

Numeric Prediction of the Visibility of Indications for Human Observers in digital X-Ray Imaging and Computed Tomography

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X-Ray Imaging and Computed Tomography (CT) is applied in industry for flaw detection, flaw evaluation and dimensional measurement. This requires the correct experimental system settings for sufficient visibility and detectability of flaws and structure elements. The visibility of indications for human observers on a monitor depends on the square root of the visible flaw area (e.g. pores with diameter < 12 mm) in radiographic images or cross sectional 2D CT-images, the Contrast to Noise Ratio (CNR) and the Modulation Transfer Function (MTF). The ASTM guide E 1441 describes three essential functions for prediction of the visibility of small circular indications in slice images of a 3D reconstruction or a 2D reconstruction. This is the Contrast Discrimination Function (CDF), the MTF (see also the revision of ASTM E 1695), and the Contrast Detail Diagram (CDD) function. The prediction of the visibility of circular indications in reconstructed slice images can be determined from the Contrast Detail Diagram function, which is the combination of CDF and MTF and a physiological factor c . This is compared to the analysis of digital radiography with Noise Power Spectra (NPS) and presampled MTF as used for the calculation of the detective quantum efficiency (DQE). The measurement procedures and formulas for the prediction of the detail visibility by CDD will be tested with test phantoms and be verified by modelling and measurements. A form factor is considered to compare cylinder holes with pore indications. Conclusions will be reported and recommendations will be given for the correct physiological factor c and the consideration of the influence of artefacts, as e.g. cupping and scatter. Approximated equations will be derived for the potential usage by practitioners.