

AbstractID: 3112 Title: MTF(f), NPS(f) and DQE(f) of an x-ray imaging system based on a photon counting MCP detector

Purpose: To evaluate inherent MTF(f), NPS(f) and DQE(f) of a prototype x-ray imaging system with photon counting microchannel plate (MCP) detector.

Methods and Materials: The MCP detector was used in edge illumination mode as a linear array x-ray detector in scanning slit image acquisition geometry. The detector FOV was 60 mm. MCPs with 63 mm length, 25 μm channel diameter and 5 μm channel wall thickness were used. The slit width was 0.25 mm. Delay line position encoding electronics was used. Images were acquired using an x-ray tube with 0.4 mm nominal focal spot size at 40 and 90 kVp using an SID of 50 cm and a magnification 1.1. MTF was measured using edge spread function method. NPS was calculated using flat field corrected flood images. DQE was calculated from MTF, NPS and using both measured and Monte Carlo calculated QE.

Results: For 25 μm channel MCP, 50% MTF was achieved at 6 lp/mm and 4 lp/mm for 40 and 90 kVp tube voltages, respectively. The highest visualized frequency was 11 lp/mm at 40 kVp. NPS was shown to be frequency independent. QE measured at 90 kVp was 56% and 70% for 25 μm and 5 μm channel MCPs, respectively. Calculated QE was 64%, 86% and 92% for 25, 5 and 2 μm channel MCPs, at 90 kVp. The above QE values represent the DQE(0). The MTF(f) curves normalized by QE represent DQE(f) due to frequency independent nature of the NPS.

Conclusion: MCP detector has shown adequate MTF(f) and DQE(f) for potential application in medical imaging. This is in addition to its inherently high count rate and scatter rejection feature of the scanning slit system. Combination of these capabilities in the photon counting system would allow for significant decrease in patient dose.