

1.4.23. DESIGN PRACTICE OF AN AFFORDABLE DIGITAL X-RAY DETECTOR

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This development was performed in course of an by the International Atomic Energy Agency (IAEA) initiated project. It was aimed at the creation of a new digital X-ray imaging detector. One of primary requirements to the device was its low production costs in order to allow its use for educational and training purposes as well as for the promotion of modern digital techniques of industrial radiographic inspection in the developing countries. Other requirements were freedom from any patents and simplicity of the (re)production of the device. The design, optimisation and construction of a fully functional prototype were done in the German Federal Institute for Materials Research and Testing.

The construction principle of this detector is similar to ordinary uroscopic systems. However, an image intensifier, conventional for uroscopic systems, or a matrix detector array (DDA) are intentionally not used due to cost reasons and to facilitate the exibility of the setup. The acquisition of optical image on the uorescent screen is performed by a commercially available high-sensitive CCD camera with configurable frame exposure time.

A naive setup of such a system delivers unsatisfactory results. However, through analysis of the inuencing factors, optimisation of the setup, right choice of used components and their settings a remarkable improvement can be done. This optimization is not a straightforward process since changing of the most system parameters leads to controversial results, i.e. improvement of some characteristics is connected with degradation of other characteristics at the same time and it is probably the reason for low commercial availability of such systems.

A specially developed for this purpose (and now freely available) image acquisition software allows elimination of important interference factors, i.e. performs frame integration, filtering of directly converted X-ray photons, detector calibration and correction.

The detector developed in this way reaches image quality of commercially available phosphor plate (CR) systems. Yet it is available only for a fraction of price of such systems. The manufacturing costs of the detector are considerably under 5,000 euro. An additional advantage of this detector over CR systems is the instant image availability without necessity of scanning process (similar to DDA). Moreover, an adaptation of the detector to requirements of specific application is possible (after new optimisation). So, for example, reaching of the higher spatial resolution is possible through lower requirements to the maximal signal-to-noise ratio (SNR) or reduction of size of the detectors sensitive area or vice versa.