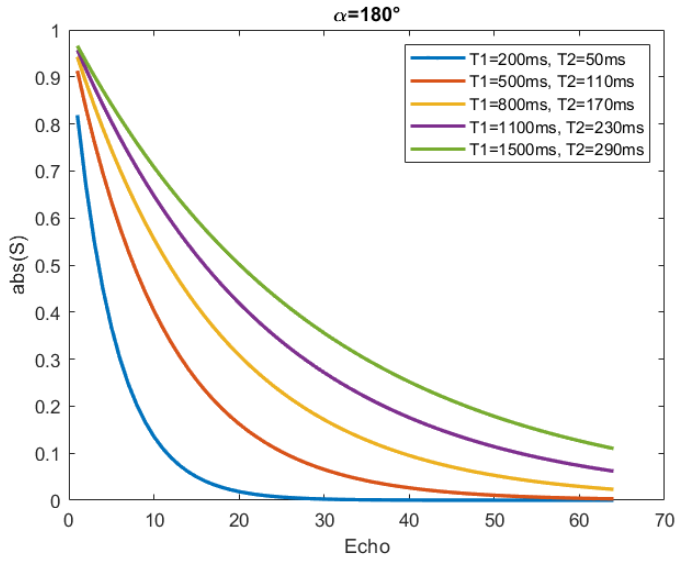
Homework 2

Question 1

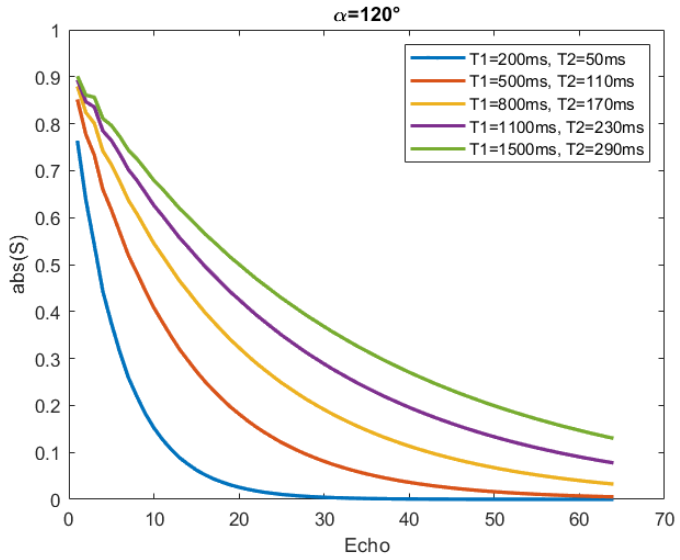
Question 1ai

See attached code for simulation details (sections Question 1 and Functions for question 1). Resultant signals from a FSE EPG simulation for 5 T1/T2 combinations using a refocusing alpha=180.



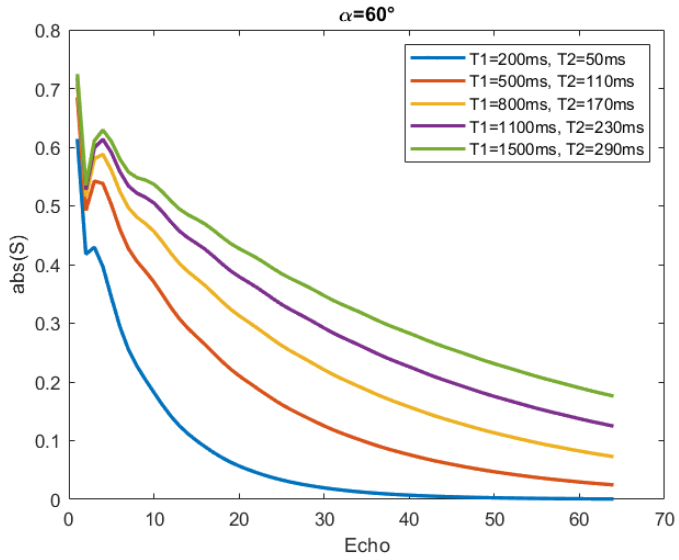
Question 1aii

See attached code for simulation details (sections Question 1 and Functions for question 1). Resultant signals from a FSE EPG simulation for 5 T1/T2 combinations using a refocusing alpha=120.



