AbstractID: 8637 Title: Instrumentation Noise Equivalent Exposure (INEE): An Investigation of Spatial Frequency Effects

Purpose: To expand on previous development of the instrumentation-noise equivalent exposure (INEE) metric which directly quantifies the quantum-limited performance range of a detector in terms of entrance exposure, by investigating spatial frequency dependence. **Method and Materials:** The INEE formalism assumes the total noise of an x-ray detector is proportional to the incident number of quanta, with an additive term representing contributions resulting from instrumentation-noise sources. The INEE then represents the threshold exposure below which the detector's performance is no longer driven by quantum statistics, becoming instrumentation-noise-limited and is measured using output signal variance plot versus exposure, fitted to σ^2=k(Exposure+INEE). Similarly, to provide a spatial frequency dependent INEE, INEE(u,v), the two-dimensional NPS (i.e. the variance of image intensity divided among the various frequency components of the image) was measured and plot as a function of exposure at each spatial-frequency and fit with NPS(u,v)=k(u,v)(Exposure+INEE(u,v)). Output signal variance and NPS were measured using 90 flat-field images on a digital x-ray detector according to IEC guidelines and using the RQA 5 spectrum. **Results:** The measured INEE(u,v) was radially symmetric with the lowest INEE values at low spatial-frequencies with an increasing INEE at higher spatial-frequencies. The frequency behavior was determined to be largely dependent on the blur and scattering of the phosphor as described by the detector MTF. Frequency independent INEE was determined to be the weighted mean of INEE(u,v) with k(u,v), over all spatial frequencies. **Conclusion:** The INEE metric addresses the need for a direct, quantitative measure of the quantum-noise-limited exposure range of x-ray detectors by providing the threshold exposure at which the detector instrumentation-noise exceeds the quantum-noise. Frequency dependence was investigated to provide a greater understanding of this promising new metric.

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