Bioengineering 208: Magnetic Resonance Imaging Laboratory
Winter 2008
Lab 6 - Week of 2/11

For these labs you will use the 8 channel head coil. This coil is composed of 8 loop coils, each one encircling one of the elongated holes in the coil. Data from each coil is digitized independently, and data from all 8 coils are stored in a single raw data file, with the coils being the outer most loop (ie, data from the 8 coils are not interleaved, but stored in 8 sequential blocks).

1. **PILS**. For this exercise, get two small (roughly ping pong ball sized) phantoms. Arrange the 2 phantoms to optimize the effectiveness of the PILS method. The two phantoms must be centered at least FOV/2 apart in the phase encode direction. Using a conventional 2D spin echo sequence, collect full k-space data in a single axial slice.
    a. **Full k-space reconstruction**. Reconstruct the data from each coil as a separate image, and combine them using RMS combination of each pixel. (2 points)
    b. **PILS reconstruction**. Reconstruct the data from each coil, replacing every other line in k-space with zeros. From the aliased images, generate a single un-aliased image using PILS. Include a discussion of how you chose the locations for the phantoms. (6 points)
2. **SENSE.** The scanner has a built in option called ASSET. ASSET is essentially (R=2) SENSE. As such, it requires a calibration scan to estimate the coil sensitivity patterns, which is referred to as an ASSET calibration scan. Using the BIRN phantom in the 8 channel coil, use a 2D sequence that supports the ASSET option (spin echo or FSE), prescribe a single axial slice, and acquire an ASSET calibration scan over a 32cm FOV.
    a. **Mapping of g factor.** Collect a 256x256 image with ASSET enabled, using an FOV of 22cm, centered on the phantom, a TR of 300ms, and a slice thickness of 1 mm. For every pixel in the reconstructed image, calculate the STD over a 5x5 pixel area as an estimate of the local noise level. In this STD image, you should notice at least 2 distinct areas. Label the two areas and describe the difference in the coil sensitivity matrix between these 2 areas. You don't need to measure the matrix, just describe in words what the key difference is, and why the areas are shaped as they are. (6 points)
    b. **EPI distortion.** Prescribe a single shot EPI scan at 128x128 resolution. Scan with and without the ASSET option turned on. Use the distortions of the images to calculate the resonance offset at one point on the edge of the phantom. Show your calculation. Hint: you will need to record some timing parameters using the oscilloscope to get the units right. (6 points)