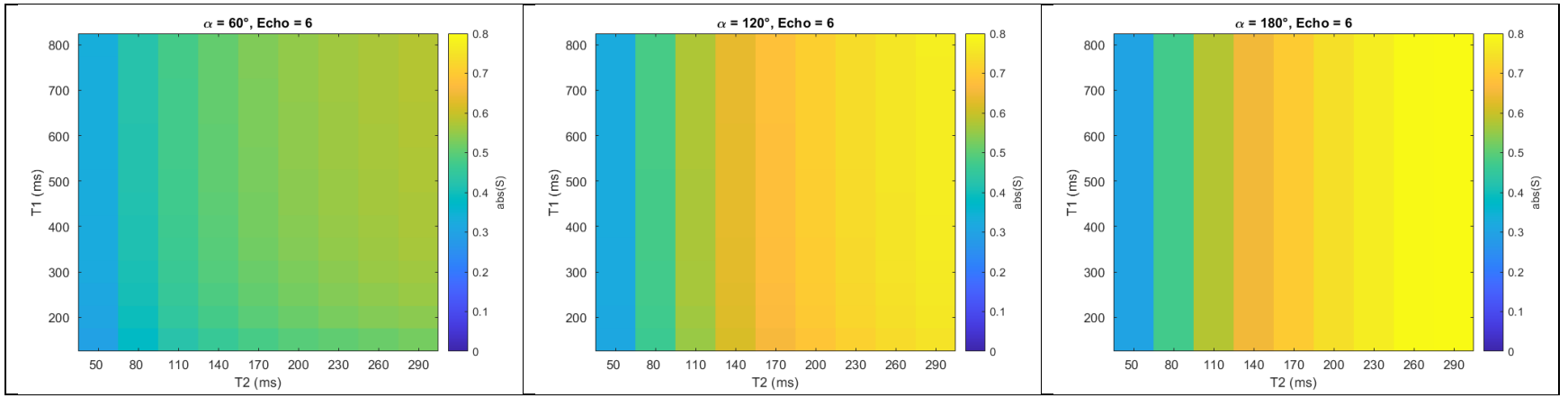
Question 1aiii

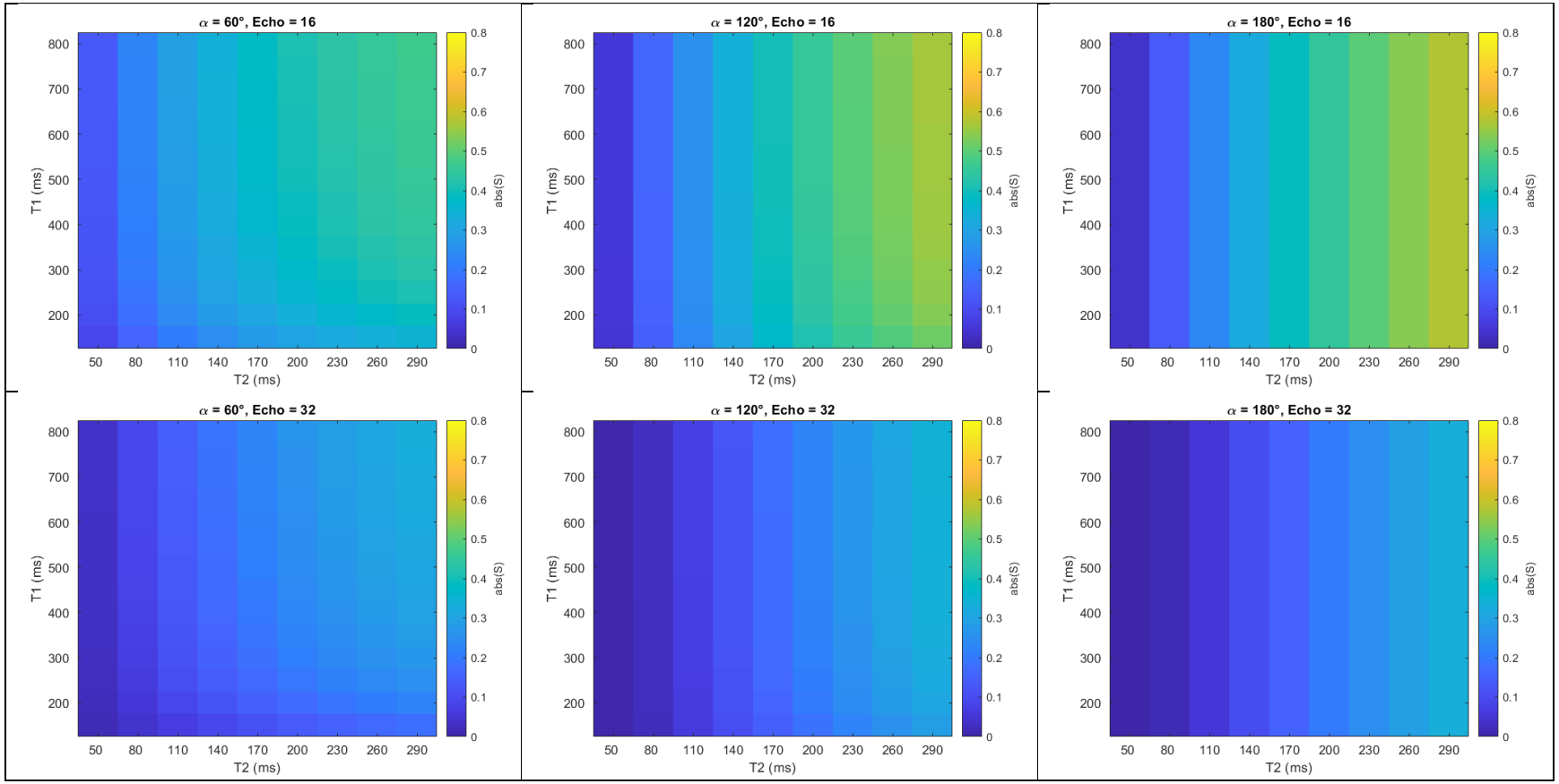
See attached code for simulation details (sections Question 1 and Functions for question 1). Resultant signals from a FSE EPG simulation for 5 T1/T2 combinations using a refocusing alpha=60.

