University of Salzburg Lecturer: Roland Kwitt

Imaging Beyond Consumer Cameras – Proseminar (911.422)

Exercise sheet **B**

X-Ray Imaging/CT

Exercise 1. 4 P.

Lets say the intensity of a (narrow) X-ray beam is reduced from 10000 to 2000 photons by 2cm thick copper. Compute the linear attenuation coefficient μ.

Exercise 2. 2 P.

The *mass attenuation coefficeint* μ_m is specified in m^2/kg, or cm^2/g and is defined as $\mu_m = \mu/\rho$. Find out ρ for copper (online) and compute μ_m.

Exercise 3. 10 P.

In the lecture, we have seen that Compton scattering is one of the main effects of X-Rays interacting with tissue. Lets say that a *maximum* energy of 30keV is transferred to the recoil (i.e., the electron that is ejected) electron.

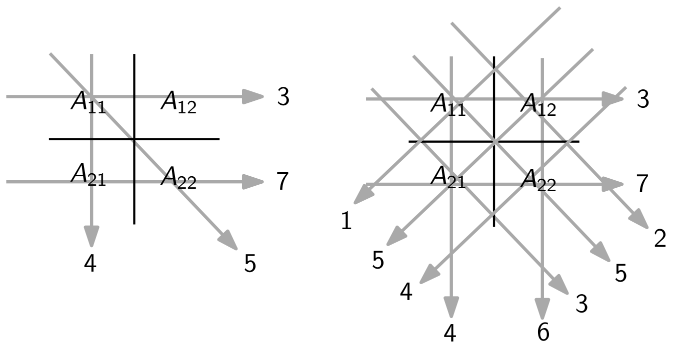
Part A (4 points): Under what condition is maximum energy is transferred to the electron?

Part B (6 points): What is the wavelength of the incoming photon in this situation, i.e., at 30keV?

Remark: Review the slides on *Compton* scattering; think about the angle ϕ and remember that energy needs to be conserved, i.e., $E - E' = 30$ keV. The slides also list the relation between E, h, c and λ.

Exercise 4. 4 P.

Consider the following two CT reconstruction examples:



Part A (2 points): Reconstruct A_{ij} by setting this up as a problem with four equations and four unknowns as $\mathbf{Fa} = \mathbf{p}$ and solve for $\mathbf{a}$. Basically, you only have to choose $\mathbf{F}$ appropriately and then use, e.g., MATLAB to solve for $\mathbf{a}$.

Part B (2 points): Solve for A_{ij} using our backprojection algorithm from the lecture.