AbstractID: 11147 Title: Stationary-gantry tomosynthesis system for on-line image guidance in radiation therapy based on a 52-source cold cathode x-ray tube

We present the design and simulation of an imaging system that employs a compact multiple source x-ray tube to produce a tomosynthesis image from a set of projections obtained at a single tube position. The electron sources within the tube are realized using cold cathode carbon nanotube technology. The primary intended application is tomosynthesis-based 3D image guidance during external beam radiation therapy. The tube, which is attached to the gantry of a medical linear accelerator (linac) immediately below the multileaf collimator, operates within the voltage range of 80 to 160 kVp and contains a total of 52 sources that are arranged in a rectilinear array. This configuration allows for the acquisition of tomographic projections from multiple angles without any need to rotate the linac gantry. The x-ray images are captured by the same amorphous silicon flat panel detector employed for portal imaging on contemporary linacs. The field-of-view (FOV) of the system corresponds to that part of the volume that is sampled by rays from all sources. The present tube and detector configuration provides an 8 cm x 8 cm FOV in the plane of the linac isocenter when the 40.96 cm x 40.96 cm imaging detector is placed 40 cm from the isocenter. Since this tomosynthesis application utilizes the extremities of the detector to record image detail relating to structures near the isocenter, simultaneous treatment and imaging is possible for most clinical cases, where the treated target is a small region close to the linac isocenter. The tomosynthesis images are reconstructed using the simultaneous iterative reconstruction technique (SART), which is accelerated using a graphics processing unit (GPU). We present details of the system design as well as simulated performance of the imaging system based on reprojections of patient CT images.

Conflict of interest: Sponsored by Siemens