# Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2012
Lab 5

**EPI.** In this lab, you will observe and correct the effects of time shifts and resonance offset in EPI. Place a phantom in the birdcage head coil and insert into scanner. Use the UCSD generated pulse sequence called spepgj, which supports both EPI and spiral image acquisition. Prescribe a single axial slice with 64x64 resolution, spin echo, set the frequency encode direction to R/L, and set CVs: gtype=1 (EPI); skipline=0; reps=1, daqdeloff=-4; dda=0. Record the value of the CVs: skip (the number of data points collected on ramps between each flat) and tsp (the sampling time in μs). The timing of the readout gradients is shown below in units of the sampling time tsp. Autoprescan and then scan under the following four conditions:

1. Default
2. X shim misset by 20 units
3. Y shim misset by 20 units
4. Frequency misset by 100Hz

In this pulse sequence, EPI data is collected using a single readout that covers all 64 echoes, in raw time order, and includes data collected on the ramps that should be discarded.

1) **Correction of Nyquist Ghosts.** Reconstruct the image from data set 1 by arranging the data in 2D K-space and applying a 2D FT. The resulting image should have significant Nyquist ghosts. The Nyquist ghosts can be improved by assuming that the data is time shifted. Determine the time shift $T_s$ (at a resolution that is much finer than tsp) that minimizes the Nyquist ghost, report $T_s$ in microseconds, and reconstruct a corrected image. (**5 points**).
2) **Off resonance effects in EPI.** Correct for $T_s$ in data sets 2-4 (the value of $T_s$ should be the same as part 1) and reconstruct the images. They should all be distorted or shifted. For each data set, correct the data for the shim or frequency offset and reconstruct corrected images. Compare your corrected images with the corrected image from part 1 by image subtraction. They should overlap accurately. For data sets 2 and 3, calculate the gain of the X and Y shim systems (in G/cm per unit shim offset) (**5 points per data set**)