

COMP0118: Computational Modelling for Biomedical Imaging

Coursework 1 Figures

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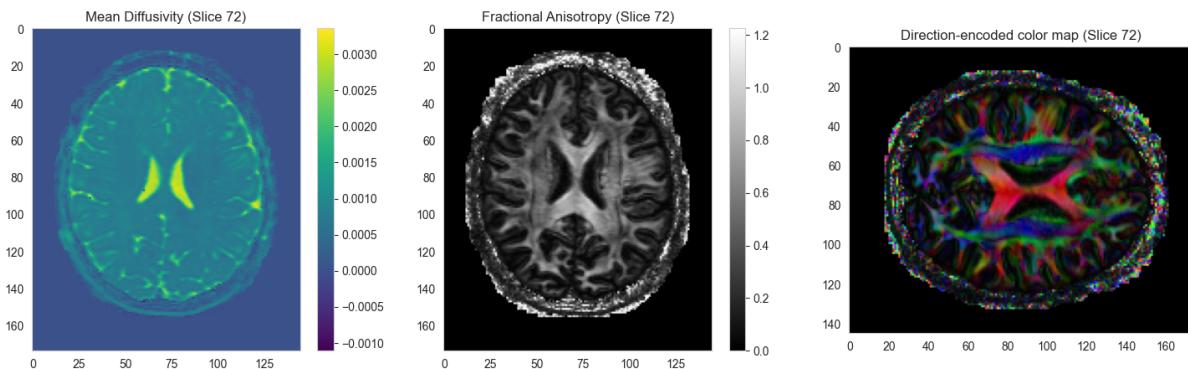


Figure 1: Maps of Mean Diffusivity, Fractional Anisotropy, and Direction-Encoded color map. Mean Diffusivity is naturally higher in the CSF where the fluid is free to diffuse throughout the ventricles. Fractional Anisotropy reveals the white matter tracts in the 2 brain hemispheres and in the corpus callosum. The color map show us the WM tracts that move left-right (magenta), the pyramidal axons which go up and down (blue), and the WM association tracts (green) of the superior longitudinal fasciculus that connect the 4 major lobes.

Ball and Stick Prediction

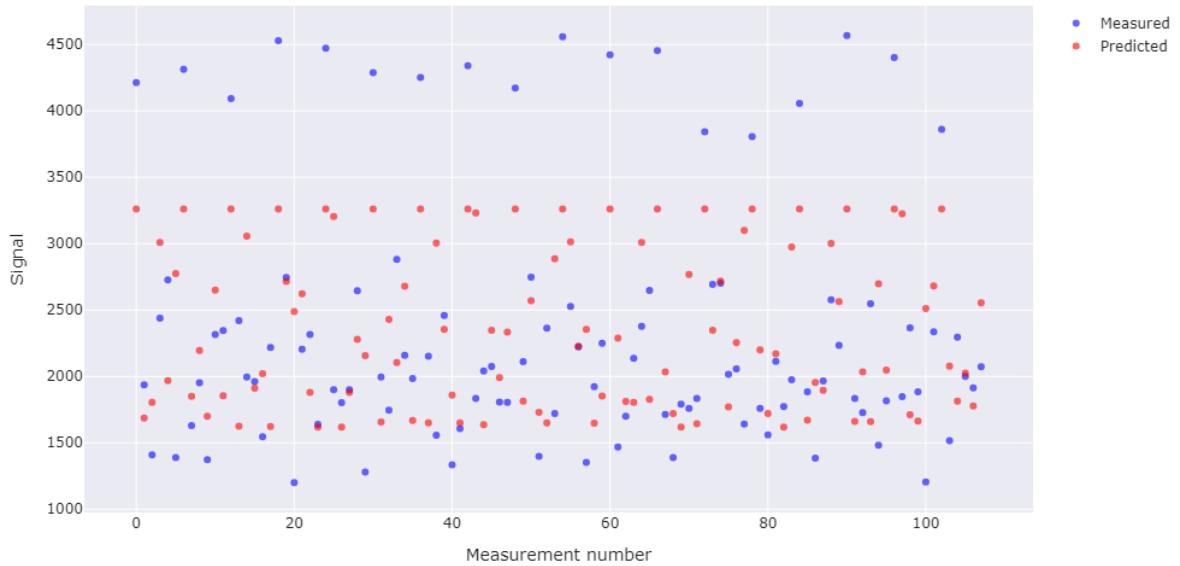


Figure 2: Measured and Predicted signal strength for the Ball and Stick model. Note the inability of the model to predict the baseline signals above 4,000 ($b = 0$ measurements). Perhaps a limitation imposed by the unrealistic start parameters.

