AbstractID: 13369 Title: Four-dimensional cone-beam computed tomography and digital tomosynthesis using motion signals extracted from fiducial marker inserted for liver cancer radiation therapy

Purpose: To reconstruct both phase-wise and amplitude-wise sorted 4D digital tomosynthesis (DTS) and 4D cone-beam CT (CBCT) images based on breathing signals extracted from transcutaneously inserted metal markers for liver cancer IGRT.

Methods and Materials: The reconstruction process consists of 4 stages where 1) features of metal marker from selected region of interest (ROI) of its position is extracted, followed by 2) generating breath induced marker motion signal based on its position and predicting the missing signal through ‘‘profiling’’ of pre-acquired breathing signal, 3) undergo amplitude-wise and phase-wise sorting with acquired projection data, and finally 4) reconstruct 4DCBCT and 4DDTS images.

Results: In half-fan geometry, the metal markers may be absent in up to 18.5% of the total X-ray projections taken, which can be successfully replaced by signal ‘‘profiling’’ method that we propose here. With this, 4DDTS and 4DCBCT images were reconstructed. Comparing the reconstruction results between phase-wise and amplitude-wise sorting of 4DDTS and 4DCBCT images, motion artifacts of fiducial marker were less in amplitude-wise than phase-wise reconstructed images due to lesser amount of residual motion at each state of sorting process, thus more ideal for use in 4D image guidance.

Conclusions: We have proposed the use of fiducial markers imaged at CBCT projections to acquire breath induced motion signal of liver to generate 4DDTS as well as 4DCBCT images. To the best of our knowledge, utilizing breath induced motion signal using metal markers for 4D imaging applications has never been attempted. Proposed method is advantageous compared to other methods in ways that 1) it does not require external gating system and 2) amplitude as well as phases-wise sorting is selectively achievable. The proposed method can be utilized as intrafractional target motion verification process to improve precision of on-line image guided radiotherapy for liver cancer patients.