AbstractID: 4825 Title: A Biological Model-based 4-D Lung IMRT Plan optimization Algorithm

Purpose: To spare the normal lung we developed a novel lung IMRT plan optimization algorithm that incorporates both biological model and respiratory motion.

Method and Materials: We implemented a novel IMRT optimization algorithm on an in-house IMRT planning system that interfaces with an Eclipse® workstation (Varian, Palo Alto, CA). The IMRT objective function is a combination of the normal lung tissue complication probability (NTCP), the equivalent uniform dose (EUD), and a penalty on tumor dose in-homogeneity. A series of 4-D CT scans were taken at different breath phases and a deformable registration was applied to trace voxel-to-voxel correspondence at each snapshot. The time averaged (4-D) dose was utilized to calculate the NTCP and EUD in the optimization process. The proposed method was compared with the gated IMRT approach, which allowed a residual respiratory motion of 3mm and used a PTV defined as the union of the tumors at different phases within the gating window. The performance of the two approaches was evaluated via comparison of DVH at the exhale phase of the breathing cycle and quantitative parameters such as V_{20}, V_{10}, and the mean lung dose.

Results: Five-field 6MV IMRT beams were setup to deliver a total dose of 63Gy in 35 fractions. Each plan was renormalized such that the prescribed dose covers 95% of the tumor volume. Comparing with the gated IMRT plan, our proposed method resulted in a reduction of 4.3%, 4.4%, 2.2Gy and 11.2%, in terms of V_{10}, V_{20}, the mean dose and NTCP, respectively. Meanwhile, the EUD obtained by our method was 65.6Gy, slightly higher than 64.5Gy obtained by the gated IMRT approach.

Conclusion: Compared with the gated lung IMRT approach, the proposed biological model-based 4-D lung IMRT plan optimization algorithm is able to further spare the healthy lung tissue while maintaining relatively homogeneous tumor coverage.