AbstractID: 8399 Title: Impact of tumor motion and size in the irradiation of moving tumors in step-and-shoot IMRT: a NCAT based 4D Monte Carlo simulation study

Purpose: To quantify the dosimetric impact of the interplay effect in step-and-shoot IMRT treatment of lung tumors of varying size and motion amplitude using a 4D Monte Carlo simulation framework and to find whether a threshold exists where implementing motion mitigation strategies might become important in such treatments.

Methods and Materials: The Non-Uniform Rational B-Spline (NURBS) Cardiac and Torso (NCAT) computational phantom was used to create 10-phase 4D CT data sets of 12 theoretical patients with tumor sizes of 1-6 cm and magnitudes of tumor motion of 1 – 5 cm. Lung density for each model was changed as a function of breathing phase. IMRT leaf sequences were generated using the CORVUS treatment planning system for each of the 12 data sets and used as input into the Dose Planning Method (DPM) Monte Carlo code. Dose at each phase was mapped back to the exhale phase using the internal NCAT deformation maps. Dose volume histograms (DVHs) of tumor and organs at risk (OARs) were used as a measure of the dosimetric effect of tumor motion and size.

Results: A population of computational patient phantoms has been created. The lung density of the NCAT phantom can vary from the default 0.30 gm/cm^3 by up to 34% for the largest diaphragm motion. The NCAT phantom has been implemented within the CORVUS treatment planning environment as well as within our 4D Monte Carlo simulation framework. Various tumor locations in the lung and tumor amplitudes were investigated to assess dosimetric effects in IMRT therapy of lung tumors.

Conclusions: This study shows the potential of using the most advanced computational model of human anatomy for finding class solutions for motion mitigation within a controlled environment. We conclude it is a valuable tool in order to study artifact free data sets for radiation therapy.