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Optimization of Gain Image Acquisition Technique for Low Noise Flat-field Correction with DR Sensors

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Each pixel of DR sensors may have a slightly different sensitivity to radiation or light compared to other pixels. To reduce the spatial non-uniformity x-ray response, we need to calibrate raw image data with offset and gain images. This flat-field correction procedure is crucial in the process of x-ray imaging. The quality of final output image depends on what kind of gain image we choose. Our purpose is to analyze the optimization of exposure for x-ray when we make an acquisition of a gain image for flat-field correction. A linear CCD sensor was used as a detector in our experiment. We selected 21-23 region- of-interests (ROIs) in a step wedge image. Both an average pixel value and a standard deviation were acquired from ROIs. Four parameters (KVp, current, sensor gain, CCD clock frequency) that affect sensor signal were considered. The clock frequency represents the inverse of time for CCD sensor to be exposed to x-ray. The range of kVp, current, gain and clock frequency are from 60 to 90kVp, from 5 to 9 mA, from 2dB to 15dB and from 200 Hz to 800Hz, respectively. During experiments, we analyzed the temperature before and after x-ray exposure to separate the effect of temperature on the measured image. The higher current, the smaller were the relative amplitudes of the random fluctuations, and the less apparent noise, and the higher the SNR. Also, averaging a few gain images could produce better SNR in the output image, which is obvious.

Keywords : Flat-field Correction, SNR, Gain Image