AbstractID: 11303 Title: Determination of optical properties in a heterogeneous turbid media using a cylindrical diffusing fiber

Purpose: For interstitial photodynamic therapy (PDT), cylindrical diffusing fibers (CDF) are often used to deliver light. This study examines the feasibility and accuracy of using the CDF to characterize the absorption (μ_a) and reduced scattering (μ_s') coefficients of heterogeneous turbid media.

Method and Materials: Measurements were done in prostate simulating phantoms. Liquid and solid phantoms were used (homogeneous and inhomogeneous, with optical properties of μ_s'=7.5cm^{-1} and μ_a=0.1cm^{-1}). The inhomogeneous phantom had three tumor simulating inhomogeneities (μ_s'=15cm^{-1} and μ_a=0.1, 0.3 and 0.9 cm^{-1}). Linear light sources of varying lengths were placed inside the phantom through the catheter. In-air measurements were performed to characterize the intensity profile of each linear fiber. Fluence rate was measured using a 0.5mm scattering tip isotropic detector that was moved along each catheter using a motorized probe. To ensure that the optimization technique was accurate, we measured the optical properties of each phantom using a well established method.

Results: Optical properties were measured in a homogeneous liquid phantom by measuring the fluence rate along a 2mm pint source and compared against results using linear source method. The absorption coefficients were then determined using a method in which μ_s' was kept fixed. Using the determination of μ_s' from the homogeneous fit, we were able to determine the absorption coefficients with a standard (maximum)deviation of 5.6 % (9.8%) while using the fixed μ_s' method, the standard (maximum) deviation were 6.9% (19%).

Conclusion: We showed that it is possible to accurately determine the optical properties inhomogeneities (μ_a) using linear sources to a relative accuracy of better than 10%. Sensitivities for determination of μ_s' is quite poor using linear sources. Linear source method is more sensitive to detector optical heterogeneities. The effect of intensity profile on determination of the absorption coefficient μ_a is relatively small – this is important for forward calculation.