AbstractID: 7781 Title: A Fast Method for Measurement of Modulation Transfer Function (MTF) and Detective Quantum Efficiency (DQE) in Presence of Phantom Scatter in Image Guided Radiotherapy

ABSTRACT

Purpose: To present an improved bar-pattern method that allows for fast measurement of modulation transfer function (MTF) and detective quantum efficiency (DQE) in conventional no-phantom scatter and phantom scatter conditions to characterize spatial resolution of both 2D and 3D imaging systems for image guided radiation therapy (IGRT) with both kilovoltage and megavoltage x-ray sources.

Method and Materials: X-ray imaging requires MTF measurements under phantom scatter free condition for DQE measurements. While slit/edge MTF measurements are laborious, the bar-pattern method allows for a simplified approach for discrete MTF measurement although its implementation for megavoltage x-ray imaging may lead to errors due to inadequate normalization. We introduce a new bar-pattern method based on based on improved normalization techniques that provide extremely accurate MTF measurement. It is well suited for MTF and DQE measurements under phantom scatter conditions, which more closely mimic patient imaging and cannot be obtained using slit/edge methods. Comparisons of the bar-pattern method are presented with slit/edge MTFs. We present a methodology to image bar-patterns placed on a multi-axial rotation jig that allows measurement of spatial resolution of not only 2D detectors (EPIDs) but also volumetric imaging systems, i.e. CBCT and MVCT.

Results: Comparisons of MTF measured with custom tungsten bar-patterns show good statistical agreement with measurements with the slit and edge for two clinical EPID systems.

Conclusions: The proposed bar-pattern method provides fast accurate measurement of discrete MTF and DQE values, and is much simpler and faster to use than traditional slit and edge methods. This method also allows for MTF and DQE measurements under scatter conditions that more closely mimic patient imaging conditions. It can be used for EPID and CBCT/MVCT imaging quality assurance within minutes of imaging time and is therefore well suited for clinical measurements.