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Optimization simulation of scintillator thickness for Dual X-ray imaging system

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A dual X-ray imaging system uses two different energy spectrums that have different penetrative power that are low and high at the same time. It is advantageous in that it reduces the hardening effect of X-ray and creates a clearer image. In this study, it is predicted that electric signal would not be sufficient for the gain caused by the low intensity of the X-ray beam which is decoupled by pre-designed prototype filters. Our research team conducted a study on the optimization of the geometric structures of each scintillator in order to maximize the signals of the scintillator-coupled-detectors.
In this simulation, we used a CsI(Tl) scintillator which makes numerous photons when it interacts with the X-ray and used 100kVp X-ray energy which is generally used for bone density measurement, growth plate check, and body fat testing. Then, the filters for separating low and high energies are Er 0.5mm, for the low energy X-ray and a Cu 0.8mm, Rh 0.4mm mix for the high energy X-ray.
For the investigation, we separated the scintillators into 10 layers. The analysis was done in terms of the absorbed energy, light generation, and LTE(Light Transmission Efficiency) of each layer to yield the scintillation count of the whole body of existing scintillator. We assumed each sensor area to be 0.32 cm x 0.14 cm pixel through the Monte Carlo simulation MCNPX code to observe the absorbed energy in the scintillator and by the DETECT97 code in order to obtain counts of photons in the sensor.
As a result of this study, we determined that the thinner scintillators derive more photons than the thicker existing scintillator. According to the study, optimized thickness of CsI(Tl) scintillator follows 2mm both in low and high energies. To use the result practically, we will compare the existing trade-off method with the newly induced method to verify the consequence by the measurement of electric signals of each condition.

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