Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2013
Lab 2

1. **The basic spin echo imaging sequence (Wednesday)**
   Place a large phantom in a birdcage coil and position in scanner. Scan the phantom using a spin echo pulse sequence with xres=256, yres=128, rhexecctrl=11 to save raw data, and bandwidth 16KHz. Record the values of CVs: a_gxw, pw_gxw, pw_gxwa, and pw_gxwd. These are the amplitude and pulse widths of the frequency encoding gradient pulse, with the a and d suffixes denoting the attack and decay of the trapezoidal gradient. a_g* is in G/cm, and pw_* is in μs. In addition, record the values of: a_gx1, pw_gx1, pw_gx1a, and pw_gx1d, which is a gradient pulse that precedes the frequency encoding pulse. Repeat the scan with the value of a_gx1 reduced to 90%, 50%, and 10% of the original value. Generate images of the magnitude of the raw data before FT for all four data sets. Generate images of both the magnitude and phase of the images after FT.
   i. Why are the phases of the images different? Write a mathematical expression that describes the phase slope (in cm^{-1}) of the images in the frequency encode direction as a function of the area of gx1 (time integral of the trapezoidal gradient pulse in G/cm-s). Plot your function, and indicate the four collected data points (images) on the plot. What does the slope of this plot represent? Does your data match your expression? (7 points)
2. **Chemical Shift (Friday)**
   Find the difference in γ between water and oil using MR imaging. Place a phantom containing both oil and water in the scanner. At 3T, the difference in precession frequency between water and oil is a few hundred Hz. You have control over: TE, TR, flip angle, resolution, sampling rate (via bandwidth), and FOV. Choose imaging parameters such that the image contains information from which you can calculate the frequency difference, and from that calculate the difference in γ. (6 points).
3. **Phase Encoding (Friday)**
   Place a live human in the scanner.
   Set up a body coil scan with a landmark on the abdomen.
   Acquire an axial gradient echo image of the abdomen.
   Adjust TR and the choice of frequency encoding direction and rescan until you have a single image from which you can calculate the subject's heart rate. You may have to repeat the scan to get clean data. It may help to ask the subject to hold his/her breath for the duration of the scan. It will help to have a subject with a steady heart beat.
   Calculate the subject's heart rate from the image. (7 points)