Bioengineering 208: Magnetic Resonance Imaging Laboratory
Winter 2007
Lab 9- Week of 2/19

1. **Construct a quadrature transmit/receive surface coil**. In this exercise you will build and test a quadrature transmit/receive surface coil. The goal is to achieve maximum SNR in the carpal tunnel of the wrist.
    a. Guess at a geometry that will provide high SNR in the wrist, at a depth of approximately 2cm. The coil will consist of a single loop in the center, and a figure 8 mounted concentrically with the loop.
    b. Build a form to hold the coils, and attach the conductors to the form by drilling holes in the form and using zip ties to secure the conductors.
    c. Install one tuning and one matching capacitor on the single loop coil, and install a coaxial cable in series with the matching capacitor.
    d. Tune and match the coil to 127.75MHz using the network analyzer set to observe the reflected signal (S11), optimizing for correct frequency tuning and minimum reflected power.
    e. Add tuning and matching capacitors to the figure 8 coil, and observe the coupling between the loop and figure 8 coils using the transmission setting (S21) of the network analyzer.
    f. Manually tweak the figure 8 coil to minimize the coupling at the Larmour frequency, and then tune and match the figure 8 using the reflected signal.
    g. Iterate back and forth between coils until both are tuned and matched and coupling is minimal.
    h. Measure the unloaded and loaded Q of the coil using the following formula: Q=(larmour frequency)/(bandwidth at 3db down points)
    i. Package up the coil so that you can scan with it without moving the components around.
2. **Scan using your new coil**. For scanning, we will use the dual lead connector from the birdcage head coil, and tell the system we are using the standard head coil. **IMPORTANT**: you will need to add 20-30db of attenuation in front of the RF amp in order to avoid applying too much power to the coil during transmit. You also need to remember to remove the attenuator after the lab, or people will get very mad at you.
    a. **Phantom scans**. Connect the two coils to the head coil connector in random order. You have a 50/50 chance of having a quadrature coil, and a 50/50 chance of having an anti-quadrature coil. In one case you should have efficient pulses and sensitivity above the center of the coil, and in the other case you should have near zero signal at the center of the coil. Place a phantom in the coil. Prescribe a localizer scan with one slice per orientation. Enter manual prescan and cross your fingers. If nothing blows up, adjust the prescan parameters and note your TG/R1/R2. Hit the scan button and continue to cross your fingers. Swap the cables and repeat the prescan and scan. Note your new TG/R1/R2. Can you figure out which configuration is quadrature and which is anti-quadrature? Using the

quadrature configuration, collect an axial gradient echo scan with TR=1000ms and flip angle = 45°. Repeat for a flip angle of 90°. From these data, calculate a flip angle map for your coil. Repeat the two scans in the anti-quadrature configuration with the same TG setting, and calculate a flip angle map for your coil in the anti-quadrature configuration.

b. **Wrist scan**. Place a human in the scanner with his/her wrist in your coil. Collect axial gradient echo images through the carpal tunnel, adjusting TR/TE/flip/resolution/FOV/etc to obtain the best images of the carpal tunnel within the time frame that your subject can tolerate. Save the images and use them for wallpaper on your laptop.