COMP0118: Coursework 1

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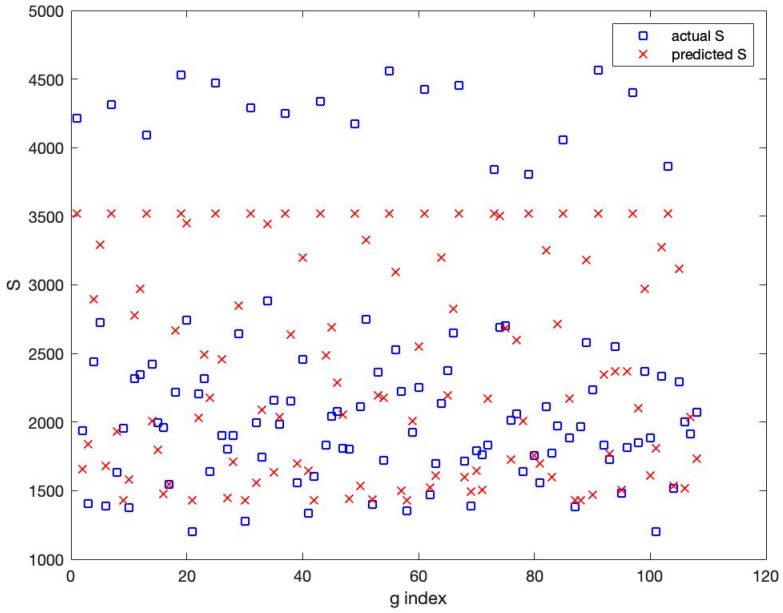
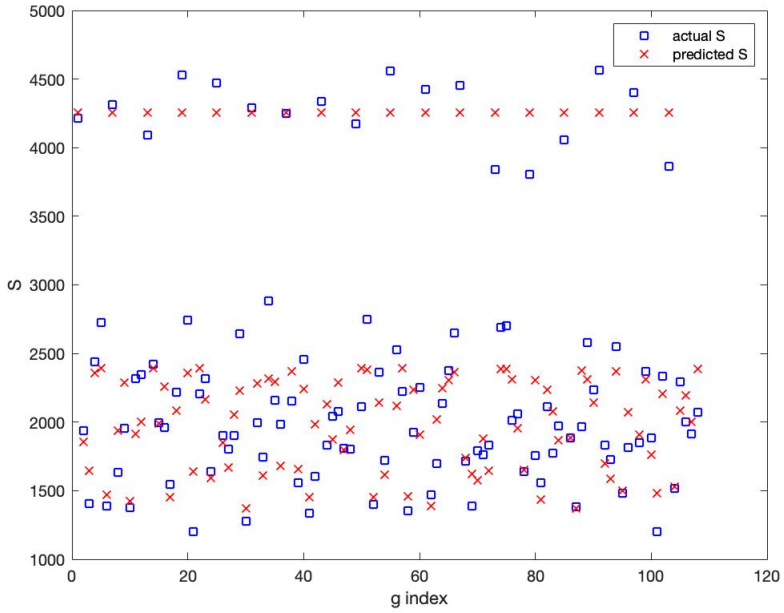
Q1.1.1

The figure(**Q1.1.1**) below shows the fit for ball and stick model at voxel(92,65,72). Since the predicted signal is not bound to the actual signal, the fit is really bad.



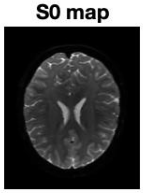
Q1.1.2

The figure(**Q1.1.2**) below shows the fit for ball and stick model at voxel(92,65,72). Since the parameters are physically realistic after transformation, the fit is better than Q1.1.1.

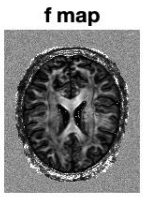


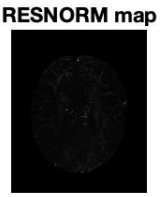
Q1.1.4

The first figure(**Q1.1.4(S0)**) below is the map of S0. We can see from the figure that S0 values are high in gray matter(neurons) and low in white matter(axons). The second figure(**Q1.1.4(d)**) below is the map of d, which is not clear, we just can see some white points. But we know that d values are high in gray matter(neurons).

