AbstractID: 6937 Title: Calibration of an optical laser CT scanner for imaging of dose distributions in polyacrylamide gels

We are developing procedures to calibrate the OCTOPUS-ONE^{TM} research laser-based optical CT scanner developed and manufactured by MGS Research, Inc. (Madison, CT). The scanner is designed for imaging 3D distributions of optical attenuation coefficient distributions in polyacrylamide gels for use in 3D dose-distribution measurements. The scanner operates in a translate-rotate configuration with a single scanning laser beam. The rotating cylindrical gel phantom is immersed in a refractive-index matching solution and positioned at the center of a square tank made of plastic and glass. A stationary polarized He-Ne laser beam (633nm) is reflected from a mirror moving parallel to the tank wall and scans the gel. Another mirror moves synchronously along the opposite side of the tank, collecting the transmitted light and sending it to a single stationary silicon photodetector. Filtered backprojection is used to reconstruct projection data in a plane, and the laser-mirrors-detector platform is moved vertically for slice selection. Preliminary tests have been conducted on the mechanical and optical setup, projection centering on the axis of rotation, linearity, spatial uniformity, noise and spatial resolution. Two different designs of fiducial markers have also been tested. The scanner linearly reconstructs optical densities of control samples, with uniformity within two standard deviations across the entire phantom (17cm diameter). Optical attenuation coefficients are reconstructed with less than 2.3% uncertainty (2σ). A measured point-spread function has a 1.5mm FWHM. The scanner is expected to improve the efficiency and cost of performing 3D dose-distribution measurements using polyacrylamide gels. This work supported in part by MGS.