MATLAB exercise

The data files `slice6_116.mat` and `slice6_1732.mat` contain actual raw complex k-space data for one 1.5 mm thick slice (out of total of 35 slices) of an object imaged with the MRI machine at Aalto AMI Center in September 2016. The imaging parameters (not of much importance in this exercise) can be found in the file `parameters.pdf`. The data files contain 32 (16 per data file) individual 1024×522 k-space data matrices, each obtained from a different receiver coil (for those interested, such arrangements are described in Chapter 27 of the main course book). Each of these k-space data matrices can be used to reconstruct an imperfect and partial MRI image. Your task is to

1. As described in Chapters 9, 10 and 11, reconstruct the 32 images corresponding to each receiver coil via discrete two-dimensional Fourier transform. Hint: Recall the MATLAB functions `fftshift` and `ifftshift` to position the image correctly.

2. You should now have 32 reconstructed partial images of the object. To produce the final complete image, try combining the coil images by (i) averaging and (ii) the sum of squares (SoS) reconstruction. Let $Z_{x,y}^{\mathrm{coil}(i)}$ stand for the pixel value at (x, y) of the ith coil image. In the SoS reconstruction, these values are combined as

$$Z_{x,y}^{\mathrm{SoS}} = \sqrt{\sum_{i=1}^{32} \left(Z_{x,y}^{\mathrm{coil}(i)}\right)^2}.$$

3. Compute the signal-to-noise ratio in the final SoS-reconstructed image.

Write a short report where you explain how image reconstruction is done and describe your signal-to-noise ratio calculations. Include some of the reconstructed 32 partial coil images as well as the final images obtained by averaging and the SoS. Also include separate MATLAB file(s). The report is to be returned by **April 16** on MyCourses (Assignments section).

If you have any questions, contact Toni Karvonen (`toni.karvonen@aalto.fi`).