Bioengineering 278: Magnetic Resonance Imaging Laboratory
Winter 2010
Lab 7

1. **Construct a single loop transmit/receive coil**. In this exercise you will build and characterize a transmit/receive surface coil.
    a. Wrap a single turn of heavy wire or copper tubing around an empty water bottle.
    b. Install one tuning and one matching capacitor on the single loop coil, and install a coaxial cable in series with the matching capacitor.
    c. 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.
    d. Measure the unloaded Q of the coil using the following formula: Q=(Larmor frequency)/(bandwidth at 3db down points). Fill the bottle with saline. Tap water and table salt will work. Measure the loaded Q of the coil. Calculate the relative noise power that will come from the coil and the sample. (4 points)
    e. 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. Connect one lead to your coil, and the other to a high power terminator. **IMPORTANT**: you will need to add 20db of attenuation on the input side 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. B1 mapping. Place the bottle in the scanner with the axis perpendicular to the main field. Acquire axial image(s) through the center of the bottle to determine a map of the B1 as a function of distance along the axis and radius of the bottle. Remember that both the transmit field and the receive field depend on the local B1. Set the transmit gain carefully (and manually) for your image(s) so that you can unambiguously calculate a B1 map. (5 points)
    b. Turn the bottle so that it is coaxial with the scanner, and repeat part 2a, using a sagittal slice along the midline of the bottle. (5 points)
    c. Calculate the theoretical B1 field using the Biot-Savart law. The course website has links to matlab code that calculates the field of a loop of current. Overlay the appropriate component of the calculated field on the measured B1, and discuss possible sources for any discrepancies. (3 points)
    d. Repeat the above for the B1 map from part 2b. (3 points)