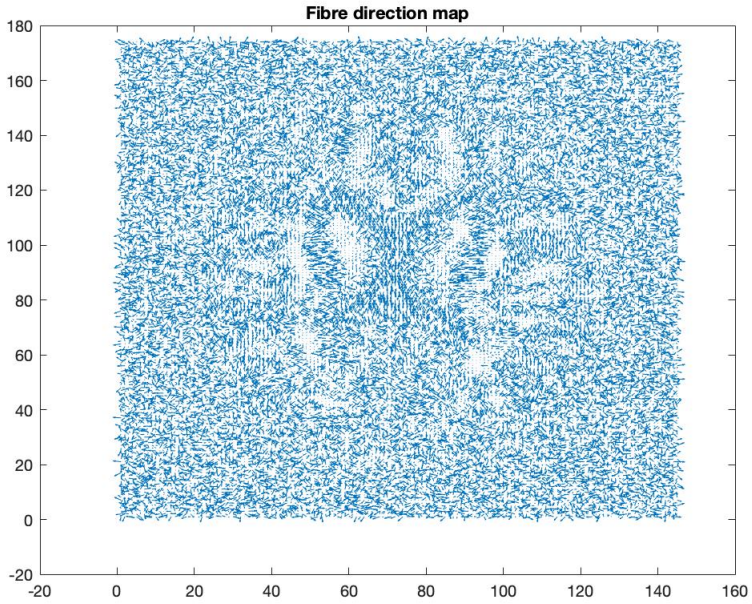


The first figure(**Q1.1.4(f)**) below is the map of f. We can see from the figure that it is the best at distinguishing between gray matter(neurons)(high) and white matter(axons)(low).
The second figure(**Q1.1.4(RESNORM)**) below is the map of RESNORM, which is not clear, we just can see an outline. It may suggest that ball and stick model is not the best or the parameters are not good enough.

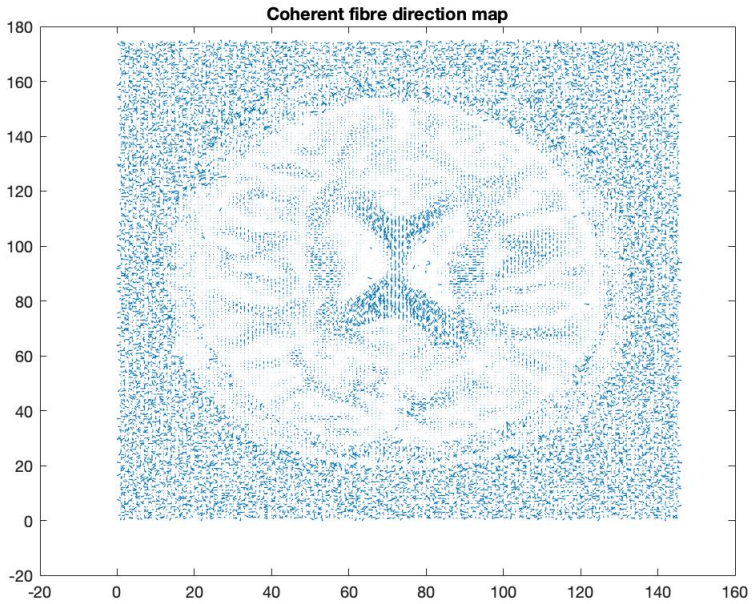




The figure(**Q1.1.4(fd)**) below is the fibre direction map, which shows the strong directions of axons that move from the front to the back of the brain.

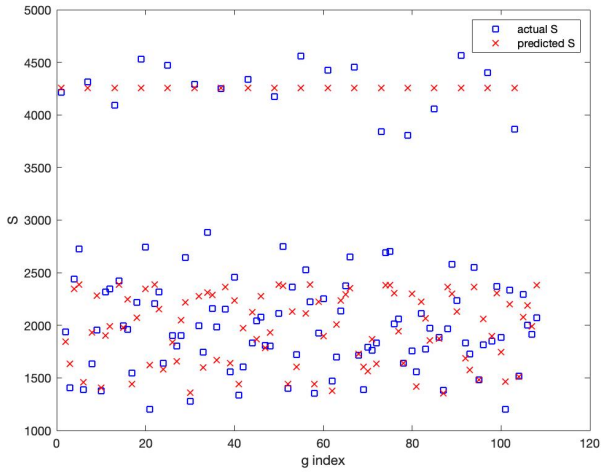


The figure(**Q1.1.4(cfd)**) below is the coherent fibre direction map. Since the fibre direction map was wighted by f, the gray matter does not show strong diffusion.



