AbstractID: 7036 Title: A Phantom and Software Analysis Tool for Quality Assurance (QA) of LINAC with Onboard kV X-Ray Imaging Device

Purpose: LINAC with integrated kV imaging device is emerging as an important clinical tool for radiation therapy. A novel strategy is developed to examine the system geometric and mechanical accuracies to ensure the adequate use of this new technology.

Method and Materials: Three major issues that are crucial to the performance of the LINAC with onboard imager are in mind when designing the phantom system: (1) the coincidence of kV and MV beam isocenters; (2) the positional accuracy of kV and MV X-ray sources; and (3) the positional and directional accuracy of the kV and MV imagers. After a computer simulation to maximize the detection sensitivity of these three sets of parameters, a QA phantom was built by placing 13 ball bearings (BBs) on the surface of the rectangular phantom (18x18x20 cm). A Varian Trilogy was used to validate the QA system design. The kV and MV projection data were collected with gantry rotating over 360^{o}. The software analysis tool then computes those three sets of parameters by comparing the measured and predicted BB locations on each projection.

Results: The performance of the QA package was assessed by intentionally introducing a number of errors. As a result, our QA system showed great sensitivity and accuracy in error detection. Specifically, it was found that the accuracy of the system in detecting angular uncertainties of the kV/MV sources was better than 0.2^{o}. For spatial uncertainties, such as the kV/MV iso-center mis-alignment, the source position, or the detector position, the demonstrated accuracy was better than 1 mm. Furthermore, the system was able to reveal any combinational error of the angular and spatial variables at any gantry angle.

Conclusions: Iso-centers, source positions, and imager positions and directions for kV and MV can be examined accurately with this QA system.