AbstractID: 10169 Title: Tomotherapy Dose Painting Delivery Robust to Respiratory Motion

Purpose: The dose painting accuracy with helical tomotherapy in the presence of intra-fraction patient motion is explored. A dose painting plan is delivered to a phantom moving in 3D, and a model that captures the fundamental physics is presented.

Method and Materials: A dose painting experiment is planned and delivered (pitch=0.287, modulation factor = 3.5, beam width = 1cm). It is verified with calibrated Gafchromatic™ EBT film. The plan is based on a 5 level approximation of a PET image from an anonymous patient. The realistic motion is produced with the Washington University 4D Motion Phantom. A 16cm diameter cylindrical lucite phantom, 16cm long, is used for calibration and delivery. The TomoTherapy, Inc. DQA™ software is used to verify the delivery performed on a Hi-ART™ device. The dosimetric uncertainty was simulated with a modulation transfer function for delivery with motion: a 'DTF.' The approach is to consider the analogy that the delivery of the dose painting map is like a 3D image of the PET image which is like the object.

Results: The dose uncertainty in the purposeful absence of motion management and in the absence of large low frequency drifts in the breathing displacement yields very favorable results. Instead of 'interference' effects, because of the averaging of many breathing cycles (and the averaging of many parts of many breathing cycles for the transverse case), the small dose errors observed are actually the result of a time-dependent blurring.

Conclusion: Dose painting with Hi-ART™ Tomotherapy is very practical. Even without motion management and with lots of modulation, significant respiratory motion is not a severe problem if low frequency drifts and randomness are minimized. The physics is best described as a dynamic blurring instead of interference.