Purpose: The constraints required for patient imaging dose received during image-guided radiotherapy differ from those applied in the diagnostic realm. Wide latitude in applied dose can be justified if it results in useful improvement in image quality. Currently, image acquisition parameters are chosen via broad categorizations in patient anatomy and imaging goal. Herein, we describe the development and early benchmarking of a patient-specific image planning system that is capable of predetermining the optimal acquisition parameters for a given level of patient dose and imaging goal.

Methods: An algorithm was written in Matlab that performed a divergent ray-trace through a 3D CT data set and impinges on a flat imaging receptor. Energy-specific attenuation through each voxel of the CT data set is calculated to derive a net transmitted intensity. The detector response as a function of beam quality and exposure was measured and integrated into the algorithm. It is primarily this feature that distinguishes this from a traditional digitally reconstructed radiograph. Verification data was collected using a flat panel imager mounted onto a linear accelerator gantry and a lung phantom with an embedded nodule. Loss of object detectability was evaluated by measuring the visible diameter of the phantom nodule.

Results: There is qualitative agreement between simulated and measured images in terms of contrast and object detectability. The simulation algorithm predicts both under-exposure and saturation of the detector over a range of beam qualities (80 keV to 120keV) and exposure levels. Object detectability erodes predictably above 60 mAs for at 80keV and above 15mAs for 120 keV for both simulated and measured images. Quantitative accuracy is currently limited by lack of beam heterogeneity, which will be added in further work.

Conclusions: The feasibility and qualitative accuracy of an image planning system has been established.

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No