X-RAY RESPONSE OF A DIGITAL DETECTOR FOR DENTAL RADIOGRAPHS

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Introduction

The purpose of this work is to study the X-ray response of a commercially available SCHICK CDR CMOS detector for dental radiography, in terms of detector response (mean pixel value and standard deviation) per incident air-kerma and the spatial resolution.

Methods 1

The detector was uniformly exposed at a Del Medical Eureka X-ray radiographic system at high voltages of 60 kV and 70 kV. The range of the incident air-kerma, measured with the RTI PIRANHA X-ray multimeter, was varying between 0.047 mGy and 0.225 mGy.

Fig. 1: The dental digital CMOS detector

Methods 2

The mean pixel value and the standard deviation of the derived DICOM images were measured with RadiAnt (Medixant) available software. The Normalized Noise Power Spectrum was calculated for the 70 KV images by means of ImageJ software, in terms of pixel values variations. Spatial resolution was optically estimated by visualizing the image of an irradiating Type1-83 bar pattern. All images were evaluated in ‘for presentation’ 8 bit format

Results 1

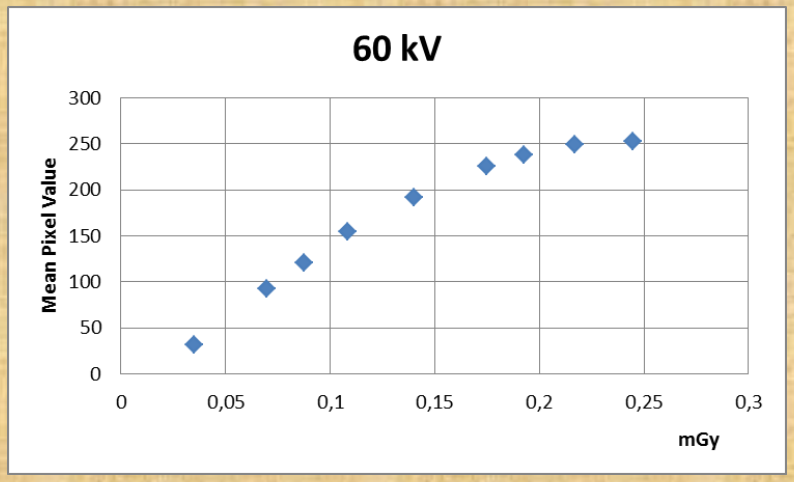


Fig.2: The detector response at 60 kV

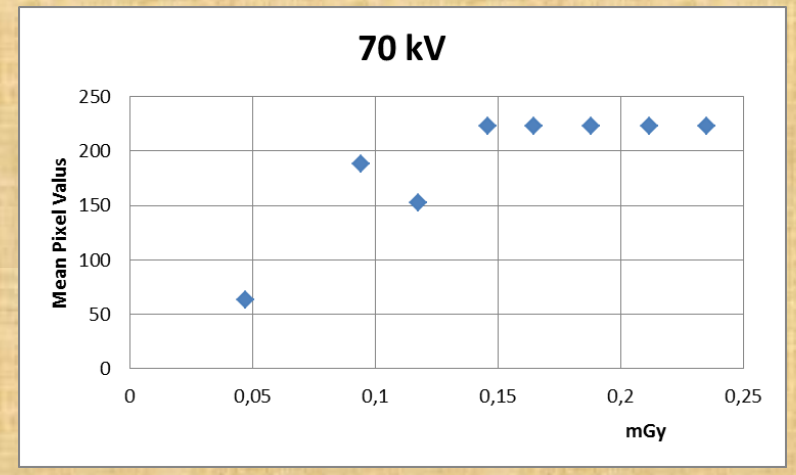


Fig.3: The detector response at 70 kV

The detector shows linear response up to 0.170 mGy for 60kV and up to 0.145 mGy for 70kVp. For higher air-kerma, mean pixel values tend to saturate. The saturation was faster at 70kV.

