Hello, my fellow workers. Today I am going to talk about Article abstracting. The title of the article is Optimal Energy Thresholds and Weights for Separating Materials Using Photon Counting X-Ray Detectors with Energy Discriminating Capabilities. The author of the article is Adam S. Wangand Norbert J. Pelc from Departement of Electrical Engineering, Stanford University. The article is published in the Physics of Medical Imaging of 2009, Vol. 7258.

The article contains eight parts. The main idea of the article is to show that PCXDs offer a wealth of information about the object being measured that traditional energy interacting detectors cannot assess.

In the first part, the authors explain us that PCXD with energy discriminating capabilities ideally allow us to extract as much information as possible from photons that transmitted through the scanned object.

The second part is model. It is spoken in details about model of x-ray registration.

The next part is maximum-likelihood estimator for binned data. Here mention was made of likelihood function with log-normalization.

The following part is relaxation of abutment constraint. Special attention is paid to the case when adjacent bins have non-overlapping intervals, but these intervals do not necessarily abut each other.

The next part is weighted measurement.

Now let’s move to introduction part

3) It is well known that decomposing an object into attenuation or material basis functions provides additional imaging benefits such as contrast enhancement or material subtraction. This can be accomplished with photon counting x-ray detectors (PCXDs) with energy discriminating capabilities, which enable us to count x-ray photons and classify them based on their energies. The richness of the information contained in these measurements can depend heavily on how these photons are binned together.

So, the goal of this paper is to identify a method that yields the optimal energy thresholds and weights for binning data from energy discriminating PCXDs.

4) Consider an incident x-ray spectrum I0(E) with maximum energy M and attenuation basis functions μ1(E) and μ2(E) that are functions of x-ray energy E. For an ideal detector with 1keV resolution, the expected number of photons of energy j that fall on the detector is λj = I0,j exp(−(t1μ1,j +t2μ2,j)) where t1 and t2 are the thicknesses of material 1 and 2, respectively. If one consider quantum statistics, then the number of photons of energy j that fall on the detector, rj , is a Poisson distribution with mean λj ; that is rj ∼ Poisson(λj)

5) Suppose that for each photon counted, our detector can increment the count in one of N bins (Fig. 1). For instance, if we have 2 bins, then our detector could increment the count in a “low energy” bin or a “high energy” bin depending on whether an incident photon is below or above some cutoff threshold energy. Therefore, d\_i, the number of detected counts in bin i is given by: *di* =

Now, let’s move to the 3nd part of my talk which is MAXIMUM-LIKELIHOOD ESTIMATOR FOR BINNED DATA.

6) One utilize a maximum-likelihood estimator (MLE) as a method to estimate *t* = [*t*1 *t*2]*T* directly from the raw data *d.* Since each *di* is independent of any other and each is a Poisson distribution, the likelihood function is

Because the measurements *{di}* are noisy, the estimate ˆ*t* will be noisy

7) To put this theoretical formulation to practice, we need to first select an *I*0*, μ*1*, μ*2

We chose calcium and water as our two materials because decomposing attenuation into these two basis materials can have direct applications.

8) In conclusion the author says that PCXDs offer a wealth of new information about the object being measured that traditional energy integrating detectors cannot assess. Their work offers new insight into increasing the precision of material or basis function decomposition.

9) That is all, thank you for your attention!