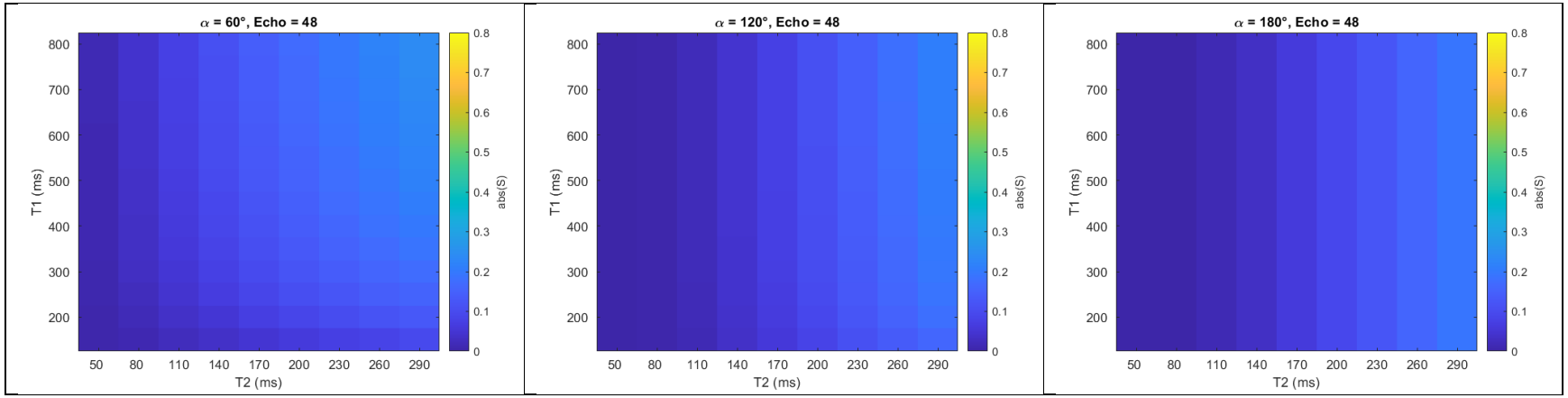


Question 1b

See attached code for simulation details (sections Question 1 and Functions for question 1). Contour plots for each alpha at echo 6, 16, 32, 48 for various T1/T2 combinations.




α = 60°, Echo = 16
α = 120°, Echo = 16
α = 180°, Echo = 16
α = 60°, Echo = 32
α = 120°, Echo = 32
α = 180°, Echo = 32
T1 (ms)
T2 (ms)
abs(S)
200
300
400
500
600
700
800
50
80
110
140
170
200
230
260
290
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8



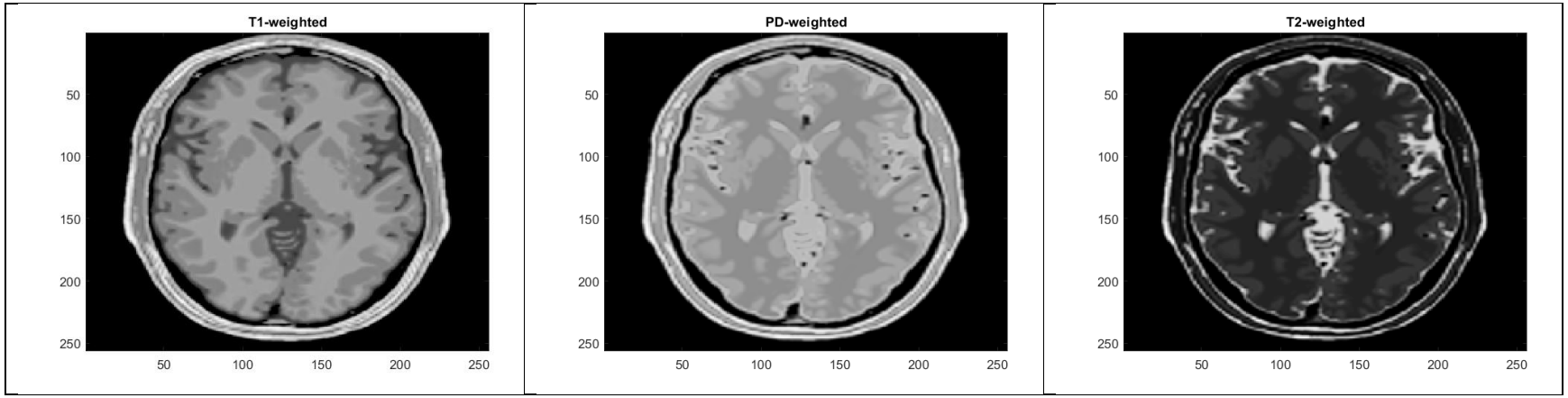
Question 1c

Looking at the contour plots, it appears that each flip angle does a fairly good job at discriminating between T2 values and would thus be T2 weighted. There is some limited T1 weighting with a flip angle of 60°, but the contrast between signals is quite poor.

