Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2013
Lab 4

Use the silicone oil (pink) phantom in the birdcage head coil.
For all scans: Stock GE sequences, single axial slice, FOV=24cm x 5mm, xres=yres=128, rhexecctrl=11

EPI. In this lab, you will observe Nyquist ghosts and resonance offset effects in EPI. Prescribe a spin echo EPI sequence and parameters: BW=62.5KHz, TE=min_full, TR=1s. Under the 'Advanced' tab, set ramp_samp to 0. Autoprescan and then scan under the following conditions:

1. Default
2. X shim misset by 20 units
3. Y shim misset by 20 units

Carefully measure the echo spacing using the oscilloscope. You will need this number. In the resulting raw data the even numbered lines have already been reversed. Reconstruct the image by 2D FT. Unless you are super lucky, there should be Nyquist ghosts resulting from phase inconsistency between even and odd lines. Assume the odd lines are perfect, and that the even lines can be corrected using a time shift of A microseconds, and an additional constant phase offset of B radians that is the same for all even lines. Find and report A and B by guess-and-check, and reconstruct a ghost free image from data set 1 (**5 points**). Reconstruct data sets 2 and 3 assuming the same values of A and B, and calculate from the distortions in these images the gain of the X and Y shim systems. (**3 points**).

Balanced SSFP. Derive or look up the dependence of the balanced SSFP signal on the ratio T2/T1. Assume TR<<T1,T2. Acquire balanced SSFP (FIESTA in GE-speak) images with a range of flip angles that will allow you to calculate the ratio T2/T1. Calculate T2/T1 (a single number is sufficient, you do not need to make a T2/T1 image) (**5 points**). Measure the T1 of the phantom using any pulse sequence you like. Multiply T1 by T2/T1 to obtain T2. Does this match your T2 from Lab 3? (**2 points**) Apply a shim offset in the X direction, and calculate from the resulting image the gain of the shim system. (**3 points**)

Single Shot Fast Spin Echo. Prescribe an SS-FSE sequence with TE=240. Set CV: overscan=64. This scan will fill all of 128x128 k-space in a long train of 128 echoes. Carefully measure the echo spacing using the oscilloscope. Acquire a single image. From the T2 you measured in Lab 3 for this phantom, simulate the blurring that should occur in the phase encode direction with this sequence at the edges of a rectangular phantom. Compare this simulated blurring with that observed at the edge of the phantom in your image. (**2 points**)