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X-ray performance evaluation between Timepix based CdTe detector and scintillator film based CMOS flat panel imager

X-ray detections have wide applications in medical imaging, security inspection and scientific research. At present, the realized way of X-rays detector can be typically divided into two types, direct and indirect conversion method. Direct radiation detection based on semiconductors like CdZnTe, a-Se and metal halide perovskites, have experienced rapid development and the demonstration of multiple application including X-ray imaging. Direct detector with a wide linear response range, fast pulse rise time, high-energy resolution, and spatial resolution can be obtained. The indirect detector refers to the conversion of X-rays into visible light through scintillators which can be further captured by an array photodiode (PD). At present, indirect X-ray detectors are widely used in ordinary flat panel X-ray detectors.
In this work, Both detection methods have been used to characterize and evaluate the imaging capabilities of two different imaging systems: a CMOS flat panel with Gadox and CsI:Tl scintillation films and a hybrid semiconductor pixelated detector(Timepix). A micro-focus X-ray source with a tungsten target was used for the measurements. A CMOS flat panel detector is consisted of photodiode array surface with 512(width) x 1,024(height) pixels and 48μm pixel pitch. 24.6x49.2mm2 photodiode array area is connected to camera module and the measured 12-bit image data are transferred to image acquisition software. Timepix3 is a single-photon counting type based readout ASIC chip. This hybrid pixel device (256x256 square pixels, 55mm pitch) developed at CERN consists of a semiconductor sensor layer (2mm CdTe in our sensor) bump-bonded to the readout ASIC. The imaging capability is evaluated in terms of several important characteristics: spatial resolution, relative X-ray sensitivity, signal to noise ratio (SNR) and contrast to noise ratio (CNR). The corresponding X-ray transmission imaging measurements with object phantoms were done under identical conditions in order to assure comparability.

Workshop topics

Sensor materials, device processing & technologies

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