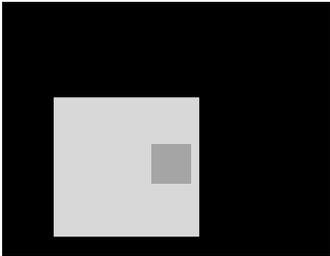


Final Project – MIR 2010

- 1) [15 point] Run the following Matlab code:

```
A= hilb(100);  
x= [1:100]';  
b= A*x;
```

 - a) Compute the condition number of A matrix.
 - b) Using two different methods, given A and b, solve for x.
 - c) Provide your opinion about which method should be used to solve this problem.

 - 2) [25 points] It is desired to implement an analytical phantom that has the shape below (image size=128x128, inner square sizes: 32 and 8, inner square intensities: 200 and 100 respectively, assume any missing geometrical distances)
 - a) Write a Matlab program to do that.
 - b) Test your phantom using k-space sampling on a uniform grid.
 - c) Generate radial k-space samples of your phantom using 64 radial lines.
 - d) Using the radial samples from c) compute the image using gridding.
 - e) Using the uniform samples from b) compute the image using gridding (gridding does not require the samples to be nonuniform).
- 
- 3) [5 points] In your opinion, would it be possible to combine partial Fourier methods with compressed sensing to make the sampling reduction higher? Give specific but brief justifications to your answers.

 - 4) [20 Points] Generate simulated magnetic resonance images with the following artifacts:
 - a) Translational intra-slice motion distortion
 - b) Rotational intra-slice motion distortion
 - c) Combined intra-slice translational and rotational motion distortion
 - d) Translational inter-slice motion distortion
 - e) Rotational inter-slice motion distortion
 - f) Combined inter-slice translational and rotational motion distortion
 - g) Combination of c) and f) above.

 - 5) [10 points] Use the data set on the class web site to implement two methods of partial Fourier reconstruction (you can consider the one you already did in your homework as one of them). The data set provided is for full k-space for you to have a gold standard to your reconstruction. You should use only part of it as an input to your reconstruction (say half + 16 lines).

 - 6) [20 points] Use one of data sets available on the class web site to reconstruct an ultrasound image using the following parameters:
 - a) Linear array reconstruction with aperture size=32 (i.e., you scan with elements 1:32 and form 1 line then shift by 1 element and get another line from elements 2:33, and so on using only focusing with no steering)
 - b) Assume linear array transmission (i.e., you send by the same elements used for reception and shift the same way) with no transmission focusing.
 - c) Assume static focus at 5 cm.
 - d) Use any data set of your preference.
 - e) Assume any missing imaging parameters outside those given in the data set description or above.

 - 7) [10 points] Provide a summary of the steps used in doing compressed sensing in MRI applications and how they can be implemented in Matlab.

Best of luck!