AbstractID: 5146 Title: Developing in-line kV fluoroscopic verification for 4D adaptive radiotherapy

Purpose: To develop a system for on-line real-time treatment verification for 4D-ART using in-line kV fluoroscopy that will be included in a new generation of accelerator.

Method and Materials: We have developed a software tool, as a component of the 4D-ART verification system, to register fluoroscopic with dynamic (time-sequenced) DRR (DDRR) images. The fluoroscopic images are obtained using kV x-rays in-line with the treatment-beam direction. The DDRR images (DRRs at different phases during respiratory cycle) are generated from 4DCT. The image registration of DDRR and fluoroscopy is based on pre-defined structures or points of interest and needs to be performed on-line in real time, allowing the treatment parameters to be modified in real time if a discrepancy is observed. To approve the principle, we have employed a simulator (Siemens/Mevasim) to acquire the fluoroscopic images. Both hardware and software tools were developed to synchronize the acquisition of fluoroscopy with respiratory signal using a pressure sensor (Anzai). This synchronization, in turn, harmonizes fluoroscopic images with DDRR. The verification system was tested on a motion phantom and on lung cancer cases.

Results: The system developed can effectively register respiration-synchronized fluoroscopic and DDRR images for both phantom and patient data. The registration is able to detect discrepancies between planning images (DDRR) and verification images (in-line fluoroscopy) for a 4D-ART delivery. The system is found to be effective for validating respiratory gating.

Conclusion: We have developed a treatment verification system for 4D-ART. The system, employing in-line kV fluoroscopy, may be used for validating respiratory gating and for 4D-ART with the new generation of image-guided delivery machine capable of in-line dynamic imaging. The system can be also potentially useful for 4D real-time tumor tracking based on fluoroscopy.

Conflict of Interest: This work is supported in part by Siemens OCS.