

AbstractID: 7161 Title: Development and validation of an MCNPX Monte Carlo IMRT source model with optimized radiotherapy interface and comparative analysis software

Purpose: Dosimetric accuracy is essential for successful radiotherapy and paramount to the medical physicist. In an effort to implement the most advanced dose deposition algorithm available, an MCNP-based Monte Carlo IMRT source model of a Novalis LINAC with mMLC has been developed and benchmarked. Concurrently, accompanying software has also been developed to facilitate and optimize CT-based Monte Carlo simulations and subsequent comparative analysis against various measurement types and calculations.

Method and Materials: A Monte Carlo source model has been developed and thoroughly benchmarked in accordance with guidelines of AAPM Task Group 53 as well as Medical Physics Monograph No. 32. To that end, extensive water phantom/ion chamber measurements as well as axial and coronal film measurements were acquired to adjust and confirm the MCNP source model. In order to better tune the source model as well as visualize datasets and provide comparative Gamma analysis against TPS calculations and various measurements, a comparative software suite has been fully developed and refined. Additionally, an input file preparation Graphic User Interface (GUI) has been created in order to provide efficient, optimized, and accurate CT-Based simulations. These simulations are optimized by greatly reducing the number of extraneous voxels present in the input file lattice while preserving patient representation.

Results: The Monte Carlo source model been refined to provide simulation results that agree with measurements on the order of a well-commissioned Treatment Planning System. The input file preparation software allows for greatly optimized patient-based simulations that decrease simulation times over 60% while preserving dosimetric resolution. The comparative analysis software provides genuinely useful visualization and analysis of multiple datasets.

Conclusion: This Monte Carlo IMRT source model, combined with the radiotherapy interface and post-processing comparative software, provides a powerful series of tools for clinical and dosimetric investigations.