Bioengineering 208: Magnetic Resonance Imaging Laboratory
Winter 2008
Lab 8- Week of 2/25

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=(larmour 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. (2 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 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. 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 the B1 along the axis of the bottle/coil. Remember that both the transmit field and the receive field depend on the local B1. Discuss your choice of:
        i. Nominal flip angle(s) (2 points)
        ii. TR(s) (2 points)
        iii. Number of images (2 points)
    b. Compare your B1 map with the textbook field of a loop, calculated using the Biot-Savart law.
        i. Make an on-axis plot of your calculated field, and overlay the Biot-Savart Calculated field on the same plot. (2 points)
        ii. Discuss the likely sources of differences between the above plots. (4 points)
3. **Coupled Coils**. Install a second coil around the bottle, displaced from the first by about one radius. Install a tuning capacitor in the second coil, but no coupling capacitor. Observe the response of your coil on the network analyzer. There should be two resonances.
    a. Tune the lower resonance to the Larmour frequency and collect an image, again in a slice along the axis of the bottle.
    b. Tune the higher resonance to the Larmour frequency and scan again.
    c. Plot the on-axis response for 3a and 3b. (2 points)
    d. Describe the relationship between the currents in the two loops for 3a and 3b. (4 points)