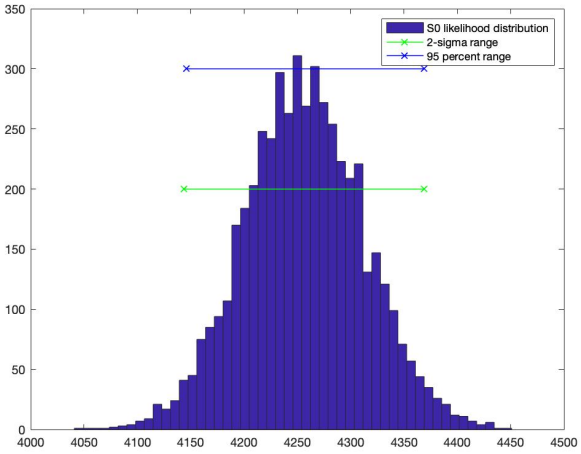
Q1.1.8

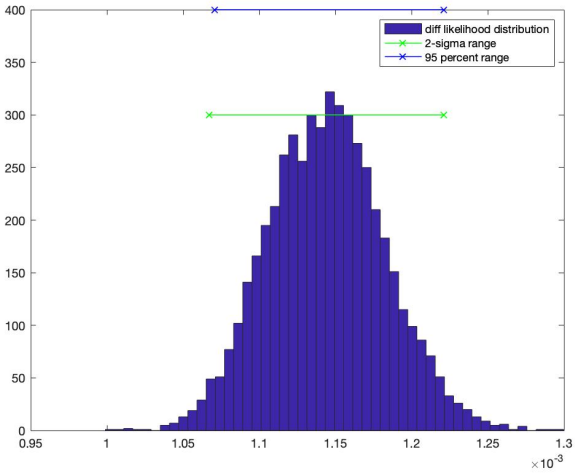
The figure(**Q1.1.8**) below shows the fit for rician noise model at voxel(92,65,72). It is clear that the fit is better than Q1.1.1 but similar to Q1.1.2.

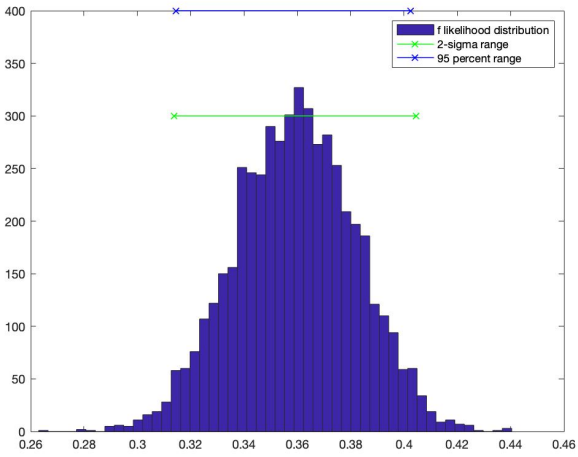


Q1.2.1

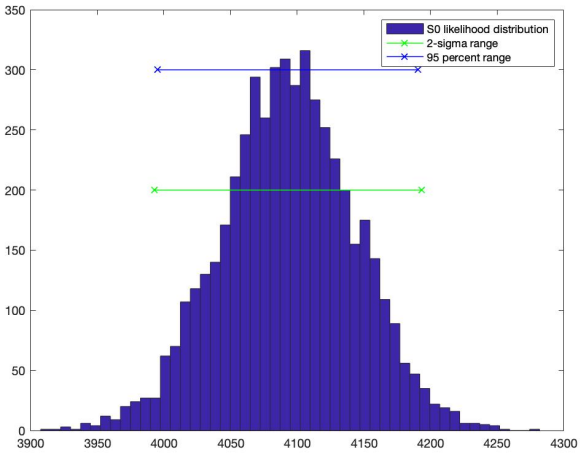
The three figures(**Q1.2.1(S0),Q1.2.1(d),Q1.2.1(f)**) below show the histogram of $p(x \mid A)$ along with 2σ and 95% ranges of parametric bootstrap for S0, d and f at voxel(92,65,72) respectively. It is clear from these figures that the ranges of 2σ is a little larger than those of 95% for all parameters.