Question 2

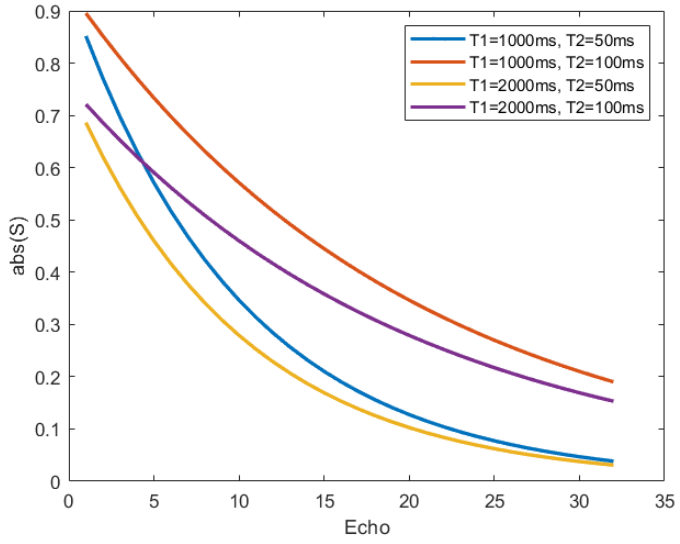
Question 2a

See attached code for simulation details (sections Question 2 and Functions for question 2). Simulated T1w images were prepared utilizing a single-echo spin echo sequence with TR=500ms and TE=15ms, a short TR was chosen to maximize T1 differences and short TE was chosen to minimize T2 effects. Simulated PDw images were prepared utilizing a single-echo spin echo sequence with TR=4000ms and TE=15ms, a long TR was chosen to minimize T1 differences and short TE was chosen to minimize T2 effects. Simulated T2w images were prepared utilizing a single-echo spin echo sequence with TR=6000ms and TE=100ms, a long TR was chosen to minimize T1 differences and long TE was chosen to maximize T2 effects.



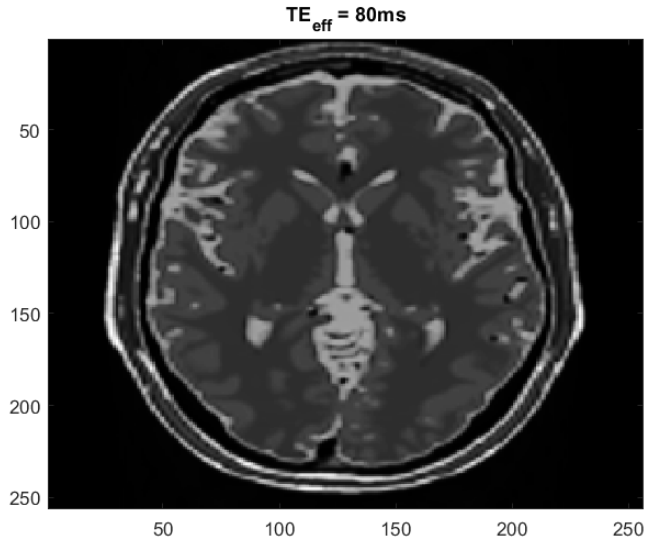
Question 2bi

See attached code for simulation details (sections Question 2 and Functions for question 2). Simulated transverse magnetization using bloch equations for FSE sequence.



