Performance Benchmarking of Stochastic and Deterministic Representation Bases with Compressive Sensing in Computerized Tomography Images

Abstract

Computerized tomography is a procedure that emits X-rays rotating around the body, projecting signals to be processed and converted to images. X-rays radiation in people may cause cardiovascular diseases, malformations in prenatal babies, and increasing the development of cancer cells. The tomography device has coded-aperture to block some X-rays and it uses recovery computational techniques to getting a tomographic image from less radiation. One useful technique for such reconstruction is compressive sensing, which can recovery images from sparse signals. Usually, the sparsity of the images is obtained through transforming it into some basis matrix. This work compares from computational models the performance of two representation bases: one deterministic and one stochastic. The tomography images dataset was represented in every one of the bases and compressive sensing was applied to decreasing the information contained in each image. Then we apply the GPSR algorithm to reconstruction. Results showed that: both representation bases combined with compressive sensing reduce the samples number of the image available for its reconstruction without significantly affecting its quality. Also, the stochastic base presented a better performance concerning the Peak Signal to Noise Ratio (PSNR), this is 4.815% higher than the deterministic counterpart. On the other hand, it was identified that the image reconstruction is possible from 50 % or higher of the compression, i.e., the minimal samples percentage required for reconstruction is 50 %. We conclude that the stochastic base outperforms the deterministic equivalent mainly regarding quality image reconstructed while the differences considering the computational time and samples nurmber are not significantly.