Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2013
Lab 3

For both labs, use the pulse sequence spep_hcp, which is a spiral pulse sequence that is homegrown. Prescribe a single slice axial spin echo sequence. 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.

1. **Spin Echoes and Gradient Echoes (Wed)** For this lab, carefully tape the provided piece of pyrolytic carbon (diamagnetic) on the surface of the pink oil phantom so that the carbon is in the imaging plane. In this pulse sequence the TE sets the time between the excitation RF pulse and the collection of the center of K-space (the gradient echo). In spin echo mode, the CV tau sets the offset in time between the spin echo and the gradient echo. Positive tau moves the spin echo to the left of the gradient echo, and negative tau does the opposite. Collect a series of images that will allow you to calculate maps of T2, T2* and T2' (8 points).
2. **Generate an interferogram (Fri)** For this lab, use the pink oil phantom in the 8 channel coil. 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. 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 the FID, 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. (3 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). (3 points)
    d. Calculate the expected profile across the stripes and compare with the acquired profile. (3 points)