Abstract

In this work we attempt to advance x-ray computed tomography (CT) image reconstruction in order to reduce the number of required projection measurements or alternatively reduce the required x-ray beam intensity. We present the concept of increased detector footprint (IDF) in an attempt to improve the CT sensing matrix in terms of its image reconstruction capability for the same number of measurements. IDF proposes to increase the number of pixels that contribute to each CT sinogram element, by a simple hardware upgrade in the CT scanner detectors. We present results that indicate that by introducing IDF we can obtain greater quality images for the same number of sinogram samples. We additionally show that implementing IDF is consistent with the theory of compressed sensing (CS) in that it can result in a reduction of the CS matrix coherence resulting from the CT sensing matrix.

This paper also presents a secondary contribution in response to an algorithmic conflict in using CS total variation (TV) minimization. TV minimization encourages smoothness throughout an image, including on its edge points and this can lead to unnecessary blurring of edges and boundaries. In response we suggest boundary excluded total variation (BE-TV) minimization, where we construct an image in the regular way and use the resulting first pass image to find edges to be excluded from a second reconstruction pass. We show that by using BE-TV image error can be reduced and edges can be sharpened.