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X-ray characterization of CMOS imaging detector with high resolution for fluoroscopic imaging application

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In recent years, CMOS(Complementary metal oxide semiconductor)-based X-ray imagers have been researched and used for high resolution and real time X-ray imaging application. The CMOS image sensor has many advantages such as the higher readout speed, low noise and high system integration compared to amorphous silicon flat panel detector. Besides the lower noise and higher speed, the smaller pixel size can be able to acquire X-ray image with higher spatial resolution. The drawback of CMOS technology is the limited size and less resistive to X-ray irradiation in comparison with a-Si TFT array X-ray imager. However, the small size limitation of CMOS image sensor can be overcome by tiling the detector into larger mosaics.
In this work, The CMOS detector was fabricated using a 0.35um 1poly/4metal standard CIS process. The CMOS detector has 94x24 pixel array of 100um x100um pixel size. The column-parallel readout architecture was used to reduce the operating speed and the random noise. The 14-bit extended counting ADC was used to reduce the area and simultaneously improve the image resolution. The CMOS detector of different frame rates with 30fps (frame per second) in normal mode and 60fps in binning mode was developed for low dose fluoroscopic application.
For measurement of the X-ray imaging characterization, a thallium-doped CsI(CsI:Tl) scintillator film of 200um thickness was directly deposited on the CMOS photodiode array by thermal evaporation method. The Gd2O2S:Tb scintillation screen with different thickness was also used for comparisons of X-ray image performance. The X-ray imaging performance such as the light response to X-ray exposure dose, signal-to-noise-ratio (SNR) and modulation transfer function (MTF), image lag etc. were measured under practical fluoroscopic systems.

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