Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2010
Lab 6

1. **Phase contrast pulse sequence.** Place a phantom in the scanner and prescribe a single slice axial vascular phase contrast scan with velocity encoding in the S/I direction and a VENC of 20cm/s. While the scan is in progress, observe the gradient waveforms on the oscilloscope, and you should see that two different waveforms are used on the slice select axis, and that the two have different flow moments. Sketch the two waveforms, and record the timing and amplitude parameters for each. For an amplitude reference, the amplitude of the slice select gradient that is on during the RF excitation pulse is the CV a_gzrf1 with units in G/cm. This should give you a conversion factor from Volts on the oscilloscope to G/cm.
    a. From the recorded waveform data, calculate the first moment from the center of the RF pulse to the center of the echo for both of the waveforms, and compare with that expected from the prescribed VENC. (8pts)
2. **Phase Contrast and Time of Flight in a human.** In this exercise you will use PC and TOF methods to measure blood flow into and out of the head. Place a human in the scanner with the birdcage coil and acquire a localizer scan.
    a. **Phase contrast MRA in the neck.** Collect an axial 2D phase contrast image at the inferior edge of the cerebellum with 5mm slice thickness, 256x256 matrix, minimal FOV to encompass the anatomy, S/I encoding with VENC=50cm/s, and NEX=4. Save the raw data. Check the image for wraparound in the velocity (ie |V|>VENC). Increase VENC if necessary. Reconstruct the complex images, and calculate the total blood flow into the head (in ml/s), and the total blood flow out of the head. Compare the inflow and outflow to each other, and to a rough literature value for total brain blood flow. (6 pts)
    b. **Time of Flight MRA.** Acquire a 3D TOF image of the carotid arteries. Use 32 partitions (slices), 256x256 matrix, and a slice thickness of 1mm. Use a TR of 18-30ms and adjust the flip angle so that the vessels of interest fade from bright to dark across the thickness of the slab. Measure the decay of the vessel signal as a function of distance into the slab, and from this decay curve estimate the velocity of flow. You might get some clues from the matlab code that was used to generate the TOF signal curves from the lecture: http://cfmriweb.ucsd.edu/ecwong/tof.m. Compare your estimated velocity at the center of the carotid to that from your phase contrast image. (6pts)