AbstractID: 8666 Title: Using Probability Density Functions of Respiratory Motion to Model Motion Effects on Dose Distributions and Optimize Treatment Planning for Lung Cancers

Purpose: Respiratory motion is an important factor potentially contributing to excessive normal tissue irradiation in radiotherapy of lung cancers. This study uses the motion probability density function (PDF) to model the motion effects on dose distributions and incorporates this information to optimize treatment planning for lung cancers.

Material and methods: PDFs were calculated from the respiratory motion signals of 10 representative patients. Motion effects were evaluated by convolving static dose distributions with various PDFs. Based on a differential dose prescription with relative lower dose to the clinical target volume (CTV) than to the gross tumor volume (GTV), two strategies were proposed to incorporate PDFs into optimization of treatment planning. The first strategy used the GTV-based-ITV to ensure full dose to the GTV, and utilized the motion induced dose gradient to cover the CTV. The second strategy was to find an intensity-modulated static dose distribution to best match the prescription dose gradient.

Results: Motion effect on dose distributions was minimal in the axial direction. A 10-mm motion amplitude induced a 3% dose reduction in the peripheral zone of the target. The motion effect was remarkable in the cranial-caudal direction. It varied with the motion amplitude, but tended to be similar for various respiratory patterns. We found that the motion-induced gradients resulting from motion with amplitudes of 10-15 mm would adequately cover the CTV (60-70% of the GTV dose). For motions <10 mm, motion-induced gradients were much larger and a planning CTV margin was needed to sufficiently cover the CTV. For motions > 15 mm, an intensity modulated static dose distribution was generated to decrease the dose to the normal tissue beyond the CTV without compromising the GTV coverage.

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Conclusion: The effect of respiratory motion on dose gradients can be utilized to individualize treatment planning and minimize the lung dose.