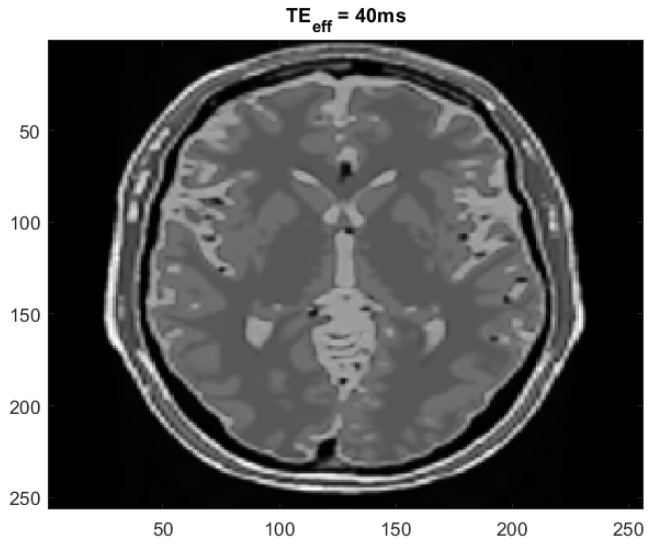
Question 2bii

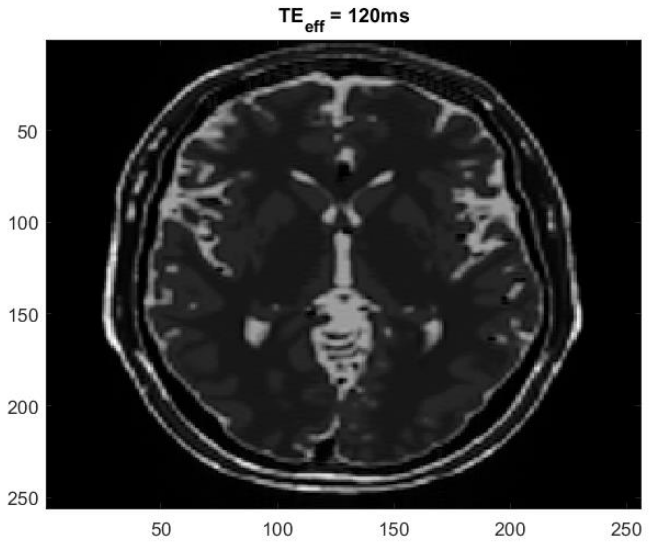
See attached code for simulation details (sections Question 2 and Functions for question 2). K-space was filled with the echo at TEeff=80ms occurring at the center line of k-space to maximize the signal here. Remaining echos were ordered such that each slab would decrease in intensity going outward toward the edges of k-space in the y-direction. The total acquisition time would be $FSE\ scan\ time = \frac{(TR)(N_Y)}{ETL} = \frac{(3sec)(256)}{32} = 24sec$ for the FSE scan which is much less than the time for the single echo acquisition which would be $SE\ scan\ time = (TR)(N_Y) = (3sec)(256) = 768sec$.



