AbstractID: 3313 Title: Commissioning Monte Carlo Dose Calculation for Lung Treatment Planning

Purpose: To commission a commercial Monte Carlo (MC) simulation package, NXEGS (Numerix LLC), for photon beam dose calculations. We investigated within NXEGS the EGS4 compatibility mode, fast MC, and post processing (PostP).

Method and Materials: We commissioned NXEGS and Pinnacle 6.2b with the same set of measured data. We compared its dose calculation accuracy and efficiency with the collapsed cone convolution algorithm in Pinnacle and the National Research Council EGS4. Dose distributions were compared in three phantoms: a water phantom to check the output and beam profiles; a water phantom with a lung slab to test the inhomogeneity correction; and a water phantom with 1-3 cm diameter cylindrical air pockets to test the PostP algorithm. We also compared fast MC using PostP with Pinnacle for a three-field lung treatment plan. Number of histories is chosen to give +/- 2% dose accuracy at the isocenter. All doses were converted to cGy per MU.

Results: Fast MC improves computational speed by a factor of ~10 from the EGS4 compatibility mode. PostP decreases number of histories required and hence the computation time by another factor of ~10. PostP adds ~1 minute per 10^6 dose voxels. Inside the lung slab, fast MC with PostP differed from Pinnacle by ~0.03cGy/MU with a misalignment of ~2mm whereas fast MC with PostP agreed within 0.03cGy/MU of EGS4. PostP did not preserve the dose perturbation from ≤1cm air inhomogeneities.

Conclusion: Without PostP, the accuracy and computational time scaled with number of histories. When we specify ±2% accuracy in the target volume, the dose calculation time using fast MC with PostP is comparable to Pinnacle for a three-field lung plan. NXEGS fast MC with PostP predicts the dose spread due to electron transport in lung with good accuracy-to-speed ratio and is suitable for routine treatment planning.