Ball and Stick Constrained Prediction

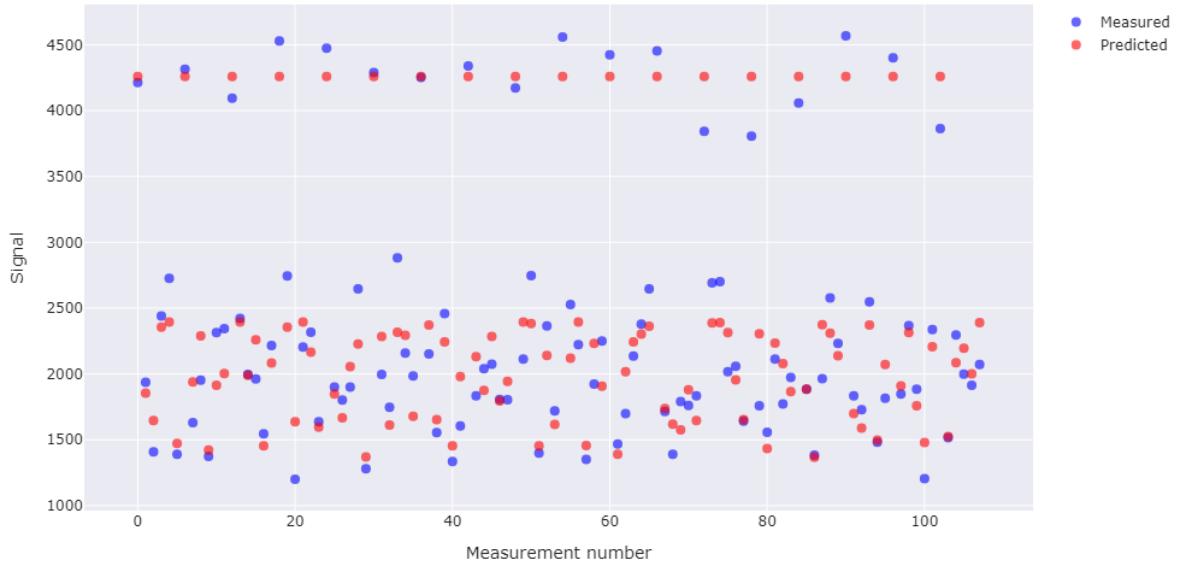


Figure 3: Measured and Predicted signal strength for the Constrained Ball and Stick model. Now, baseline signals are captured much more accurately. The parameter constraints are effective.

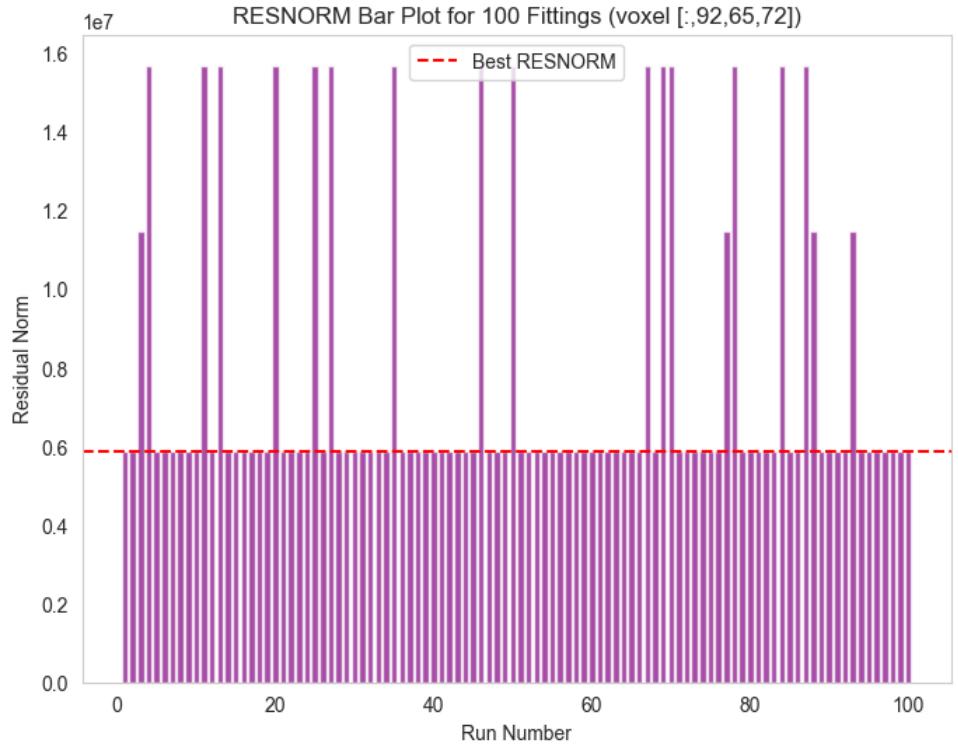


Figure 4: Bar Plot of RESNORMs over 100 Ball and Stick Constrained model fittings.