Question 2biii

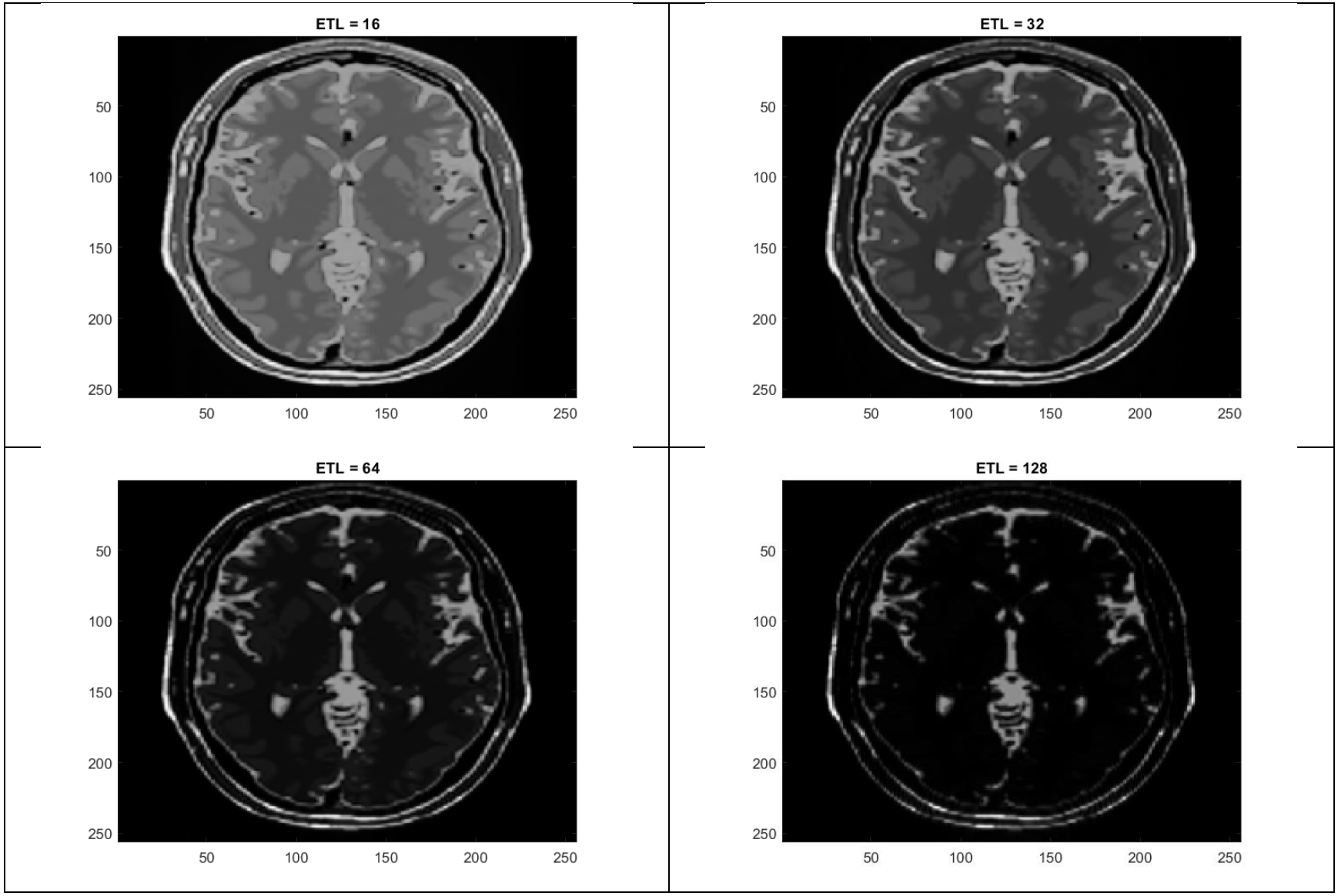
See attached code for simulation details (sections Question 2 and Functions for question 2). K-space was filled with the echo at TEeff=40 and 120 ms occurring at the center line of k-space to maximize the signal here. Similar ordering from the center out was applied for these images.

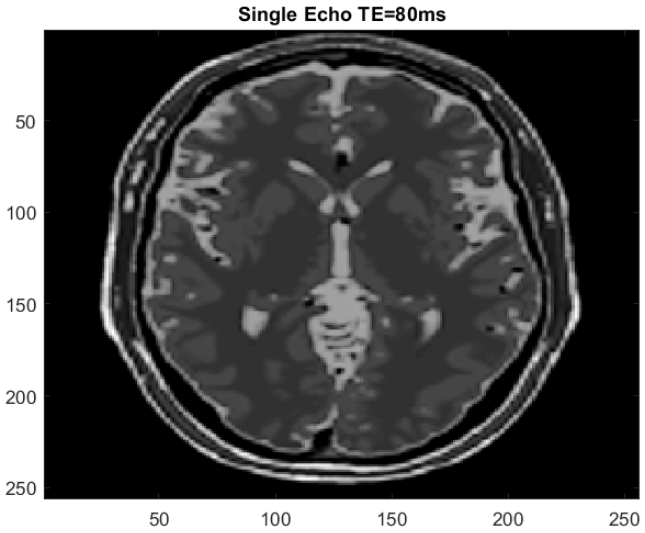




Question 2biv

See attached code for simulation details (sections Question 2 and Functions for question 2). As the ETL increases, the image signal intensity overall decreases relative to the single echo image which occurs due to more relaxation that occurs as the echo train increases.


ETL = 16
ETL = 32
ETL = 64
ETL = 128
50
100
150
200
250


Single Echo TE=80ms
50
100
150
200
250
50
100
150
200
250