AbstractID: 13440 Title: Dosimetric Interplay Effects for Proton Uniform Scanning Lung Treatments

Purpose: To investigate the dosimetric impact of respiratory motion on proton lung treatments delivered by uniform scanning. **Method:** Uniform scanning is an aperture and compensator based technique in which the pristine energy layers are delivered sequentially ('energy stacking'). Because of high scanning frequency (3Hz) compared to breathing motion, the study ignores lateral effects and focuses on interplay between energy stacking and tissue motion/deformation. This exercise is based on actual lung patient plans that, however, were delivered by simultaneously irradiating the whole SOBP. To simulate the breathing motion the full SOBP dose is recalculated on all 10 4DCT phases. To simulate the energy stacking, the per phase dose distributions are deconvolved into energy layers with appropriate weighting. Based on delivery parameters such as total irradiation time (doserate), time offset, and switching times and patient specific parameters like average breath rate, a series of dose distributions belonging to various breathing phases and energy layers are identified to constitute a treatment. For total dose accumulation deformable registration methods are used to deform all dose maps to a mid-exhale phase. The interplay effect of breathing motion and energy stacking is deduced by comparison of the total dose distributions over multiple breathing cycles for both all-energies and by energy layer deliveries. **Results:** No dramatic discrepancies on beam dose distributions produced by the two methods are observed. For a doserate of 2Gy/min and a respiratory rate of 20bpm the PTV coverage, maximum dose, and lung mean dose differences are within 2, 2.5, and 1.5% of prescribed dose (per beam). Doserate is the sole parameter that significantly influences the interplay effect which becomes insignificant for values below 0.5Gy/min. **Conclusions:** Based on the cases that we applied our uniform scanning evaluation method we conclude that lung treatment can safely be delivered by uniform scanning for low doserates.