AbstractID: 7579 Title: Image guided 4D Monte Carlo study of the dosimetric effects of intra/inter fraction motion in lung tumors

Purpose: Application of an image guided 4D Monte Carlo framework to the evaluation of intra/inter fraction motion effects between patient organ-movement and dynamic delivery effects

Materials & Methods: An IGMC toolkit that accounts for time-dependent geometries of organ motion and dynamic delivery and provides accurate dosimetry was developed for lung cancer patients. Fluence calculation for VARIAN-2100C/D photon accelerator is performed with EGSnrc and for patient dose calculation we use dose-planning-method. The time dependent beam delivery information is obtained from the treatment-planning program in the form of MLC leaf-sequencing files, while the organ motion pattern was obtained with the use of RPM signal and 4D-CT. A voxel displacement map is used to quantify the motion of the organ in the voxelized geometry. The study was performed for lung patient for several breathing phases. The data analysis was performed with the freely available package VODCA.

Results: Differences between the conventional CORVUS dose plan and the Monte Carlo dose results suggest that Monte Carlo dose calculation is vital for assessing effects in lung tissue. For the free breathing CT, CORVUS was under-dosing the lung-tumor by approximately 3Gy. When accounting for temporal effects, comparison between IGMC dose distributions for free breathing, inhale and exhale phases, show that dose coverage of the primary/secondary tumors was significant worse in the inhale phase relative to the exhale/free-breathing phases. For inhale phase, 5-10% of the volume was receiving 10Gy less than in exhale or free-breathing phases, leading to large cold spots inside the tumor. This is mainly due to the motion of the diaphragm, which subsequently moves the tumor in the superior-inferior by more than 2 cm.

Conclusions: Image guided 4DMC methods can significantly improve the planning of lung tumor treatments by accurately modeling the motion of the tumors and large heterogeneity in the tumor region. Supported NIH/NCI-R01/CA111590