Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2014
Lab 4

1. EPI. In this lab, you will observe Nyquist ghosts and resonance offset effects in EPI. Prescribe a spin echo EPI sequence and parameters: FOV=24cm x 5mm, matrix 64x64, BW=62.5KHz, TE=min_full, TR=1s, rhexecctrl=11. 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 using the oscilloscope the timing parameters you will need to do the calculations below. 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. (**5 points**).

2. Balanced SSFP. An approximate expression for the balanced SSFP signal on resonance is:

$$M_{xy} = \frac{M_0 \sin(\alpha)}{[1 + \cos(\alpha) + (1 - \cos(\alpha))(T_1/T_2)]}$$

Acquire balanced SSFP (FIESTA in GE-speak) images of the water/oil phantom with a range of flip angles that will allow you to calculate the ratio T_2/T_1. Calculate T_2/T_1 for water and oil (**5 points**). Does this match your T_1 and T_2 values from Lab 3? Apply a shim offset in the X direction, and calculate from the resulting image the gain of the X shim system. (**5 points**)