AbstractID: 12977 Title: Wide field array calibration dependence on beam shape stability

Purpose: To simulate the effects of beam symmetry instabilities on detector array calibrations and explore compensation methods during actual calibration with a linear accelerator (LINAC).

Methods: The array calibration method that was investigated is known as wide field (WF) calibration. With this method, a linear array [*y*-axis (65 detectors) of the IC PROFILER™; Sun Nuclear Corporation, Melbourne, FL USA] requires three calibration measurements (α, θ, and λ) using a radiation field that is larger than the array. Measurement θ is a 180° rotation from α, and λ is a physical shift by one detector from θ. The relative detector sensitivities are then determined through ratios of detector readings at the same field locations. This method results in error propagation that is proportional to the array size. The WF calibration postulates that the dose distribution is constant for each calibration measurement. Postulate violations were quantified by applying a sine shaped perturbation (of up to 0.1%) to a calibration measurement and determining the error relative to a baseline calibration. Actual postulate violations were limited by using a continuously on beam and mechanized array movement during θ and λ. Symmetry is more stable for a continuously on beam.

Results: Simulated perturbations to θ or λ resulted in calibration errors of up to 2%, while α was relatively immune (<0.1% error). Wide field calibration error on a LINAC with similar symmetry instabilities was (±) 1.6%. Using a continuous beam during θ and λ reduced the calibration error to (±) 0.68%.

Conclusion: This work increased the reproducibility of WF calibrations by limiting the effect of measurement perturbations due to LINAC symmetry instabilities. The same technique would work for any array using WF calibration.

Conflict of Interest: Research sponsored by Sun Nuclear Corporation.