AbstractID: 7396 Title: Automated linear accelerator quality assurance using a commercial cylindrical calibration phantom

**Purpose:** Precise mechanical operation of a linear accelerator is critical for accurate dose delivery. Available quantitative procedures for the linac mechanical quality assurance (QA) are time consuming and therefore conducted on a relatively infrequent basis. We present a method for evaluating the mechanical performance of a linac based on a series of projection portal images of a prototype cylindrical calibration phantom with embedded markers.

**Method and Materials:** We used non-linear multiobjective optimization of information extracted from the images to determine a number of geometric parameters of interest. The markers detection included modeling the imager response to radiation beams where significantly non-uniform background was expected.

**Results:** The average results for the parameters of our geometric linac model were: gantry angle deviation $0.066\pm0.085$ (1 SD), gantry sag $0.026\pm0.02$, imager in-plane rotation $0.026\pm0.055$, roll $0.082\pm0.16$, and pitch $0.9\pm0.64$, SDD $1489.7\pm5$ mm, SAD $998.3\pm1.7$ mm, and the imager shift $[-0.66, -3.9] \times [0, 30.1, 6]$ mm. The results were corrected for the phantom center shift relative to the linac rotational center. The average rotational center was $(R_c)=[0.0\pm0.0012, 0.14\pm1.38, 0.08\pm0.98]$ mm. The average couch height and angle variations were $0.15\pm0.9$ mm and $0.154\pm0.1^\circ$, respectively. The image analysis quality was examined by comparing the detected set of marker coordinates to its simulated counterpart for three regions of the phantom image: central, near the edge and the intermediate region (relative to the central line of the cylinder). The upper limit of the mean difference was less than $0.25$ mm with the cumulative mean of $0.146$ mm and SD of $0.07$ mm. The results of the primary optimization of directly detected marker coordinates virtually coincided with their counterparts based on the simulated coordinates for all the geometric parameters of the model.

**Conclusion:** This procedure is accurate and automated, which allows precise mechanical QA to be performed more frequently.

**Conflict of Interest:** partially supported by Varian Medical Systems.