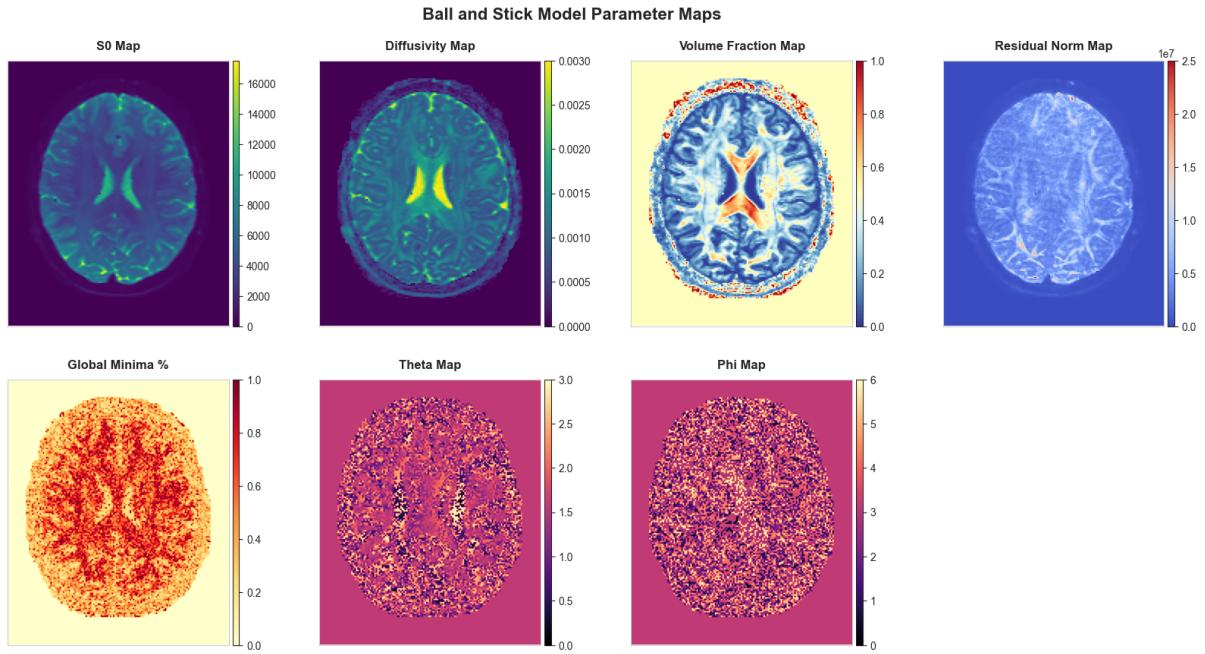


Figure 5: Parameters Maps of Slice 72. Note the few voxels (particularly in the S0 and diffusivity maps) where the model has estimated 0 signal or diffusion. This can likely be attributed to a substandard fit on the voxel or some measurement error. Each voxel was fitted 5 times to find the global minimum.

