EE369C: Assignment 5

Due Nov 8

The problems this week will be concerned with a simple 2DFT SENSE reconstruction. The SENSE data is a simulated resolution phantom, so that the sensitivies are known exactly. The data is in

`http://ee369c.stanford.edu/mr_data/sense_2dft.mat`

This simulates a 24 cm FOV acquisition, with 24 cm circular diameter coils directly above and below the object. The acquisitions is an axial slice, so the coils are aligned with the y axis.

1. g-Factor The most important characteristic of a SENSE acquisition is the geometry factor g. This tells you how well conditioned the reconstruction problem will be. The two sensitivity maps are stored in `S1` and `S1`. Assume that the noise covariance matrix is $\sigma^2 I$, meaning that the noise is uncorrelated between coils, and is of equal intensity.

a) Make an image of the g-factor if the the phase encode is along the y axis. Show the image with the range of g-factors limited to 1 (the minimum possible) to 4. Plot a cross section along the y axis. Where is the largest g-factor? What is it?

b) Repeat the calculation for phase encoding along the x axis. Show the image, and plot a cross section along the x axis. Again, limit the g-factor image to a range of 1 to 4.

c) For the second case, the g-factor is large in specific places. What is it about the coil sensitivities there that cause this to happen?

2. 2DFT SENSE Reconstruction Two acceleration factor 2 aliased images are in the matlab variables `im1a` and `im2a`. Write an mfile that performs the SENSE decomposition. Show the resulting image.

3. SENSE and Averaging One of the tradeoffs with SENSE is that it reduces SNR in exchange for speed. Occasionally, the SNR will be too low, and the operator will decide to average multiple SENSE acquisitions to get the SNR back.

a) Assume that the acquisitions has been accelerated by a factor R, and then averaged R times. In this amount of time, we could have simply acquired a fully encoded data set. Find an expression for the ratio of the SNR's of the two alternatives.

b) When would acceleration and averaging be a reasonable thing to do?