AbstractID: 9586 Title: A Formulism towards Clinically Relevant Radiographic Imaging Metrics in the Presence of Patient Scatter and Attenuation: cMTF, cNPS, and cDQE

Purpose: We present a formulism to extend conventional radiographic metrics: modulation transfer function (MTF), noise power spectrum (NPS) and detective quantum efficiency (DQE), to clinically equivalent analogues: cMTF, cNPS and cDQE, that include patient specific influences of scatter and beam attenuation. We also propose a clinical interpretation of the above metrics: clinical resolution index (CRI), clinical noise index (CNI) and clinical contrast index (CCI), in which a clinical confidence level of resolution, noise and contrast is predicted for a given anatomical structure and geometry.

Method and Materials: The formulation and validation of our clinical metrics were conducted on an Elekta iViewGT portal imager. We used a bar-pattern to evaluate MTF as a function of spatial frequency (f), build-up (b) and scatter depth (s) within 30 cm thickness of water to obtain cMTF(f,b,s). Uniform flat-fields through 30 cm thickness of water containing varying attenuating media indicated by mass thickness (δt), a reasonable approximation for Compton limited megavoltage imaging, were used to measure cNPS(f,δt). Finally, cDQE(f,b,s,δt) was computed and normalized by the exit fluence associated with the attenuated fields. Clinical confidence indices for delineating anatomical structures (CRI, CNI and CCI) were obtained by expressing cMTF, cNPS and cDQE as a function of radiographic object size ($w = 0.5/f$), along with calibrated charts providing the transformation from anatomical size or form to the radiographic size marker (w).

Results: Major differences were observed between conventional MTF, NPS and DQE measurements and our clinical equivalents (cMTF, cNPS and cDQE) that reflected the significant influence of patient attenuation and scatter. CRI, CNI and CCI curves were established for several selected anatomical sites that included bony as well as soft tissue contrast.

Conclusion: The clinically equivalent imaging metrics described above provide a significant link between conventional radiographic metrics defined for idealized systems and realistic clinical image quality.