

Bioengineering 278: Magnetic Resonance Imaging Laboratory

Winter 2010

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, we will generate an interferogram between a spin echo and an FID (gradient echo) generated by the refocusing pulse. We will visualize the interference by applying a shim offset in the X direction. The shim offset should perturb the phase of the gradient echo 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. Place the BIRN phantom in the birdcage coil. Use the pulse sequence spep, which is a spiral pulse sequence that is homegrown. Prescribe a single slice axial spin echo sequence using default flip angles (90-180), and verify that you get an image. This is the reference image.
 - a. Calculate what combination of flip angles (rf1 and rf2) will generate a spin echo and a gradient echo of equal amplitude (neglecting T1 decay, and assuming that crushers around rf2 don't exist). The solution may not be unique. (3 points)
 - b. Adjust ia_rf1 and ia_rf2 to achieve these flip angles, and scan. The default crushers 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 crusher gradients by setting CV:zcrush->-2. Verify using the oscilloscope that the FID from rf2 will not be crushed. Scan, and compare your results with the predicted values. In this pulse sequence, rf2 is phase shifted to satisfy the CPMG condition. Pay attention to signal phases in your calculation of the expected signal. (3 points)
 - d. Change the value of the X shim, and rescan until your image has stripes. Plot a profile of your image across the stripes and compare with the expected profile. (3 points)
 - e. From the stripes, calculate the gain of the manual X shim adjustment (in G/cm per unit shim offset). (3 points)
2. **Resonance offset sensitivity in FIESTA (balanced SSFP, FISP).** Place the BIRN phantom in the birdcage coil. Scan the phantom using a single axial slice. Using the FIESTA sequence, determine the gain of the manual X shim adjustment (in G/cm per unit shim offset), and compare with the same measurement from part 1. (5 points)