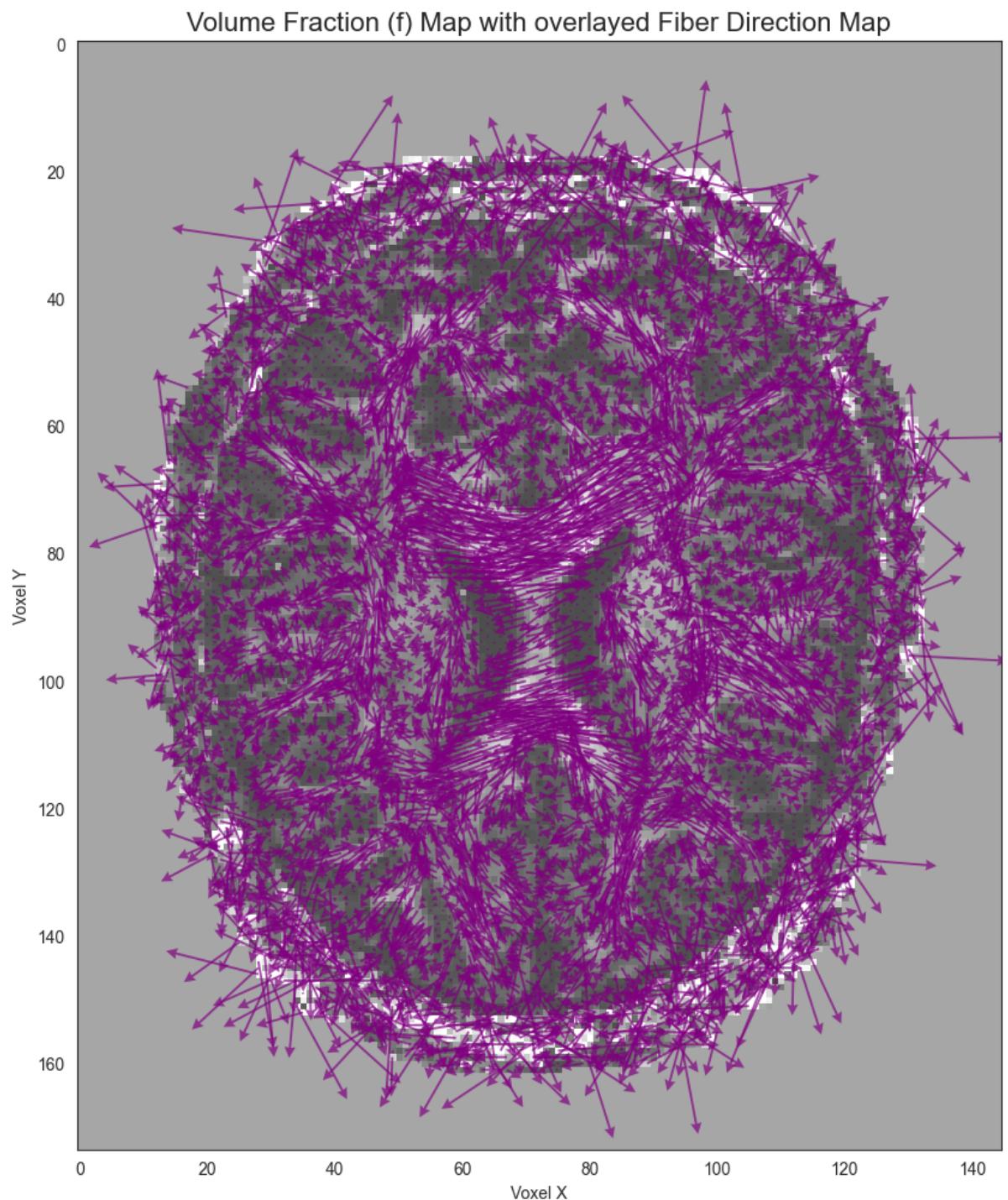


Figure 6: Volume Fraction Map with overlayed Fiber Direction vectors. Corpus callosum WM tracts visibly go left and right, whereas CSF in the ventricles are shown as arrows with no tail. GM regions lack diffusivity and thus arrows. I wasn't sure to plot with or without arrows, since the fibers are bidirectional. But I thought I'd leave it in to get a better idea of the voxel origin. (Note: this image should be flipped vertically, but this was causing issues with the fiber direction plotting)

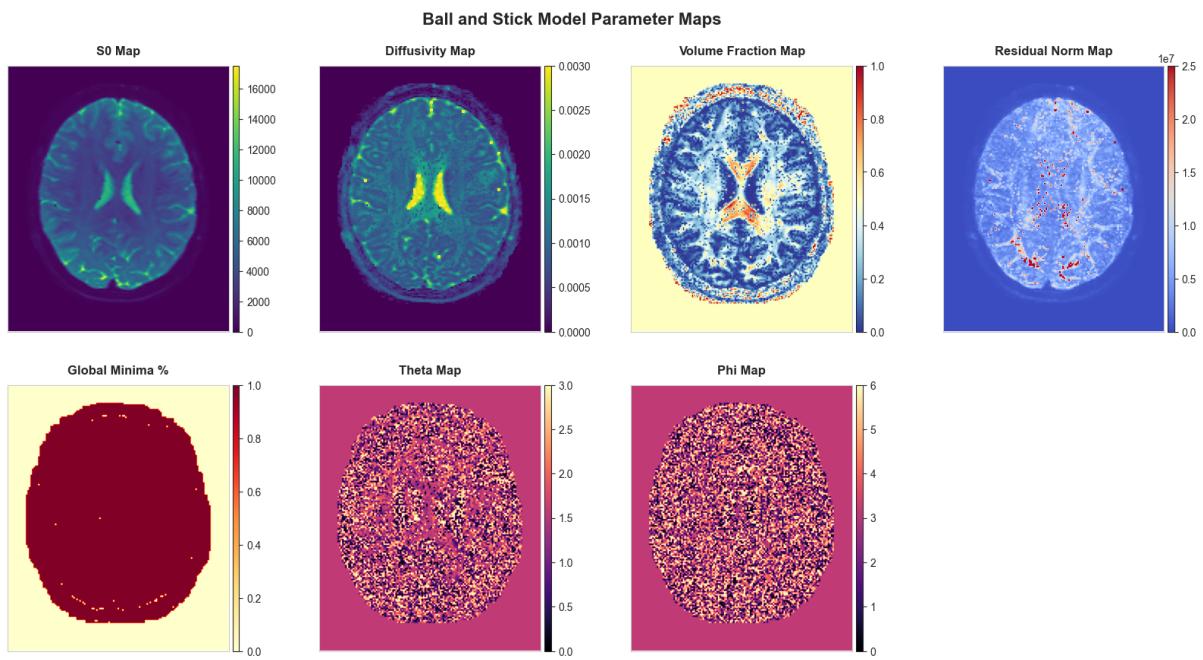


Figure 7: Rician Approximation Parameter maps. Note: all voxels were fitted just once for 2000 iterations for expediency. There are a significant number of incorrectly fitted voxels, but, results are still reasonable. Compared to the regular ball and stick fitting, which had many more errors for just 1 fitting/voxel.

