AbstractID: 10683 Title: The Instrumentation Noise Equivalent Exposure (INEE): Including conversion, secondary quantum, structure and electronic noise

Purpose: To provide a quantitative and clinically relevant measure of the instrumentation noise of digital x-ray imagers, using the Instrumentation Noise Equivalent Exposure (INEE). **Method and Materials:** The NPS was "decomposed" into constituent elements of primary quantum noise, Poisson excess noise (Swank noise), secondary quantum noise, structure noise and additive electronic noise using a plot of the total measured NPS versus exposure and using known relationships based on a generalized parallel cascade model analysis. The INEE was determined by measuring the exposure at which the *total* instrumentation noise and primary quantum noise were equivalent. Exposures at the INEE correspond to a drop in DQE of one-half. To demonstrate the usefulness of this new metric, the spatial-frequency-dependent INEE was measured on a clinical (indirect) dynamic flat panel detector (FPD) with a pixel pitch of 194 µm and a 600 µm thick CsI:Tl phosphor. **Results:** The INEE was measured to be 2.0, 7.1 and 75 µR at 0, 1 and 1.2 cycles/mm, respectively. Above 1.2 cycles/mm the detector was instrumentation-noise-limited at all exposures, resulting in a degradation in image quality beyond that dictated by the noise in the incident x-ray quanta alone. Hence, above 1.2 cycles/mm the DQE was always less than half the maximum value. **Conclusions:** In this work, *all* sources of instrumentation noise were incorporated into the INEE formalism, consisting not only of the additive electronic noise, but also including the Poisson excess noise (i.e. noise resulting from the phosphor), secondary quantum noise (i.e. noise resulting from the conversion and transmission of quanta) and structure noise (i.e. noise resulting from variations in the detector sensitivity). The INEE can be used to assess quantum-noise-limited operation at *all* spatial frequencies of interest by characterizing the *total* instrumentation noise in terms of equivalent detector entrance exposure.

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