Purpose: To design and test the feasibility of a novel dual source array, dual detector array TBCT system which is capable of both volumetric CT imaging as well as real-time stereoscopic x-ray imaging for image guided radiotherapy (IGRT).

Methods: Besides producing improved image quality, the geometry of TBCT is also more compact and flexible. It is possible to mount two x-ray source arrays and two detector arrays on a LINAC gantry. Each pair of source/detector arrays generates real-time fluoroscopy images at four different view angles, which can be used in real-time target/marker tracking. FDK and iterative CT image reconstruction algorithms were developed for this new geometry. Stereoscopic imaging was simulated using CT images of prostate patients with implanted radiopaque markers.

Results: Although the cone angles to the central slice of the reconstructed image are nonzero due to the shifting of the detector arrays, reconstructed patient CT images are visually identical to the original fan beam images. Anatomical structures and implanted radiopaque markers are visible in at least two of the radiography images. The 3-D spatial coordinates of the implanted markers can be determined from the stereoscopic images.

Conclusions: TBCT with dual source and dual detector arrays can produce high quality CT images as well as real-time stereoscopic imaging for target tracking. High quality online CT images and stereoscopic imaging in MV beam-eye-view direction can be very useful for advanced treatment techniques.

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