AbstractID: 10855 Title: Morphological seed identification and removal of the post-implant prostate brachytherapy patients in cone-beam CT sinogram projections

Purpose: To digitally extract and remove elongated seed features from measured 2D cone-beam CT (CBCT) sinogram projections of the post-implant prostate brachytherapy patients.

Methods and materials: The method identifies the seeds at the projections and removes them by 2D spatial-interpolation. Theragenics Model-200 ^{103}Pd seed images were identified and removed from 2D patient projections by (a) normalizing the image intensity by finding its maximum and minimum values in the image, (b) top-hat-filtering, (c) thresholding using the 3σ-value of the pixel intensity histogram, and (d) labeling to create a binary mask of each seed in each projection. The binary masks were subtracted from the corresponding raw projection. The subtracted images were then interpolated in the seed regions using natural-neighbor interpolation method to recover the missing soft-tissues information's obscured by the implanted seed images. Four Pd^{103} post-implant patients were scanned using an Acuity-digital-simulator with full-660 projections CBCT (in half/full-fan-mode) for post-implant dosimetry. In-house filtered-back projection algorithm was used to reconstruct CBCT images before and after seed removal applications. To quantify this method, we compared the reconstructed CBCT images before and after corrections, image-profiles and a difference image on a single central slice to demonstrate the effects of seeds removal.

Results: For the example cases, the streaking artifact is reduced by a factor of 3.5 and artifact spatial extend. The corrected images exhibit significantly improved image quality in and around the prostate.

Discussion: Our preliminary results indicate that this method can be used to mitigate metal-streaking artifacts specific to the brachytherapy seed implant geometry. By reducing streak and associated noise propagation artifacts, significant clinical value can be added to brachytherapy CBCT imaging. Improving the auto-segmentation method and applying scatter-subtraction corrections will be further study to improve the CBCT image quality for the intra/postoperative brachytherapy patient's images.