AbstractID: 7014 Title: Optimizing Low-Dose Megavoltage Fluoroscopy for 4D Radiotherapy

Purpose:
This study explores the feasibility of using megavoltage fluoroscopy (MVF) for on-line real-time verification and guidance for gated/4D treatment delivery. Initial experiences in implementing MVF and methods developed to minimize required dose and optimize the signal-to-noise ratio will be presented.

Methods and Materials:
A Siemens LINAC retrofit with a flat panel imager in the beam direction was used to acquire MVF images with 1024^2 pixel matrix at 7 frames-per-second (fps) using 6 MV photons. Image processing software tools were developed to remove artifacts caused by beam pulsing, dead pixels and stuck bits and to average pixels and video frames. The beam delivery rate was adjusted during MVF acquisition in an attempt to minimize the dose per frame. A phantom designed to test the contrast resolution of kilovoltage fluoroscopy systems was used to assess the MVF image quality at different beam delivery rates.

Results:
Good quality MVF images with sequences longer than a typical respiratory cycle (5 sec) were obtained with an estimated dose as low as 0.6 cGy. Matching the beam pulse frequency to a multiple of the video frame rate minimized striping artifacts. Image sequences acquired at a frame rate of 3.5 fps and beam delivery rate of 12 MU/min had an SNR of 125; the minimum object resolvable during cine display was 0.063 inch in diameter, and the 0.31 inch diameter object was detectable at 2% contrast. Contrast detectability was improved by averaging video frames, reducing spatial resolution and displaying video in high-speed cine mode.

Conclusions:
It is feasible to acquire good quality megavoltage fluoroscopy images using a low dose-rate treatment beam, indicating that MVF can be used to verify or guide gated/4D treatment delivery in real time (e.g. prior or during treatment delivery).

Conflict of Interest:
This work was supported in part by Siemens OCS.