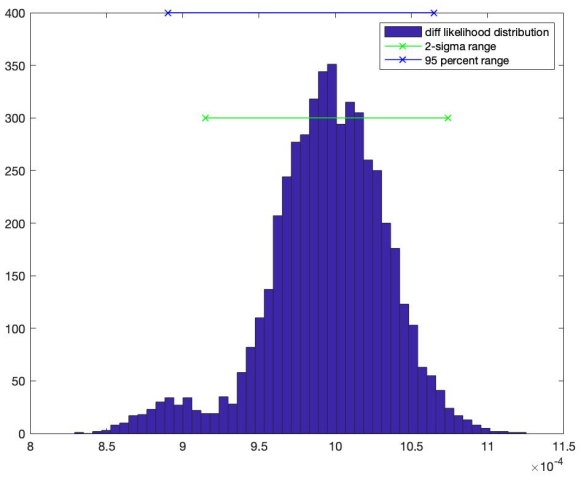


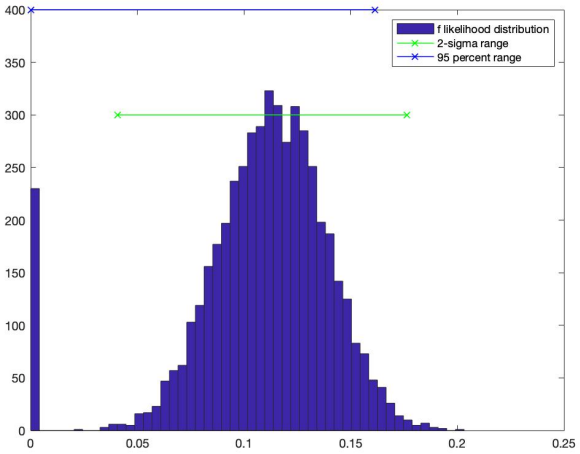

diff likelihood distribution
2-sigma range
95 percent range
400
350
300
250
200
150
100
50
0
0.95
1
1.05
1.1
1.15
1.2
1.25
1.3
×10^-3


f likelihood distribution
2-sigma range
95 percent range
400
350
300
250
200
150
100
50
0
0.26
0.28
0.3
0.32
0.34
0.36
0.38
0.4
0.42
0.44
0.46

The three figures(**Q1.2.1(S0)(2),Q1.2.1(d)(2),Q1.2.1(f)(2)**) below show the histogram of $p(x \mid A)$ along with 2σ and 95% ranges of parametric bootstrap for S0, d and f at voxel(56,39,48) respectively. It is clear from these figures that the ranges of S0 are similar to above, while the ranges of d and f are different from above.

