Title: CT resolution for lung treatment planning: an application of a 2 ½-D random lung model using MC method

Purpose: To investigate the effects of CT resolution on treatment planning where heterogeneities exist, such as in the lung, using a recently developed, realistic random lung model and Monte Carlo method.

Methods: A thoracic phantom with a realistic random lung model embedded was built and two representative realizations with two different sizes of tumors were generated. The MC code DPM was employed to calculate dose distributions in the phantom with different CT resolutions. The three-field conformal setup used a 6MV photon beam. Both qualitative and quantitative dose evaluation metrics were applied.

Results: A reference CT resolution of 1x1 cm^2 was established by comparing the CAX depth doses between a detailed lung model and its voxelized version. The fine details revealed in high resolution can be smoothed, especially when the geometrical voxels cross the heterogeneities, hence introducing a potential systematic error. Visible difference, up to 1%, can be seen in the DVHs of the cases with a small tumor. The insensitive relative absolute differential dose shows the DVH's disadvantage of lack of positional information of the dose distribution.

Conclusion: A realistic random lung model was applied to show the effect of the accuracy of the geometrical representation on dose distribution in heterogonous sites, such as the lung. Our results show that a CT resolution up to 2x2 mm^2 may be sufficient while a 4x4 mm^2 could lead to significant perturbations. This may be especially problematic for treatment planning involving small tumors and tissue heterogeneities.