AbstractID: 3765 Title: Treatment Simulation for 4D Image Guided Radiation Therapy

Purpose: To investigate the feasibility of a dynamic treatment simulation system, PortSim[+] for four-dimensional image guided radiation therapy (4DIGRT) and respiratory gated Intensity Modulated Radiation Therapy (RGIMRT).

Method and Materials: PortSim+ is an in-house developed software package that allows for simulation of 4DIGRT and RGIMRT. The software is integrated with our conventional simulator. Prior to simulation, a set of DRRs at different respiration phases along with the corresponding anatomic contours were imported from the treatment planning station. The respiratory rhythm and cycle of the patient is captured using a radio-opaque marker which reflects the circumference change of a binding belt around patient's chest. The marker correlates with the respiratory cycle and can be easily detected. In 4DIGRT simulation, the displayed reference DRR and corresponding MLC is triggered by the respiratory cycle. Similarly for RGIMRT, the MLC overlay is linked to the respiration phase and duty cycle threshold. Once the dynamic MLC characteristics are accounted for, both 4DIGRT and RGIMRT can be simulated prior to delivery in order to ensure that patient is positioned accurately and the treatment is delivered as planned.

Results: PortSim[+] incorporates live acquisition of high quality fluoroscopic images (1024 x 1024), image intensifier distortion correction, breathing phase detection, reference DRRs and MLC display. The software runs on a Pentium IV 2.2 GHz, with 1G RAM computer. Initial results show that the system can successfully detect the breathing cycle and sequence the display and superposition of DRRs and dMLC. The complete simulation can be recorded at a rate of 30 frames per second for later review and analysis.

Conclusion: The initial experience with this system indicates that uncertainties in set-up and delivery of 4DIGRT and RGIMRT treatment can be greatly reduced. The recorded simulation provides information that could influence field design and plan development.