Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2013
Lab 3

1. Generate an interferogram An interferogram (in the context of MRI) is an image in which two or more coherence pathways are present in the image and are allowed to interfere with one another. In this exercise, you will generate an interferogram between a spin echo and two FIDs (gradient echoes), one generated by the initial RF pulse, and one by the refocusing pulse. You will visualize the interference by applying a shim offset in the X direction. The shim offset should perturb the phase of the gradient echoes but not the spin echo. The shim offset will cause the spin echo and gradient echoes to interfere with one another in a spatially dependent manner. For this lab use the pink oil phantom in the 8 channel coil, and use the pulse sequence spep_hcp, which is a spiral pulse sequence that is homegrown. Prescribe a single slice axial spin echo sequence. The refocusing pulse is 90° phase shifted from the excitation pulse. Set CVs: dda=4, reps=1, rf1type=1, fsat=0, pw_rf1=3200, pw_rf2=6400, cyc_rf1=2, cyc_rf2=2, slwid180=1, nl=32, opxres=128, optr=1s. Set flip angles using: ia_rf1=20479*flip1/90, ia_rf2=20479*flip2/180. Prescan and scan using flip1=90, flip2=180, te=30ms, and verify that you get an image. This is the reference image.

a. Calculate what combination of flip angles (flip1 and flip2) will generate a spin echo and a gradient echo from rf2 of equal amplitude (neglecting T1 decay). The solution may not be unique. (3 points)
b. Adjust ia_rf1 and ia_rf2 to achieve these flip angles, and scan. The default crusher gradients around the refocusing pulse should destroy both FIDs, so you should only see the spin echo. Calculate the expected signal intensity relative to the reference image, scan, and compare your results with the predicted values. (2 points)
c. Eliminate the effect of the crusher gradients by setting CV:zcrush=-3.9 Verify using the oscilloscope that the FID from rf2 should not be crushed. Change the value of the X shim by 40 units, and rescan. From the spacing of the stripes, calculate the gain of the manual X shim adjustment (in G/cm per unit shim offset). (2 points)
d. Calculate the expected profile across the stripes and compare with the acquired profile. (3 points)

2. Steady state coherences In this lab, you will calculate the T1 and T2 of the water and oil components of the oil/water phantom. Use the GE pulse sequence called GRE, which is a gradient spoiled but not RF spoiled gradient echo sequence. Use a small matrix in the phase encode direction for speed, BW=32KHz, and TE=min_full. Collect several images at different values of TR and flip angle, from which you can calculate both T1 and T2. Make sure the prescan settings are the same across scans so that the scaling of the images is the same. For this calculation, you will need to simulate the GRE pulse sequence, and calculate the expected signal as a function of TR, flip angle, T1, and T2. Your estimation of T1 and T2 should be the values that best fit the data. The more you understand about this dependence ahead of time, the easier it will be to choose values of TR and a that provide sensitivity to T1 and T2. The paper by Klaus Sheffler linked on the class website should be helpful. (10 points)