AbstractID: 4339 Title: A Delivery Transfer Function (DTF) Analysis of Helical Tomotherapy

Purpose: Explore the delivery resolution (blurring) for any given beamlet for a helical tomotherapy unit. Based on this analysis, then to determine how the optimization procedure can be further improved to account for the source motion blurring inherent to the unique intensity modulation method used. Also, organ motion blurring effects can be evaluated in this context.

Method and Materials: We rely upon and expand previous theoretical work of the "Delivery Transfer Function (DTF)" [K. Otto, *et al*., Med. Phys. **29**, 1823 (2002)] to include the unique intensity modulation method of helical tomotherapy. In addition to the collimation of each beamlet, and the Gaussian convolution spreading of the dose that other radiotherapy units have, helical tomotherapy used small arcs of varying lengths to adjust the intensity. The blurring from these arcs are not taken into account in the current Hi-ART® TomoTherapy device.

Results: Near the isocenter, the transverse (to a given beam direction) blurring is small but at larger radii, the source blurring dominates over leaf size. The longitudinal blurring is dominated by the jaw width, and organ motion blurring less than this width will not be noticed. When a large number of angles are averaged together and with the varying intensities of a real sinogram, the average blurring is very close to the leaf width value >~ 6.5 mm for typical parameters – even well off-axis where source motion blurring will be larger.

Conclusion: The treatment planning which does not include this source motion can be improved by adding a penalty to beamlets that give large blurring at a particular voxel. Organ motion blurring effects may not seem as deleterious in the context. The averaging effects of many beam directions and many leaf intensities reduces the overall transverse blurring to a very low level for typical situations.