Department of Electrical and Computer Engineering
The Johns Hopkins University
525.628 Compressive Sensing and Sparse Recovery – Spring 2022

Module 6 - Homework Assignment

Computer Assignment: Real Image Recovery

This exercise confirms the feasibility of compressed sensing on real signals, particularly images, where the sparsity level S is unknown and there might be noise in the collected measurements.

The sensing scheme under consideration are: Random Gaussian and Random Subsampling (directly in the pixel domain) as we have described in previous assignments. You will find the following three images: Phantom (synthetic), Brain (real) and Boat (real). The sparsifying matrix can be set to be the DCT. You might consider a patch-based sparse recovery implementation scheme, rather than a global image recovery. For example, consider the recovery of small local image patches, say of size 8×8 or 16×16 or 32×32 . Compute the distortion based on the peak signal-to-noise ratio, often abbreviated PSNR, defined as follows

$$PSNR = 10 \log_{10} \frac{MAX^2}{MSE} \quad \text{where} \quad MSE = \frac{1}{N^2} ||\hat{\mathbf{x}} - \mathbf{x}||_2^2.$$

For our three test images, $MAX = 255$ (the maximum dynamic range) and N is the image dimension. Plot the PSNR between the recovered images and the original with respect to various numbers of measurements M.

What are your observations on how to obtain the best recovery performance? Which sensing scheme is better? Which sensing scheme do you prefer?