

AbstractID: 4545 Title: Development of the X-Ray Detector with Sequential Readout Circuits for Multidetector-Row Computed Tomography

Purpose: To develop a low-cost X-ray detector with sequential readout circuits, to realize enough low noise for multidetector-row computed tomography(MDCT), and to evaluate image quality.

Method and Materials: We have developed an X-ray detector that has a MOS-switch for each pixel, connects many pixels of a common column with the electric readout circuit, and outputs the signals of these pixels from one circuit by turning on lines of switches in order. It has fewer readout circuits than a conventional MDCT detector, but new design is necessary to realize enough low noise for MDCT. First, to make the required noise specific, we simulated the relation of the detector noise and image noise (simulation(A)). Second, to consider how to realize it, we simulated the detector noise with the circuit noise model (simulation(B)). Third, we constructed the detector in order to evaluate its noise. Last, we developed a test CT system with these detectors to evaluate image noise with phantoms.

Results: The result of the simulation(A) indicated that detector noise had to be less than about 10-k rms electrons, and we found to be able to achieve it by optimizing the circuit parameters of the low pass filter and the data line as a result of the simulation(B). We constructed the detectors with these parameters to evaluate these noise, and it turned out that it was about 10.5-k rms electrons and the required noise was achieved. Moreover, the result to evaluate the noise from images with phantoms indicated that the main was X-ray quantum noise and the detector noise was low enough to be ignored when the object was a cylindrical water-filled phantom less than about 30 cm in diameter and the slice thickness of the images was 0.625 mm.

Conclusion: We developed a low-noise X-ray detector with sequential readout circuits for MDCT.