Results 2

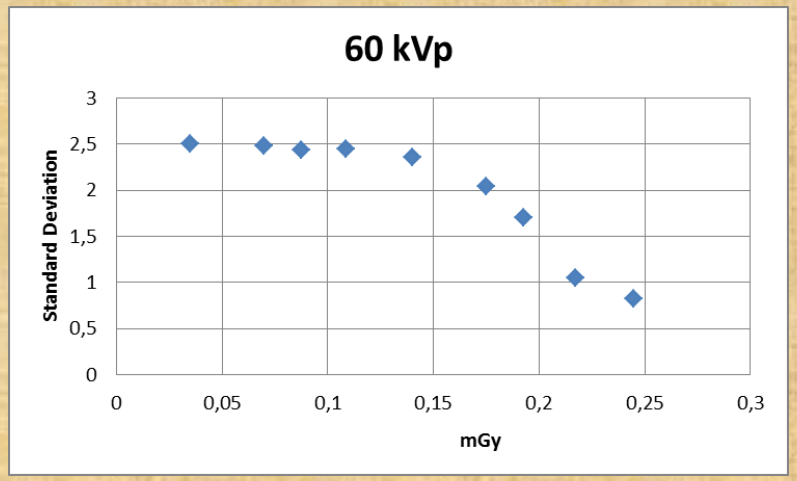


Fig.4: The detector noise response at 60 kV

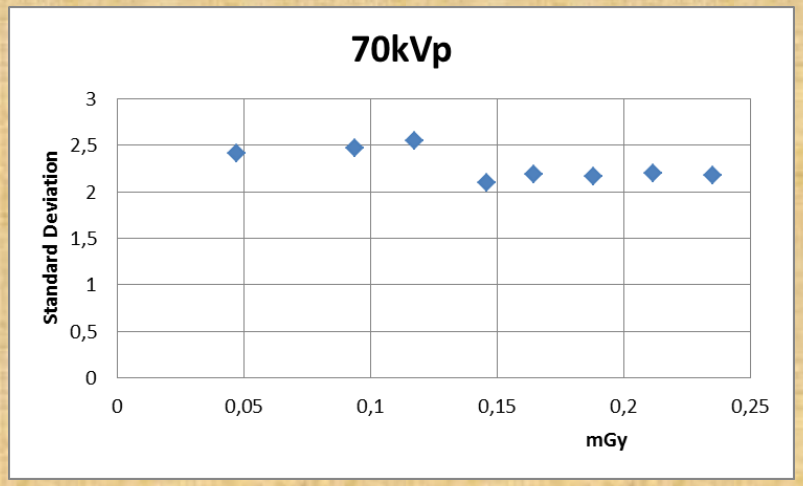
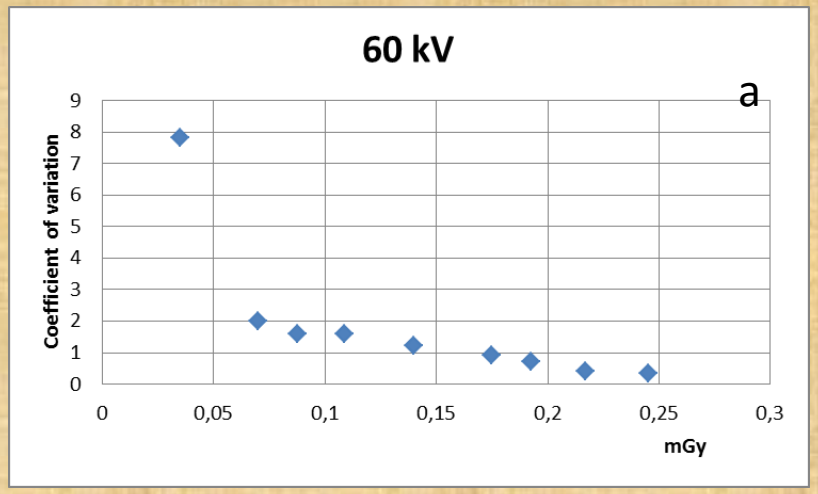


