AbstractID: 14064 Title: Modeling a Multi Leaf Collimator for IMRT Monte Carlo Dose Calculations

Purpose:
To investigate the effects of modeling a multi leaf collimator (MLC) with a simplified discrete block geometry for Monte Carlo (MC) simulations.

Method and Materials:

In our MC simulations (NxEGS NumeriX, LLC) we modeled each leaf in the MLC using 3 layers of staggered blocks to simulate the rounded tip, tongue and groove, and leaf divergence. Dose calculations were compared against measurements and the collapsed cone convolution algorithm in Pinnacle. Profiles from a water phantom were measured with ion chamber or diode both orthogonally and parallel to leaf travel directions for field sizes of 15x15cm, 10x10cm, 5x5cm, 3x3cm, and 2x2cm (with jaws always set to 20x20cm). Two abutting 10x5cm fields were measured with film on a solid water phantom, to determine how well the simulations handle the tongue and groove effect. A 3-field IMRT lung patient was also planned and simulated on both the patient CT and a solid water phantom.

Results:
Gamma analysis (3mm/3%) comparing MC dose calculations and measurements for the range of the 2x2cm to 15x15cm fields collimated by the MLC showed good agreement. Results for the two abutting 10x5cm fields indicates NxEGS is modeling the tongue and groove effect, where as Pinnacle has under estimated it. When the IMRT lung patient plan was evaluated by MC calculations and Pinnacle on the solid water phantom, < 2% of points failed the gamma analysis (3%/3mm) whereas ~5% increase in dose in the lung was observed in the MC dose calculation when compared to Pinnacle.

Conclusion:
A 3-layer block geometry for modeling the MLC rounded leaf, divergence and tongue and groove is easily implemented, forgoing the minute details of a MLC, while still giving an accurate distribution as compared to both measurements. This can be used to verify dose distributions in 3D for IMRT treatment plans.