

Fast Measurement and Reconstruction of Small Focal Spot Sizes by Single Shot Computed Tomography from Hole Radiographs

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New measurement methods for focal spot sizes of X-ray tubes were developed in the European EMPIR project „NanoXSpot“ (Measurement of the focal spot size of X-ray tubes with spot sizes down to 100 nm). A part of the project was the development of an alternative measurement to the pin hole camera method via “Single Shot Computed Tomography (CT)”. ASTM E 1165:2012(2017), Annex A, describes the determination of focal spot sizes for X-ray tubes with spot sizes $> 50\text{ }\mu\text{m}$ from edge profiles. It was proposed earlier to calculate the focal spot shape and size by analysis of the direction-dependent edge unsharpness of a hole diaphragm, with following CT reconstruction, as equivalent method to a pin hole exposure. The pin hole method, as described in EN 12543-2 and ASTM E 1165, is not suitable for microfocus tubes, since pin hole diaphragms with diameters $< 10\text{ }\mu\text{m}$ are difficult to manufacture and very long exposure times are expected. The “Single Shot CT” method has the potential to measure spot shapes and sizes of microfocus tubes with diameters below $50\text{ }\mu\text{m}$ and this would be an alternative to measurements with edges or line pattern test gauges. Reconstructed focal spot shapes in the range $> 50\text{ }\mu\text{m}$ were validated by simulations and quantitatively compared to pin hole camera measurements. Furthermore, CNR and measurement times are estimated to evaluate the efficiency of the Single Shot CT.