AbstractID: 1340 Title: Preclinical Testing of a Low-Dose Megavoltage Cone Beam CT (CBCT) System

We examine the applicability of a prototype electronic portal imaging device (EPID) to megavoltage cone beam CT in the thorax. The EPID consists of a crystalline CsI scintillator coupled to an amorphous silicon imaging plate and has exceptionally high quantum efficiency at MV energies. An external counter circuit limits the dose to one accelerator beam pulse (0.028 cGy) per image and synchronizes image acquisition with the pulse. The gantry moves continuously during the acquisition.

The projection images are preprocessed to correct for detector sag, accelerator output variation and imperfections in the readout electronics. A Feldkamp backprojection algorithm is used to create 3D reconstructions. Reconstruction requires accurate knowledge of gantry angle for each projection image, and we discuss methods to determine this.

For a 360 degree gantry rotation consisting of 450 projection images (total dose 12.5 cGy) electron density differences as low as 2% can be visualized in phantom. Similarly tumor-like structures in an anthropomorphic thorax phantom with Hounsfield numbers 100 units greater than surrounding `lung' are clearly observable. Automatic registration of the reconstructed thorax phantom scan to a diagnostic (kilovoltage) CT reconstruction is also demonstrated. We discuss the characteristics of the system, including the relationship between reconstruction quality and number of projection images, image artifacts, their causes, and techniques for improving the reconstruction quality.

The system is shown to be practical for clinical use and capable of acquiring 3D images at doses comparable to conventional portal images. This work was supported by NIH grant P01-CA59017 and by Varian Medical Systems.