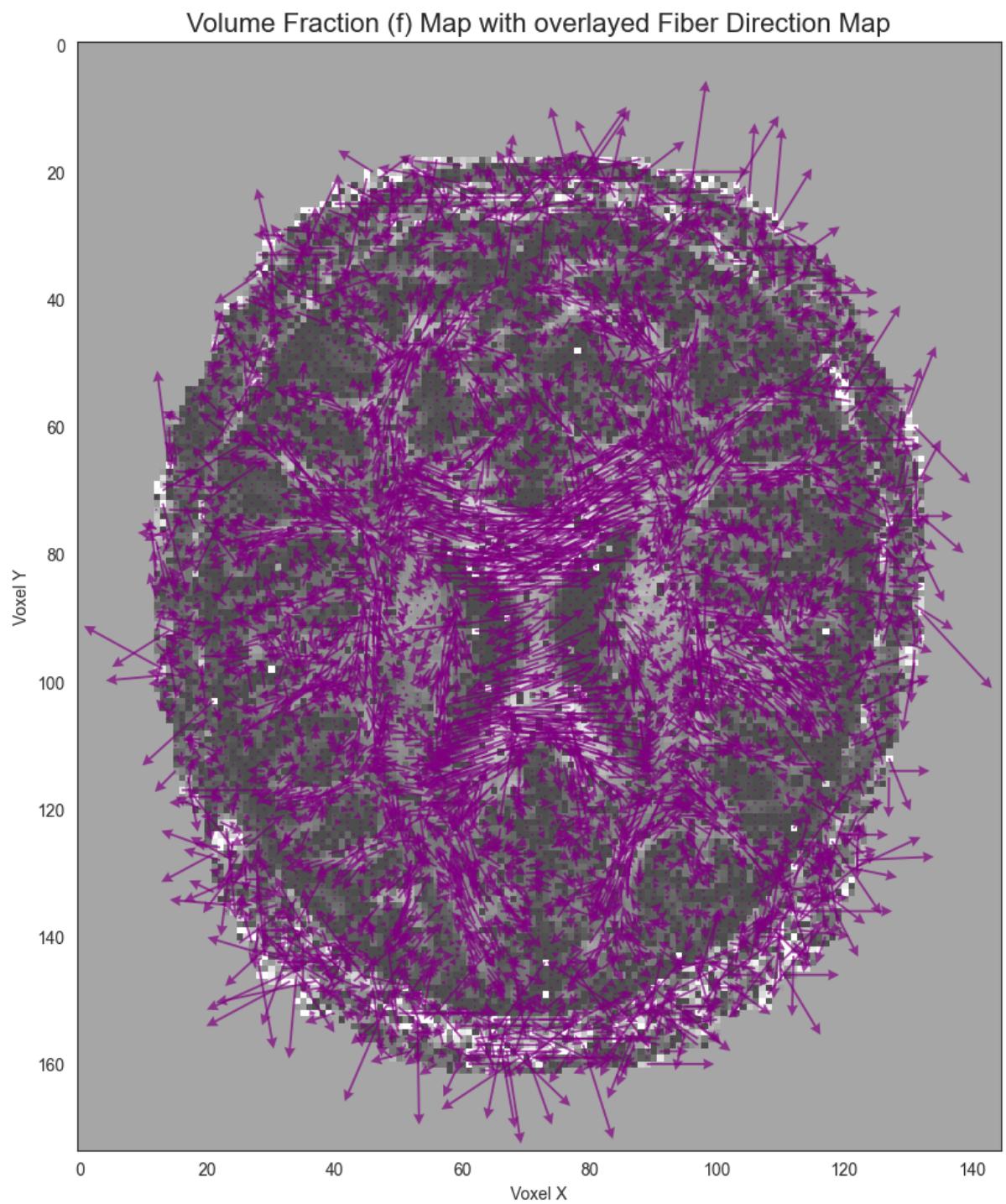


Figure 8: Rician Approximation fiber directions.

