

Purpose: To demonstrate the enhancement of contrast to noise ratio (CNR) and dose reduction in dual energy CT when the Prior Image Constrained Compressed Sensing (PICCS) Algorithm is used to reconstruct images.

Methods: CT projection data was acquired over a range of mAs (10-500 mAs) at 80 and 140 kVp. A material density plug phantom and a live canine were scanned to allow for quantitative and qualitative evaluation. Standard filtered back projection (FBP) and PICCS images were reconstructed from the data at a range of mAs levels. The 80-140 kVp images were then decomposed into material density (MD) images. CNR and noise variance measurements were then compared between the FBP and PICCS images. CNR and MD measurements were taken on the density plug phantom for a variety of different plug materials. Noise variance was measured inside the cranium of the canine MD images.

Results: (1) In phantom studies, the difference between FBP and PICCS MD images were within 4.3% (average difference 1.8%) for all ROIs at 500 mAs. However, at this dose level, the average (over all plug materials) CNR improvement factor of PICCS MD images over FBP was 44. (2) In in vivo animal studies, when compared with the FBP images, the noise standard deviation in PICCS images was 32.7 times lower at 30 mAs and 17.7 times lower at 200 mAs. (3) Due to the CNR enhancement in PICCS images, features like blood vessels and epidermis/adipose boundaries were visible on PICCS MD images that were unidentifiable on even the highest mAs FBP MD images.

Conclusions: At a fixed radiation dose level, CNR can be significantly improved when the PICCS algorithm is used to reconstruct dual energy CT images. At a fixed CNR level, PICCS reconstruction enables significantly lower radiation dose in dual energy CT imaging.