AbstractID: 7303 Title: Improving Soft Tissue Contrast in Megavoltage Cone-Beam CT Images for Adaptive Radiotherapy

Purpose: To investigate image quality improvement in Megavoltage Cone-Beam CT (MV-CBCT) images using image filtering techniques for adaptive radiotherapy (ART) protocols. MV-CBCT imaging is often used for daily patient localization. However, soft tissue contrast in MV-CBCT images is limited and accurate delineation of targets and organs-at-risk is sometimes challenging. Image post-processing with advanced image filtering techniques can improve the quality without the need to increase the dose exposure for the imaging procedure.

Method and Materials: MV-CBCT images of two image-quality phantoms and of patients with prostate cancer were post-processed using noise-reducing, edge-preserving image filters. On the phantom images, the contrast-to-noise ratio and the spatial resolution before and after filtering were evaluated. The improvement in image quality for the prostate patients was qualitatively judged by physicians based on the ability to delineate the prostate, rectum, bladder and seminal-vesicle volumes. The optimal combination of MV-CBCT delivery protocols with different patient doses and filtering techniques was determined for online and offline ART protocols.

Results: Using an edge-preserving noise-reducing curvature flow image filter, the quality of MV-CBCT images was improved. The contrast-to-noise ratio on the phantoms was improved by up to 30%, while maintaining the spatial resolution. Although the raw cone-beam image quality of the prostate patients was sufficient for patient treatment localization, the ability to contour anatomical structures was increased on the post-processed images.

Conclusion: Using advanced filtering tools for MV-CBCT images can improve the image quality, especially soft-tissue contrast. This allows delineation of organs not clearly visible on the raw images. The tools are potentially beneficial for deformable registration of MV-CBCT images with planning CTs, for monitoring the delivered dose to targets and organs-at-risk, and for ART protocols. Finally using protocols with lower exposure, patient dose from daily imaging procedures can be reduced.