Reverse Geometry Imaging with MV Detector for Improved Image Resolution

**Purpose:** Improved image performance in MV detectors can be achieved using thick pixelated crystalline scintillators that increase x-ray attenuation and restrict the spread of light. Most of the light is generated near the scintillator entrance surface (Fig. 1). This corresponds to the lower energy x-rays that generate lower Swank noise light photons and better image contrast. But these light photons spread across pixels as they traverse the crystal. The opposite is true for higher energy photons. Hence if the x-rays are incident on the photodiode side, light from low energy x-ray absorption suffers less scatter before detection (higher MTF) while higher energy x-ray photons produce similar signal as the lower energy ones (lower Swank noise). Here we present the results of simulation and the demonstration of this phenomenon.

**Methods:** A PaxScan4030 (Varian Medical, CA) flat panel detector with 194µm pixels was modified by moving all the readout electronics and power boards to the periphery. A 2.5Wx5.0Lx2.0H cm³ pixelated cesium iodide (CsI:Tl) scintillator with a scintillator pixel pitch of 784µm with white plastic septa between pixels was used. Images were acquired using a CX1 1MeVx-ray source (Varian Medical, CA) on a table top setup (Fig. 2). Images were acquired at 2frames/s with the source running at 50Hz repetition rate and 2µs pulses. A 0.5mm thick slanted tantalum edge was used for measuring the MTF. Data was acquired with the detector facing forward and reverse with respect to the x-ray beam. The MTF as well as DQE data were simulated using Geant4. The DQE measurements are currently underway.

**Results:** The agreement between the simulated and the measured MTF was within 3.4(±3.7)% in the forward and 4.4(±1.5)% in reverse geometry (Fig 3(a)). On an average the MTF in the reverse geometry was higher by 6.2(±4.5)% and the MTF doubled to 0.25 at 0.3lp/mm. The DQE simulations show an 6.5% increase in DQE(0) and average overall improvement of 12.9±5.2% in the reverse geometry (Fig 3(b)).

**Conclusions:** Reverse geometry imaging is an attractive solution for improving MV detector performance. Improvements should be more pronounced with increasing scintillator thickness.