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 ($\mu_a$) and reduced scattering ($\mu_s'$) 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 $\mu_s'=7.5\text{cm}^{-1}$ and $\mu_a=0.1\text{cm}^{-1}$). The inhomogeneous phantom had three tumor simulating inhomogeneities ($\mu_s'=15\text{cm}^{-1}$ and $\mu_a=0.1, 0.3$ and $0.9\text{cm}^{-1}$). 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 $\mu_s'$ was kept fixed. Using the determination of $\mu_s'$ 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 $\mu_s'$ method, the standard (maximum) deviation were 6.9% (19%).

Conclusion: We showed that it is possible to accurately determine the optical properties inhomogeneities ($\mu_a$) using linear sources to a relative accuracy of better than 10%. Sensitivities for determination of $\mu_s'$ 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 $\mu_a$ is relatively small – this is important for forward calculation.