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The energy response function of the flat-panel detector

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Introduction

Whether radiation image detectors with high spatial resolution can be used for accurate dose estimation, this would improve existed radiation protection systems. The detectors, for example, are capable to estimate a patient dose during radiation diagnosis in real time, and thus help medical staff's activities. In this study, an Imaging Plate (IP) and a Flat-Panel Detector (FPD) were selected among commercially available 2D detectors in order to consider their capability for dose measurements.

In order to apply a radiation detector as a dosimeter, one should first determine its basic input-output characteristics. These are signal-to-dose dependence and the energy response function. In the energy range below 100 keV, however, the detailed energy response functions of IPs and FPDs were not obtained.

Previous experiments in KEK-PF, the detailed energy response function of IP had investigated by Suzuki [1] so that in this time the energy response function of FPD was investigated.

Experiment

In this experiment we used CXDI-50G produced by Canon, which convert X-ray energy to light by scintillator (Gd_2O_2S:Tb) and then light to electric signals by photodiode. Raw image that reflects the physical property of the detector cannot be obtained from this FPD. This is why energy response functions cannot be obtained from image analysis. Therefore, the output in EXP units was used, which is the average pixel value of raw image in the automatically recognized exposure field.

First, the relation between dose and EXP values was investigated to confirm linearity of EXP detector response. The FPD was exposed to continuous X-rays from a medical X-ray photography system, RADspeed safire by Shimadzu. The distance from the focus of X-ray tube to the FPD and the field size were respectively 150 cm and 10 cm × 10 cm. The dependence was studied for the three different tube voltages: 40, 80, and 120 kV. The tube current was kept constant and the exposure time was changed to obtain different dose values. EXP value was obtained on each exposure condition and dose was obtained by semiconductor dosimeter, MOM322 produced by Unfors.

Then, the energy response function was obtained by changing tube voltage in the same exposure arrangement as before. The energy response of the FPD was calculated as EXP value per dose for each tube voltage.

In addition, although experiment of KEK-PF was done by monochromatic X-rays, the area of exposure field was too narrow to calculate EXP values.

Results and Discussion

At each studied tube voltage, the relation between dose and EXP values is linear. Because input-output characteristics of FPDs are reported as linear [2], EXP value can be used for investigation of the energy response function. The energy response function of the FPD obtained by using continuous X-rays is shown in Figure 1. In the effective energy range of 25-45 keV, the efficiency is monotonically growing with the effective energy. Although, the FPD contains Gadolinium and its K_α-edge is about 42 keV, sudden changes of the energy response do not appear. This reason can be explained by using continuous X-rays.

In the future, the energy response function of FPD by using monochromatic X-ray would be obtained at KEK-PF, if the output of raw image becomes applicable.

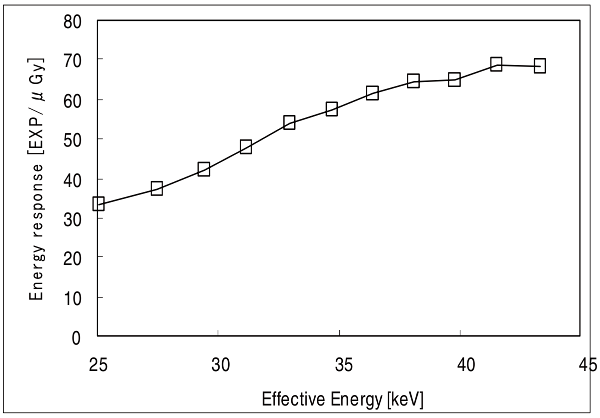

Figure 1. Energy response function of the FPD

Conclusion

The energy responses of FPD were obtained by using continuous X-rays.

References

[1] Chihiro S. 2nd Joint International Symposium on Nuclear Science and Technology, Ibaraki, Japan (2009)

[2] Masami S, Yoichi E, Kinichi, et al. *JJRT* **57**(1): 68-77 (2000)

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