Optical Methods in Diagnosis

Homework #8

Detector geometry

Expand Homework #7 to include a detector. Determine the fraction of photons detected for an infinitely narrow beam at normal incidence. Variables are (i) distance L between the center of the detector and the incident ray, (ii) height of the detector h above tissue, (iii) detector diameter D, and (iv) detector field of view (FOV). Assume the index of refraction of the detector is 1.4 and ignore specular reflection at the detector surface when $h=0$. Let $\Delta r = 0.1$ mm. Do the following analyses:

(A) For $h = 0$, $D=2\Delta r$, and FOV=30°, plot the results in the same graph with $L = 0$, Δr, $2\Delta r$, $5\Delta r$, and $10\Delta r$.

(B) For $L=0$, $h=0$, and FOV=30°, plot the results in the same graph with D equal to $m\Delta r$ where $m = 1, 2, 5$, and 10.

(C) For $L=10\Delta r$ and $D=5\Delta r$, plot the results in the same graph for FOV= 15°, 30°, 60° and 180°, and for each detector height $h = 0, 0.1, 0.2$, and 0.4 cm.