Fig.5: The detector noise response at 70 kV

The coefficient of variation (calculated as the standard deviation over the mean pixel value), as well as the standard deviation (SD) was found to reduce with respect to incident air-kerma for both X-ray tube voltages. Although the SD values for the 70kV images were practically constant above 150 mGy

Results 3



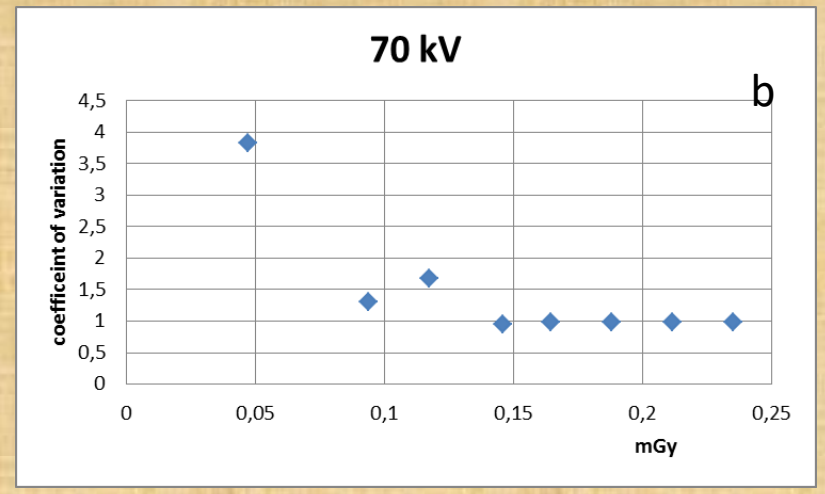
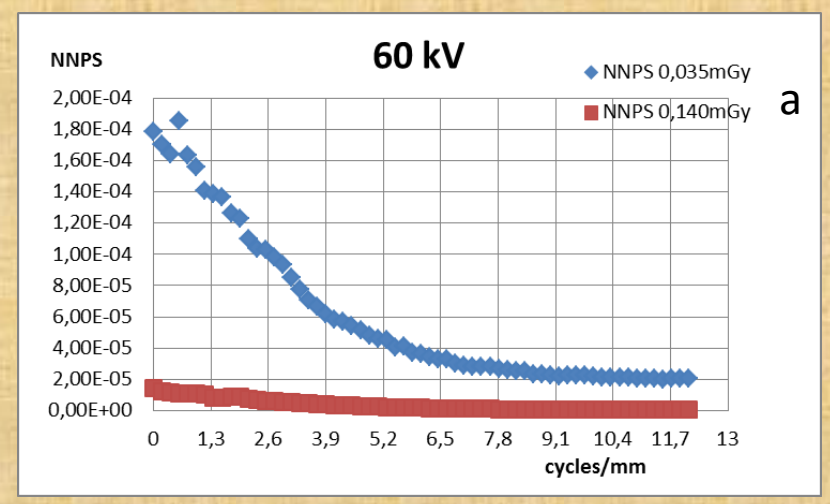


Fig.6: The detector relative noise responses at 60 kV (a) and 70 kV (b)



