AbstractID: 9414 Title: A fast optical CT scanner for gel dosimetry

Purpose: To evaluate the performance of a fast optical CT scanner and discuss methods for improving scanning speed in 3D gel dosimetry.

Method and Materials: The performance of a fast optical laser CT scanner for 3D gel dosimetry (OCTOPUS-10X, MGS Research, Madison, CT) is evaluated. This scanner uses three stepper motors to guide a single laser beam to move in three dimensions relative to the gel to be scanned. Fresnel lenses were used to generate parallel- or fan-beam geometry inside the scanning tank. Non-uniform averaging was applied to the parallel-beam data to compensate for the non-uniform linear speed of the laser beam refracted by the first Fresenel lens. Image reconstruction was done using filtered back-projection functions “iradon” and “ifanbeam” built in Matlab. The geometric accuracy of the scanner in two fast-scanning modes was tested using test objects. Dosimetric accuracy of the scanner in conjunction with BANG polymer gel dosimeter was tested by comparing dose distributions from the gel dosimeters with those from Eclipse treatment planning system and film dosimetry for several static and dynamic treatment plans.

Results: The scanner can acquire a single slice image of 100 pixels x100 pixels from an irradiated gel in 30 seconds. This is about 20 times faster than the previous model of optical CT scanner based on translational-rotational motion. The reconstructed images of test objects show the geometric accuracy of the scanner is at sub-pixel level. The reconstructed dose distributions from the two different scanning modes agree well between themselves and are also in good agreement with the planning system and film dosimetry.

Conclusion: Optical CT scanner based on a single laser beam and rotational motion of 3 stepper motors can reproduce complete 3D dose distributions from regular external beam treatment plans in a matter of half an hour.