University of Salzburg | Lecturer: Roland Kwitt

Imaging Beyond Consumer Cameras – Proseminar (911.422)

Exercise sheet B (April 04, 2018) | Prepare for presentation on **April 10, 2018**

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.

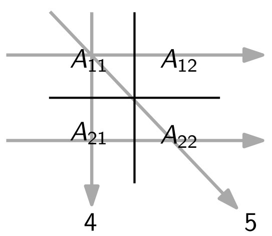
Exercise 3. 10 P.

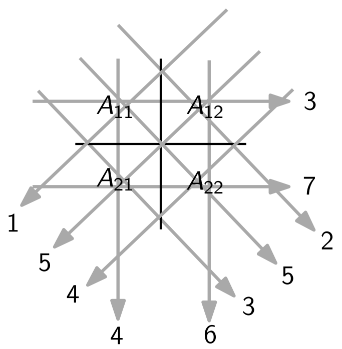
In the lecture, we have seen that Compton scattering is one of the main effects of X-Rays interacting with tissue. Lets say that a *maximum* energy of 30keV is transferred to the recoil (i.e., the electron that is ejected) electron. *First* question: under what condition is maximum energy is transferred to the electron? *Second* question: What is the wavelength of the incoming photon in this situation at 30keV?

Hint: 1) see the slides on *Compton* scattering; think about the angle ϕ and 2) remember that energy needs to be conserved, i.e., $E - E' = 30$ keV (for the relation between E, h, c and λ, see slides).

Exercise 4. 5 P.

Consider the following two CT reconstruction examples:





Left: Reconstruct A_{ij} by setting this up as a problem with four equations and four unknowns as

$$\mathbf{F}\mathbf{a} = \mathbf{p}$$

and solve for $\mathbf{a}$. Basically, you only have to choose $\mathbf{F}$ appropriately and then use MATLAB to solve for $\mathbf{a}$.

Right: Solve for A_{ij} using our backprojection algorithm from the lecture.

Total #points: 21 P.