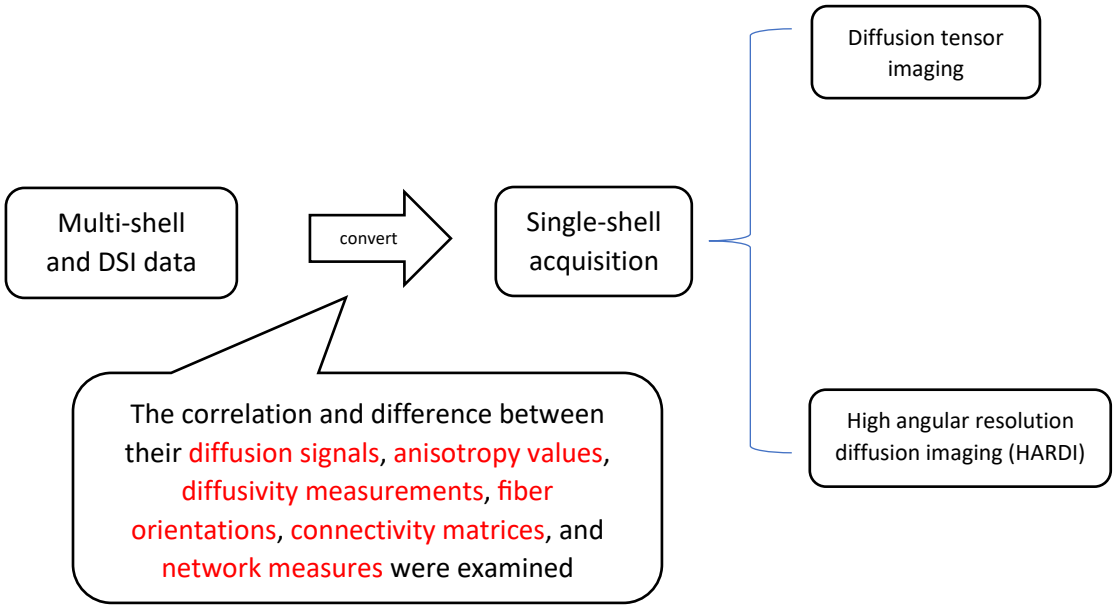
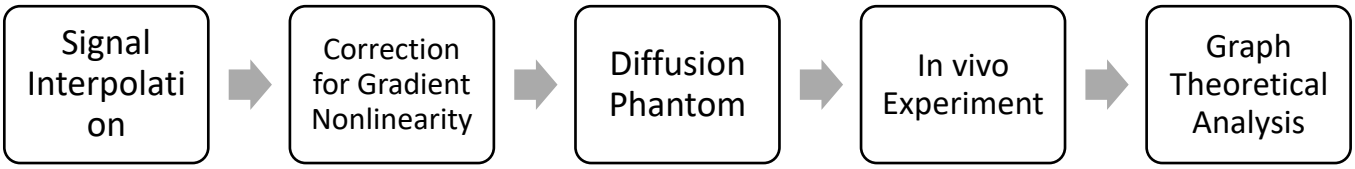
Summary

Converting Multi-Shell and Diffusion Spectrum Imaging to High Angular Resolution Diffusion Imaging

Preference: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5021685/



1. Workflow



2. Signal Interpolation

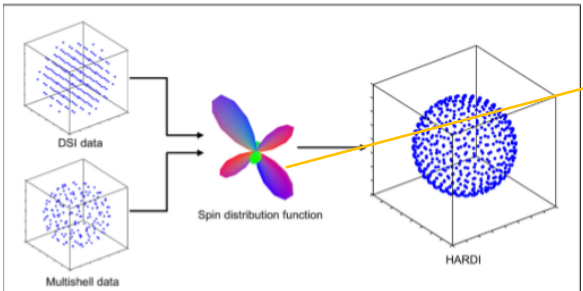


FIGURE 1 | The scheme conversion method uses the spin distribution function (SDF) to convert multi-shell or DSI data to their corresponding HARDI representation. This is made possible by the linear relationship between the diffusion signals and the SDF provided by the generalized q-sampling reconstruction approach.

SDF measures the density of diffusing water at different orientation and is thus a measurement of spin density.

DSI or multi-shell data can be converted to a common SDF and the linear relation between SDF and the HARDI signals will allow for estimating the corresponding HARDI representation by solving the inverse problem using constraint optimization

3. Results:

The converted HARDI data are strongly correlated with the original acquired HARDI data in the phantom. The high correlation coefficient (>0.9) suggests that the converted HARDI is a good predictor of the original HARDI.

