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Configuration and X-ray image characterization of a dual-layer based flat panel detector

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In recent years, digital X-ray imaging detectors with indirect detection technology have been widely used in many medical imaging applications such as radiography, fluoroscopy and cone-beam CT. These indirect X-ray imaging detectors are based on the combination of a thin film transistor (TFT) array with different scintillating screens such as typical CsI, GOS materials. Currently, a large area TFT-based X-ray flat panel detector with low dose and high spatial resolution has been widely utilized for dual energy imaging tasks such as material decomposition.
In this work, we have designed and developed a dual-layer integrated a-Si array panel with high-resolution top layer and high-sensitive bottom layer for medical imaging tasks. A prototype image detector consists of TFT array with a 43cm x 43cm active area with 3072x3072 pixel array and 140um pixel pitch. Different high efficient scintillation model such as columnar CsI:Tl and powder type Gd2O2S:Tb(GOS) with various thickness and spectral middle filter were used to investigate the imaging characterization. The used scintillator's configuration parameters were selected and tested for excellent image quality at low X-ray dose condition.
For evaluation and optimization of the dual-layer X-ray detector structure, different scintillating screen materials were directly coupled on the prototype panel photodiode array. The initial imaging performance such as the detector sensitivity to X-ray exposure dose, signal-to-noise-ratio (SNR) and modulation transfer function (MTF) was measured under practical general imaging systems with 60-120kVp voltage and adjustable tube current. The experimental results with a dual-layer based flat panel detector using different scintillators demonstrated its ability to perform accurate dual-energy radiography and fluoroscopy with single –exposure.

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