AbstractID: 1360 Title: Sombrero Dose Distribution for Correction of Tumor Positioning Variability During Fractionated Extracranial Radiotherapy

Purpose

Isolated, 8-20mm, metastatic lesions in the lung and liver are being treated with very high control rates (>90% in lung; >80% in liver) using hypofractionated conformal high-dose stereotactic radiation therapy (HCHDSRT) and breath holding for respiratory motion correction. However, breath-hold reproducibility error leads to physiologic target position variability (PTPV) that, in addition to target registration error (TRE) associated with use of surface fiducials, alters the dose field observed by the target and contributes to the use of enlarged treatment margins causing increased damage to surrounding healthy tissues.

Methods and Materials

Alterations in the tumor-observed dose are modeled in 3D using convolution of the static-target dose field with a Gaussian point spread function representing PTPV+TRE. To create a dose field inherently corrected for PTPV+TRE, the computational method is inverted, via Weiner filtering and deconvolution in the Fourier domain, and applied it to the desired (static) dose field. The result is then presented to simulations of the treatment environment.

Results

For a spherical target; an idealized dose distribution with central plateau, r^{-3} falloff and 0mm margin; and unilateral 4mm PTPV+TRE, the inversion result is a 3D **sombrero**-shaped dose distribution. When convolved with the Gaussian point spread function the output is a dose field that is indistinguishable from the original static field. Moreover, when the sombrero field is subjected to ten pseudo-random target displacements within the static dose field, a PTPV+TRE-corrected dose distribution is achieved that satisfies the dose requirement for complete tumor ablation while minimizing surrounding tissue damage.