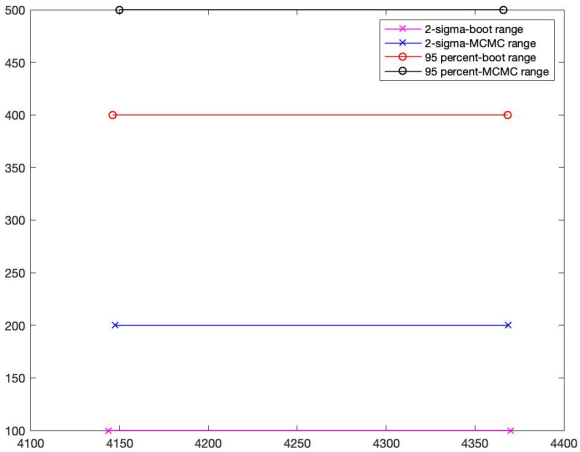


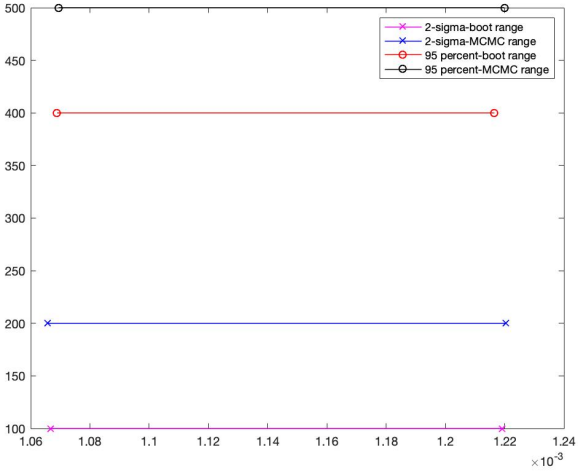


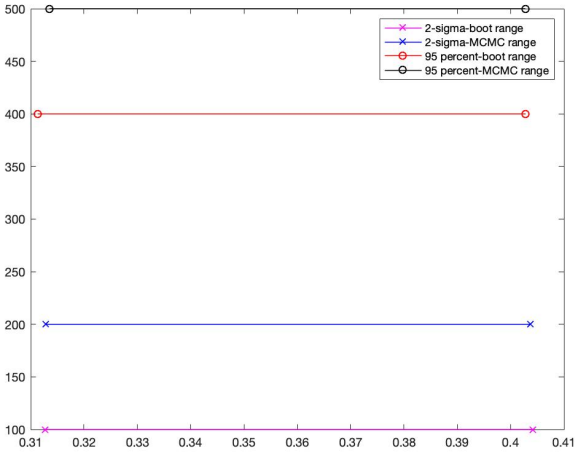


Q1.2.2

The three figures(**Q1.2.2(S0),Q1.2.2(d),Q1.2.2(f)**) below show the comparison of ranges for S0, d and f of bootstrap and MCMC. We can see from these figures that the ranges for two methods are very similar and the ranges of MCMC are a little smaller than bootstrap for all parameters.

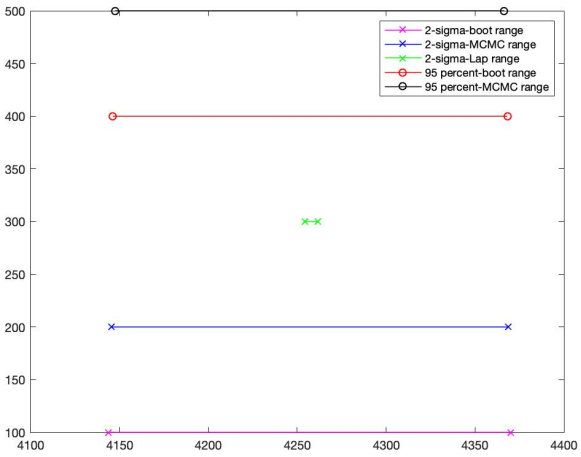


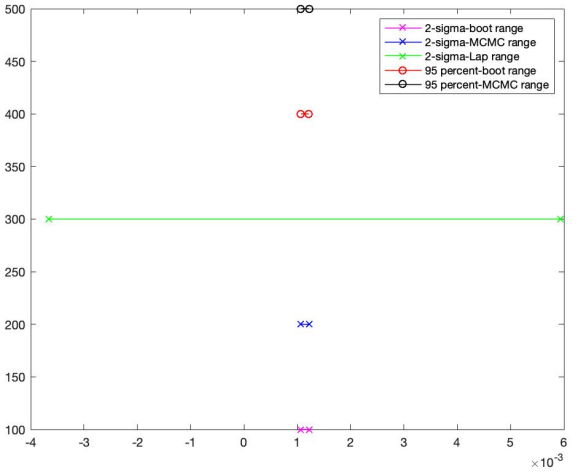

2-sigma-boot range
2-sigma-MCMC range
95 percent-boot range
95 percent-MCMC range
500
450
400
350
300
250
200
150
100
1.06
1.08
1.1
1.12
1.14
1.16
1.18
1.2
1.22
1.24
×10-3

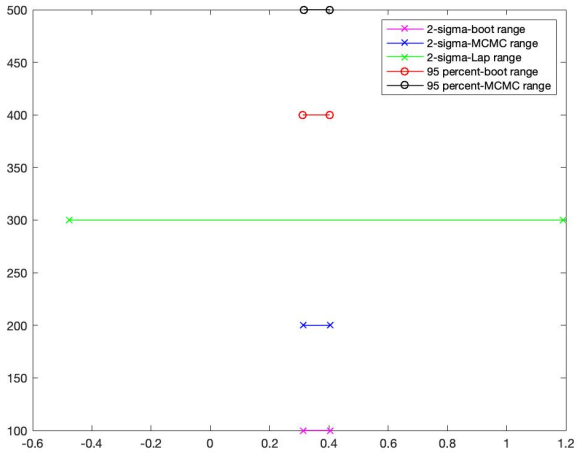

2-sigma-boot range
2-sigma-MCMC range
95 percent-boot range
95 percent-MCMC range
500
450
400
350
300
250
200
150
100
0.31
0.32
0.33
0.34
0.35
0.36
0.37
0.38
0.39
0.4
0.41

Q1.2.3

The three figures(**Q1.2.3(S0),Q1.2.3(d),Q1.2.3(f)**) below show the comparison of ranges for S0, d and f of bootstrap, MCMC and Laplace. We can see from these figures that the S0 range for Laplace is the smallest among the three methods, while for d and f ranges, using Laplace method covers the largest area.

