AbstractID: 8318 Title: Improving image quality of CCD cameras exposed to stray radiation from a linac

Purpose: Charge coupled devices (CCDs) are being increasingly used in radiation therapy. CCD cameras are becoming the tool of choice for applications such as two-dimensional dosimetry of scintillator sheets or to read hundreds of miniature scintillation detectors arranged in arrays. However, CCDs are sensitive to stray radiation. This effect induces transient noise. Radiation-induced noise strongly alters the image and therefore limits its quantitative analysis. The purpose of this work is to characterize the radiation-induced noise and to develop filtration algorithms to restore image quality.

Method and Materials: Two models of CCD cameras (Andor Luca and Apogee U2000) were used for measurements in linac environments. Images were acquired with and without radiation. The structure of the transient noise was first characterized. Then, three methods of noise filtration were compared: median filtering of a time series of identical images, uniform median filtering of single images and an adaptive filter with hard-switching mechanism.

Results: The intensity distribution of noisy pixels was similar in both cameras. However, the spatial distribution of the noise was different: the average noise cluster size was 1.2±0.6 and 3.2±2.7 pixels for the U2000 and the Luca respectively. The median of a time series of image resulted in the best filtration and minimal image distortion. For applications where time series is impractical, an adaptive filter must be used to reduce image distortion. We have implemented a modification to the switch filter in order to handle non-isolated group of noisy pixels.

Conclusion: We have characterized the transient noise produced in CCD cameras by scattered radiation from a linac and have developed an efficient filtration scheme to remove this noise and restore image quality. Use of our filtration scheme allows detailed quantitative analysis of an image even when subjected to scattered radiation.

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