Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2009
Lab 6 - Week of 2/9

1. **Phase Contrast and Time of Flight in a rotating phantom.** In this exercise you will be using a rotating phantom to provide a sample with a range of consistent velocities. We have a cool new rotating phantom with a motor that Ron made to help us test velocity selective inversion pulses. Tim will set up the phantom. You can use the higher SNR 8 channel coil because we will let the scanner do the recon this week.
    - **a. Use phase contrast MRA to measure the angular velocity of the rotating phantom.** Prescribe a 2D phase contrast MRA with an appropriate plane and velocity encoding direction(s) to measure the rotational velocity in the phantom. The velocity encoding is described by a VENC (Velocity ENCoding), which is defined as the velocity that results in a phase shift of π. You can convert this easily into a flow moment. Experiment with the VENC until you have a scan with no phase wrap. From the resulting phase images, calculate the angular velocity of the phantom, and compare with the angular velocity measured using a stopwatch and direct observation of the phantom with your eyes.
    - **b. Use TOF MRA to measure the angular velocity of the rotating phantom.** Use a 3D TOF MRA (which is nothing more than an SPGR scan) to determine the angular velocity of the phantom and compare with part a.
2. **Phase Contrast and Time of Flight in a human.** In this exercise you will use PC and TOF methods to estimate the total blood flow into and out of the head.
    - a. **Phase contrast MRA in the neck.** Place a human in the scanner. Collect axial localizer scans below the brain and look for a slice where all the major vessels going in and out of the head are clear and appear to be flowing straight north/south. Collect a 2D phase contrast image in this plane at 5mm slice thickness, 256x256 matrix, minimal FOV to encompass the anatomy, Z only encoding with VENC=50cm/s, and NEX=1. Check the image for wraparound in the velocity (ie $|V|>$VENC). Increase VENC if necessary, and recollect with more NEX if the image looks noisy. Calculate from the image 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.
    - **b. Time of Flight MRA.** Acquire a 3D TOF image of the carotid arteries and jugular veins. Use 64 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. You may need to collect different scans for carotids and jugulars, as the flow velocities are different. 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 velocities to those from your phase contrast image.