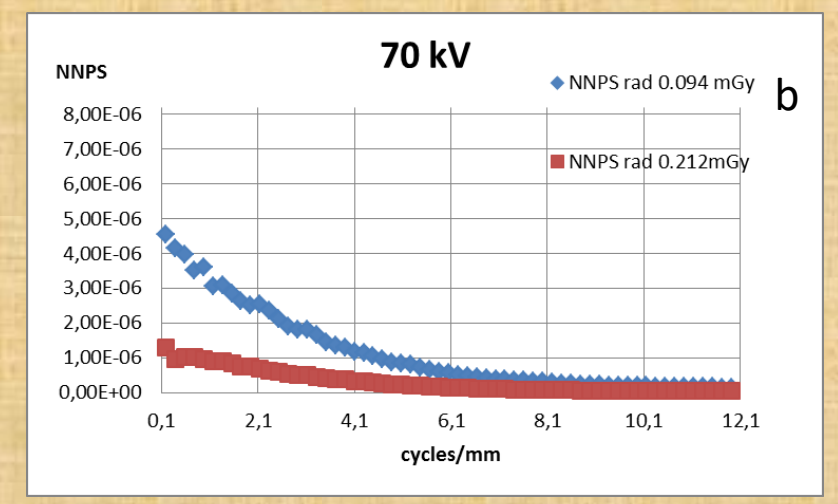


Fig.7: The detector NNPS at the min and max air-kerma corresponding to the linear range region at 60 kV (a) and 70 kV (b)

Results 4

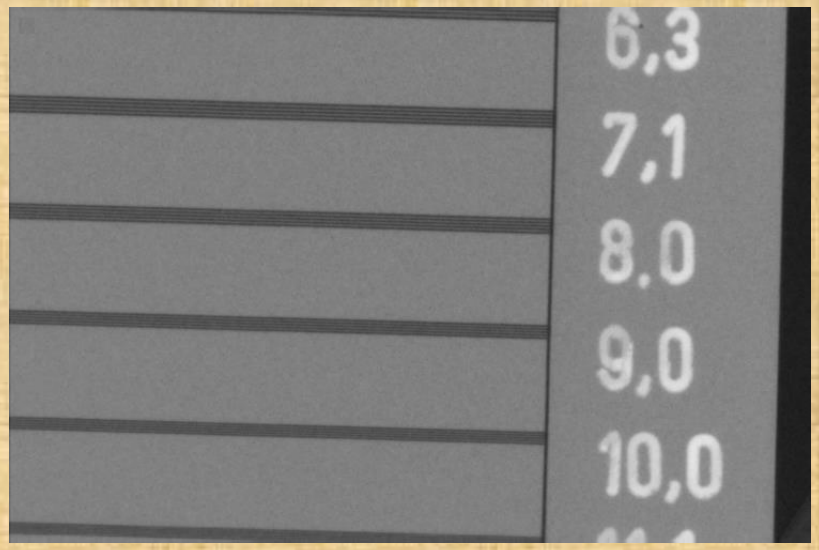


Fig.8: The bar pattern image at 60kV

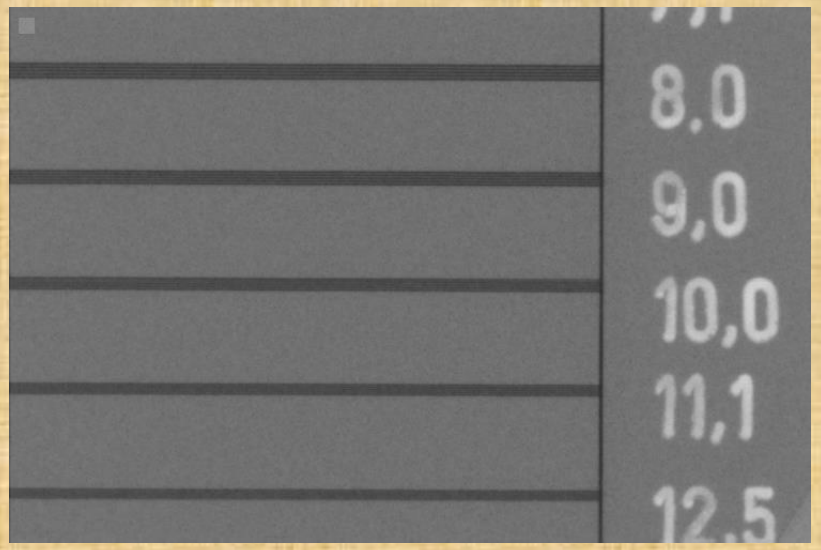


Fig.9:The bar pattern image at 70kV

Spatial resolution, under optimum observation conditions was estimated approximately 10 lp/mm at 60kVp and 9 lp/mm at 70kVp.

Conclusion

The observed digital detector was found to have better resolution and exposure range at 60kVp.

References

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