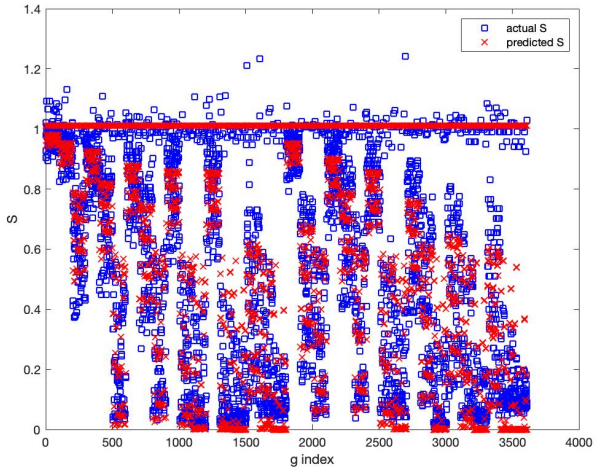






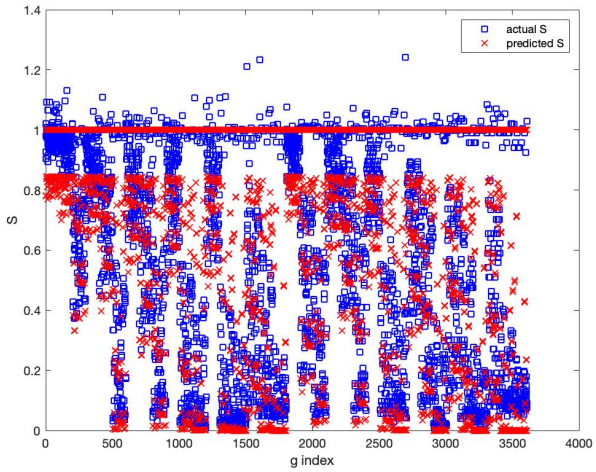
Q1.3.1

The figure(**Q1.3.1**) below shows the fit for ball and stick model using new data set(RESNORM=15.106). It is clear that the fit is good in this case.

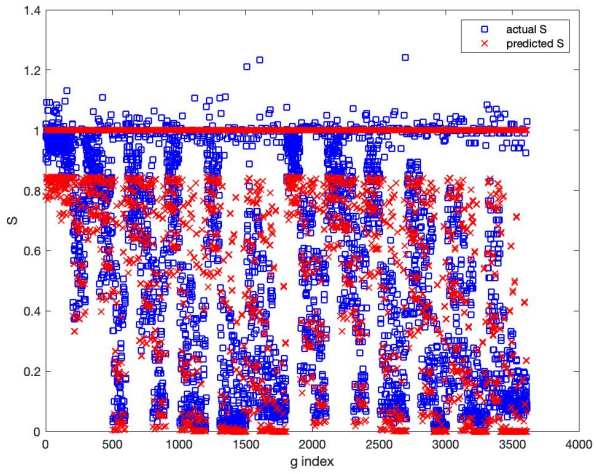


Q1.3.2

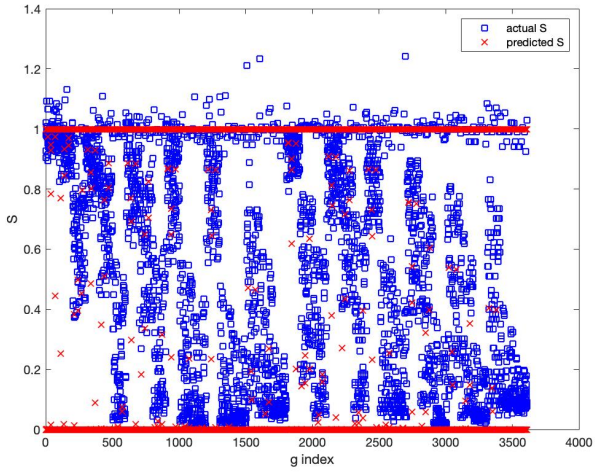
The figure(**Q1.3.2(zs)**) below shows the fit for zeppelin and stick model(RESNORM=8.2893). It is clear that the fit is good in this case.



The figure(**Q1.3.2(zst)**) below shows the fit for zeppelin and stick with tortuosity model(RESNORM=11.5939). It is clear that the fit is good in this case, while the RESNORM is bigger that that of zeppelin and stick model.



The figure(**Q1.3.2(dt)**) below shows the fit for diffusion tensor model(RESNORM=53.7948). Since the predicted signal is not bound to the actual signal, the fit is really bad.



Q1.3.4

The figure(**Q1.3.4**) below shows the fit for ball and two stick model(RESNORM=11.7357). It is clear that the fit is quite good in this case and better than the three models in Q1.3.2.