Homework 2 (Due: 2024/12/25)

Instruction

Please use Matlab to solve the following problems. Please follow instructions on moodle to upload your homework.

1. Given a series of 90^0 RF pulses spaced TR apart in time (i.e., RF pulses applied at t = 0, 1*TR, 2*TR, 3*TR, etc.), use your computer to plot the longitudinal and transverse magnetization (in unit of fraction of the thermal equilibrium magnetization M_0) as a function of time from t = –TR to t = 4*TR. Assume for simplicity that T2 << TR and T1 is somewhat larger than TR. Also, assume the duration of RF pulses to be very short and negligible. (e.g., Given that T1/T2 of gray matter is around 1300/80ms at 3 Tesla, you can set TR to be 1000ms.)

2. The formation of an MR image is through 2D Fourier transform of the two-channel raw data. Hence you can always simulate the raw data of an MRI by performing 2D Fourier transform of an existing image. Now, discuss in theoretical terms what happens if there is an imbalance in the gain of the two receiver channels. Then use computer simulation to show that your inference is correct. Hint: Use 'phantom' in Matlab as an example, Fourier transform it to simulate the raw data before image reconstruction. The raw data have two components (real and imaginary) corresponding to the signals received by the two channels. Give them different weightings and Fourier transform back to see the artifacts. Vary the weighting factor and see how the artifacts change in appearance. Then construct your theory to explain the source of artifacts.