AbstractID: 1543 Title: Object Detection Probability vs System DQE for X-ray Imaging Optimization

We define the System Detective Quantum Efficiency (SDQE) and System Noise Equivalent Quanta (SNEQ) at the object plane taking into account geometric unsharpness, x-ray scatter, and detector characteristics to obtain realistic metrics of image quality. The object detectability is then determined using the SNEQ and the object frequency distribution. The SNEQ and SDQE were measured for a microangiographic detector for a 0.8 mm focal spot, using a uniform head equivalent phantom. Magnification of 1.1 for instance was found to degrade the higher frequencies of SDQE while slightly improving the lower frequencies (below 2 cycles/mm). Scatter causes an abrupt, low frequency decrease in SDQE which is transferred to the higher frequencies in a uniform manner. SDQE can be used as a system optimization metric, to gauge the effect of scatter and geometric unsharpness on the system's efficiency, as well as for intersystem comparisons. From detectability calculations and a 2-Alternative-Forced-Choice experiment performed by our group in the past, we found the dose to the patient which results in 75% detection probability. When the scatter fraction increases from 0.35 to 0.62, the patient dose must increase by 18% in order to maintain the same detection probability, at constant object magnification. When the object magnification changes from 1 to 1.2 with a constant air gap, only a 9% increase in the patient dose is required. The object detection probability is a good optimization parameter since it can be directly related to the required patient dose. (Support from NIH grants R01NS38746, R01EB02873, and Toshiba Corporation)