AbstractID: 7573 Title: The Effect Of Set-up Uncertainties, Contour Changes and Tissue Inhomogeneities On Target Dose-Volume Histograms

Introduction: Understanding set-up uncertainty effects on dose-volume histograms (DVHs) is an important clinical problem but difficult to model accurately due to their dependence on tissue inhomogeneities and changes in surface contour (i.e. non-invariant effects).

Purpose: To evaluate and quantify the invariant and non-invariant effects of set-up uncertainties, contour changes and tissue inhomogeneities on target dose-volume histograms.

Materials and Methods: Target DVHs in a lung cancer patient are calculated for 15 displacement errors (with respect to the isocenter) using: 1) an invariant shift of the dose distribution, 2) a full non-invariant calculation using the collapsed cone dose calculation algorithm, and 3) a B-spline interpolation applied to sparsely sampled non-invariant DVHs. To determine set-up uncertainty effects, the weighted mean equivalent uniform dose (EUD) and the root mean square (RMS) deviation are used.

Results: The maximum absolute difference and RMS deviation in the integral DVHs' relative dose between the invariant and non-invariant calculated curves are 65.2% and 5.8% and between the interpolated and non-invariant calculated curves, 16.9% and 2.5%. Similarly, the maximum absolute difference and RMS deviation in mean EUD as a function of the set-up uncertainty's standard deviation between the invariant and non-invariant calculated curves are 0.02 and 0.01 Gy and between the interpolated and non-invariant calculated curves, 0.01 and 0.006 Gy, respectively.

Conclusions: The non-invariant effects of contour changes, tissue inhomogeneities and set-up uncertainties on EUD are clinically negligible for most patients. Interpolation is a valid, efficient method for approximating DVHs.