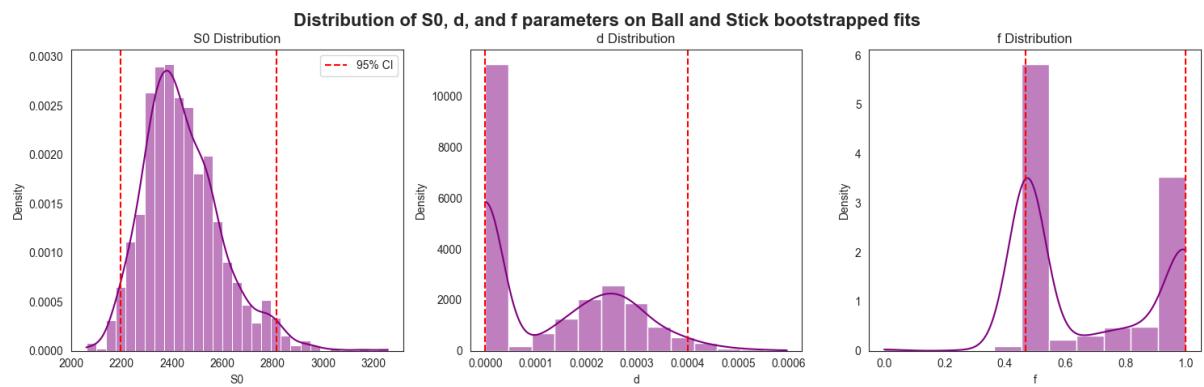


Figure 9

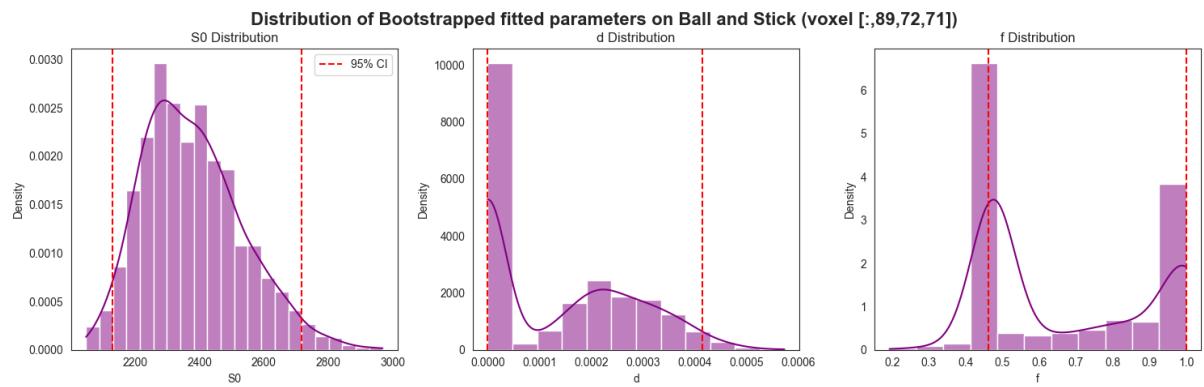


Figure 10

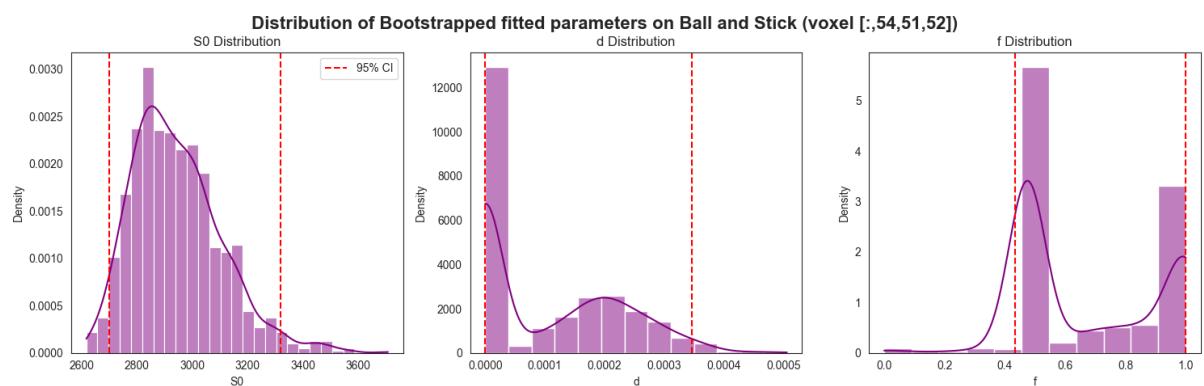


Figure 11

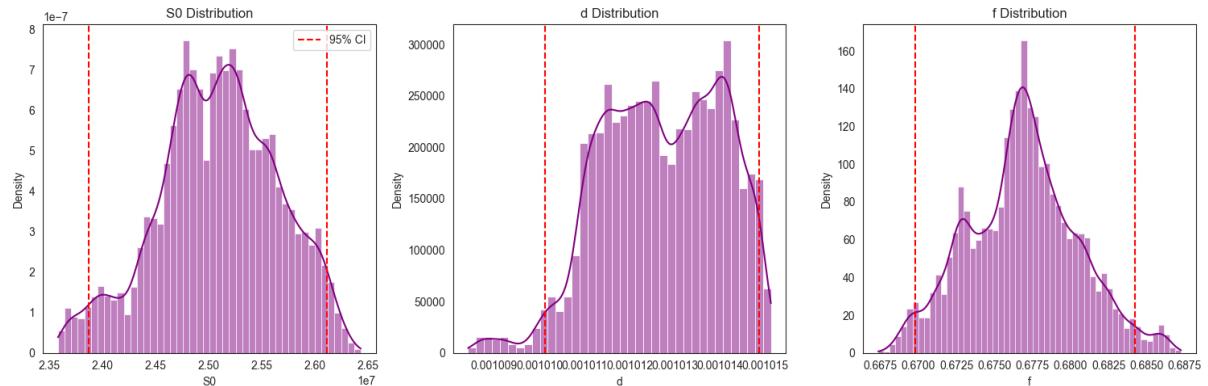


Figure 12: MCMC distribution of parameter estimates for the voxel from part 1.

