

Physics 290 – Winter 2004

Assignment 4

Due February 5, 2004

1. The difficulty in CT image construction is finding the unique solution to a large algebraic problem of many equations and many unknowns. With sufficient information, it can be done. The following table shows the intensity measured for four combinations of four pixels from a 2x2 image. Use this information and the additional constraint that I/I_0 for pixel 11 ONLY is 0.37 to find the x-ray opacities of each pixel. Sketch the gray scale image.

Detector	I/I_0
11 + 12	0.018
21 + 22	0.05
11 + 21	0.05
12 + 22	0.018

2. One gram of H_2O with 0.1 ppb (part per billion) ^{15}O is injected into a patient for PET cerebral blood flow studies. What is the activity (in Becquerel and/or Curies) of the sample, given the ^{15}O half-life of $T_{1/2} = 122$ s?

3. Estimate the equivalent dose (in REM or SV) from a simple chest x-ray with:

photon energy; $E_\gamma = 80$ keV

incident intensity: $I_0 = 10^{10}/\text{cm}^2/\text{s}$

area: $A = (25 \text{ cm})^2$

exposure time: 0.5 seconds

attenuation coefficients (80 keV) ($\mu\rho$): $0.05 \text{ cm}^{-1}/0.14 \text{ cm}^{-1}$ respectively for tissue/bone.

4. Estimate the incidence of cancer (cases per year) for men and for women in Ann Arbor (total population 125,000) assuming general natural and man-made radiation exposure.