AbstractID: 11225 Title: A 3D system for spatial localization of scanned proton beams: characterization and experimental validation

Purpose: Intensity-modulated proton therapy (IMPT) using scanned proton beamlets relies on the delivery of a large numbers of beamlets to shape the dose distribution in a highly conformal manner. We have developed a 3D system based on liquid scintillator to evaluate the spatial localization, intensity and depth of penetration (energy) of the proton beamlets in near real-time.
Method and Materials: The liquid scintillation (LS) detector system consists of a volume of Liquid Scintillator (20x20x23 cc) in a light tight enclosure connected to a CCD camera. This camera has a field of view of 25.7 cm by 19.3 cm and a pixel size of 0.4 mm. While the LS is irradiated, the camera continuously acquire images of the light distribution produced inside the LS. Irradiations were conducted with proton pencil beams produced with a spot-scanning nozzle. Pencil beams with nominal range in water between 9.5 cm and 17.6 cm were irradiated in a square area 10 cm wide. Image frames where acquired at 50 ms per frame.
Results: The signal to noise ratio of a typical Bragg peak was about 170. Proton range measured from the light distribution produced in the LS was accurate within 0.3 mm on average. The largest deviation seen between the nominal and measured range was 0.6 mm. Lateral position of the measured pencil beam was accurate within 0.4 mm on average. The largest deviation seen between the nominal and measured lateral position was 0.8 mm. However, the accuracy of the measurement of lateral beam position could be improved by correcting light scattering artifacts.
Conclusion: Our LS detector system has been shown to be capable of fast, sub-millimeter spatial localization of proton spots delivered in a 3D volume. This system could be used for quality assurance of IMPT.

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