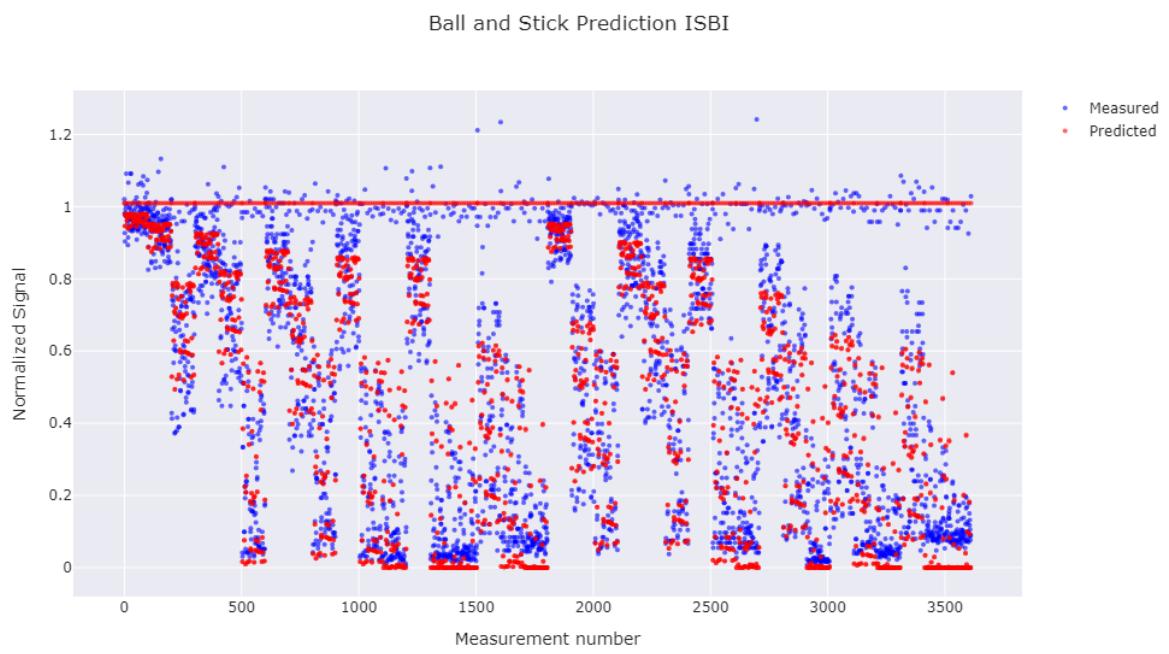


Figure 13

Diffusion Tensor Prediction ISBI

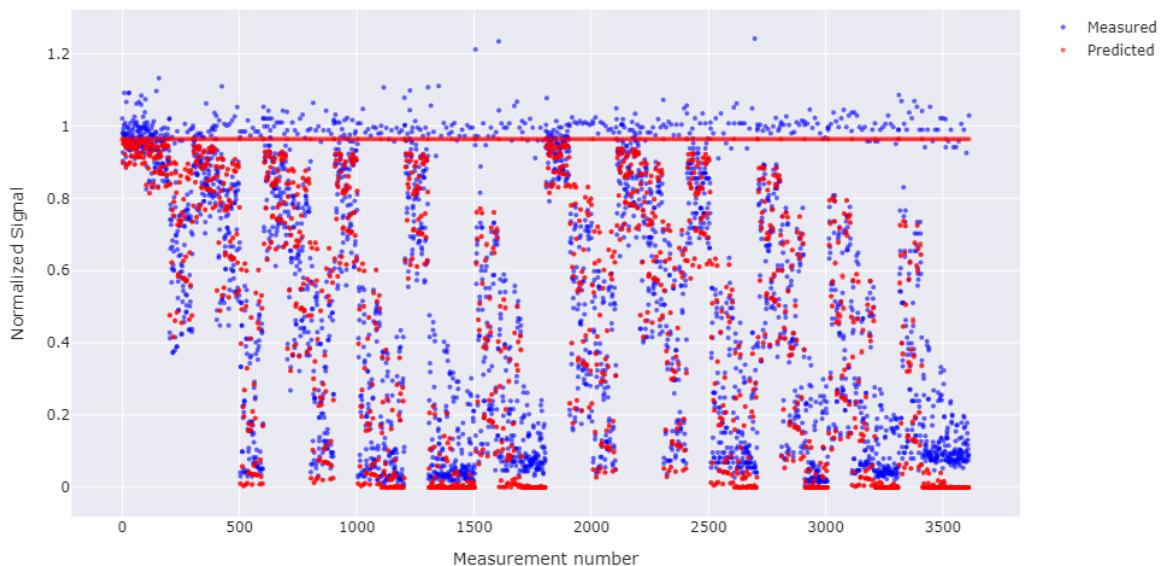


Figure 14

Zeppelin Stick Prediction ISBI