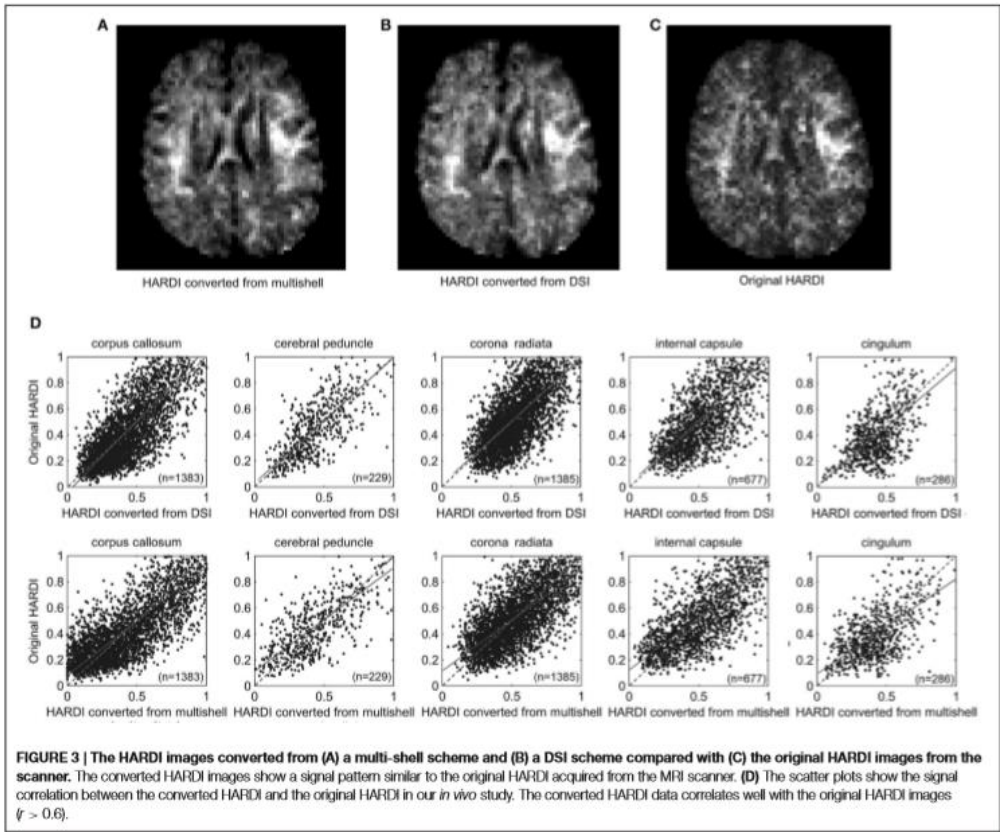


FIGURE 3 | The HARDI images converted from (A) a multi-shell scheme and (B) a DSI scheme compared with (C) the original HARDI images from the scanner. The converted HARDI images show a signal pattern similar to the original HARDI acquired from the MRI scanner. **(D)** The scatter plots show the signal correlation between the converted HARDI and the original HARDI in our *in vivo* study. The converted HARDI data correlates well with the original HARDI images ($r > 0.6$).

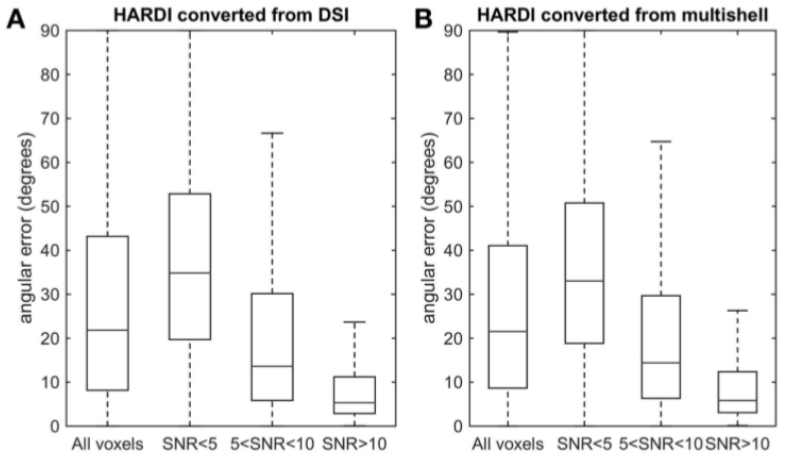


FIGURE 7 | Boxplots showing the angular error between (A) HARDI converted from DSI and the original HARDI and (B) HARDI converted from multishell and the original HARDI. Overall, the median of the angular error is around 20°. At voxels with SNR greater than 5, the angular error is substantially lower than the limit an orientation distribution function, suggesting that the fiber orientations calculated from the converted HARDI are sufficiently close to those of the original HARDI.

4. Conclusions

I. Conclusion1:

- ✓ Here we show that schemes with multiple b-values have conversion flexibility. The diffusion signals converted from DSI and multi-shell acquisition strongly predict those of the original HARDI in our phantom and in vivo experiment.

II. Conclusion2:

- ✓ The high predictive power was also observed for common diffusion indices, such as fractional anisotropy and diffusivity.

III. Conclusion3:

- ✓ The fODF, connectivity matrix, and network measures all show a highly similar profile between converted HARDI and the original HARDI.