AbstractID: 13719 Title: Automated Photon Monte Carlo Linear Accelerator Model for Calculating In-Field and Out-of-Field Dose

Purpose: Monte Carlo methods have been used extensively to calculate radiation does to organs both in-field and far-field. However, particularly for out-of-field dose calculations, this process has relied on the very time consuming and potentially error-prone manual conversion of radiation field parameters and CT datum to a Monte Carlo input format. The purpose of this study was to develop computational infrastructure to automate a Monte Carlo-based dose calculation algorithm for a previously modeled and benchmarked Varian 2100 linear accelerator operating at 6 MV. This system would be suitable for in-field and out-of-field calculations.

Method and Materials: A computer program was written using a Digital Imaging and Communications Tool Kit (DCMTK) to extract patient position data and radiation field parameters from a photon radiation therapy (RT) file and, based on this data, set the MCNPX simulation geometry for the modeled linear accelerator. A shell script was written to automate extraction, writing MCNPX geometry input files and submission of simulations to a computer cluster. The accuracy of the automation process was tested by examining the accuracy of the in-field dose from an eight-field, intensity modulated radiotherapy plan. Each field corresponded to a different gantry angle and set of control points. For each field, simulated depth-dose curves and cross-filed dose profiles at isocenter were compared with dose profiles calculated from Varian treatment planning software (Eclipse).

Results: In-field dose profiles calculated from the automated system agreed within 4% to dose profiles calculated using the Eclipse. Statistical uncertainty of simulated in-field dose profiles was at most 4%.

Conclusion: The automated dose calculation system accurately extracted the complex treatment geometry parameters, and successfully incorporated them into the Monte Carlo framework. This process substantially reduces the time required, and potential for error, for conducting Monte Carlo simulations within or outside the treatment field.