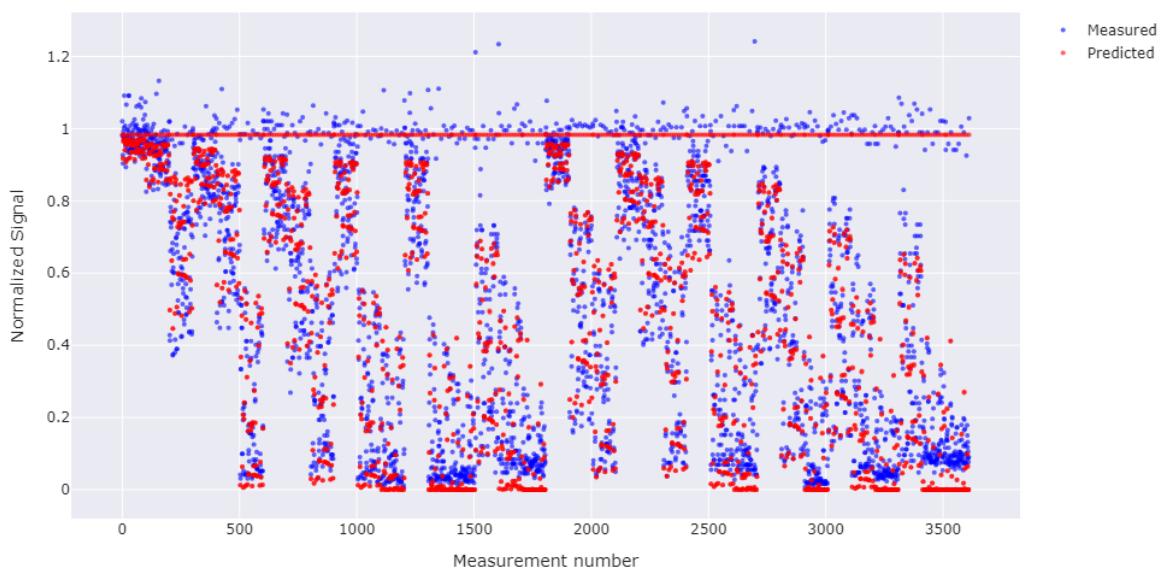


Figure 15

Zeppelin Stick with Tortuosity Prediction ISBI

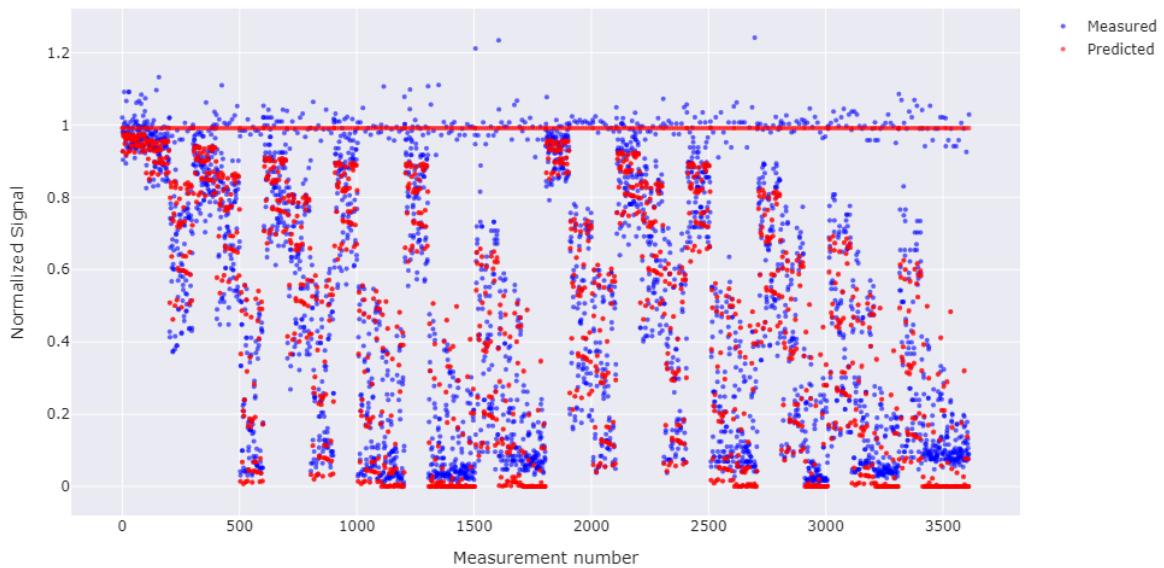


Figure 16