AbstractID: 4967 Title: A Method for Evaluation of the Dose Prediction and Optimization Convergence Errors

Purpose: IMRT optimization solutions are influenced by the computation algorithms used in the estimation of the radiation field incident upon the patient as well as the dose calculation algorithm. This work describes a technique for evaluating the dose prediction errors (DPEs) and optimization convergence errors (OCEs) due to inaccuracies in the heterogeneity correction of the optimization dose calculation algorithm.

Method and Materials: The heterogeneity-induced DPE and OCE of convolution-based optimization are studied by utilizing a sequential deliverable-based IMRT optimization. Initially, a method (Mx^{Opt}) utilizing a Monte Carlo (MC)-based algorithm to estimate the incident upon a patient fluence (derived from the MLC leaf sequences), coupled to a conventional (convolution) dose calculation algorithm, is used for the optimization. Following the Mx^{Opt} optimization convergence, a second method which utilizes MC for both fluence prediction and dose deposition in a patient is performed. DPEs due to patient heterogeneities and incident fluence prediction are evaluated by re-computing Mx^{Opt} converged solution with a full MC (Mx^{Opt}+MC) method, while OCEs are evaluated by comparing the Mx^{Opt}+MC computed dose with the converged MC^{Opt} optimization result. The technique is evaluated by performing the optimization sequences on two Head-and-Neck IMRT patient plans. Dose-volume indices were evaluated to compare the plans.

Results: For the plans assessed, the GTV D_{98} and CTV D_{95} indices agree within ±2% for both DPE and OCE estimations. The Nodal-CTV D_{90} DPEs and OCEs are within 3%. The DPEs and OCEs in the critical structures (Cord D_{02}, Brainstem D_{02}, and Parotid D_{50}.) are less than 3.5%. When MC^{Opt} follows Mx^{Opt}, only 3-4 iterations were required for convergence.

Conclusion: A technique for evaluation of the DPEs and the OCEs in the deliverable IMRT optimization has been developed. The feasibility of the proposed technique was demonstrated on two Head-and-Neck deliverable IMRT plans. (Supported by NIH-1R01CA98524)