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Optimization of Flat Field Correction with a Linear Array Detector for Dual Energy X-ray Absorptiometry

Jai-Woong Yoon[1] Tae-Suk Suh[1], Chan-Sang Yun[2], Jeong-Joon Lee[2], Cha-Hyun Kim[2], Min-Young Jung[2], and Heung-Kyu Lee[2]

[1] Department of Biomedical Engineering, College of Medicine, The Catholic University of Korea, [2] ISOL Technology Co., Ltd

tini75@hanafos.com

Flat field correction factors were optimized for dual energy X-ray absorptiometry (DXA) with a linear array detector. Flat field correction is a general method in an X-ray imaging system using array detectors to remove non-uniformities resulting from a different sensitivity of pixels and X-ray beam intensity distribution. In the case of a fan beam bone densitometer with a linear array detector, a conventional flat field correction technique of applying a single correction factor which was acquired from a uniformly exposed gain image had a limitation of remaining non-uniformities in the image taken from a different energy scan. In this study, two correction factors derived from gain images taken at corresponding X-ray energies were applied for both low and high energy X-ray image acquisition. A 64-channel CdZnTe array detector was used in a counting mode, and detected low and high energy X-ray photons separately while changing energy thresholds. Offsets were subtracted and temperature drift was automatically compensated. X-ray source was operated in a continuous mode at the tube voltage of 86 kVp, and dual energy spectra were generated after a K-edge filtration. Gain correction data were acquired for 5 seconds with uniform attenuation by varying tube currents. Pixel counts were plotted against 64-channel averages by varying various exposure levels, and were linear fitted for the determination of gain correction factors. A spine phantom image after the flat field correction with multiple points demonstrated more uniformity by presenting less line artifacts than the image corrected with one point reference. The channel variation for 64 channels with uniform attenuation was within 0.5 %. Linear fitting method and separate application of correction factors for both low and high energy could improve the image uniformity in fan beam DXA and the precision of correction factors.

Keywords : Flat Field Correction, Linear Array Detector, DXA