AbstractID: 8482 Title: Modifications of the MCNP code to facilitate Monte Carlo dose calculations with a CT geometry

Purpose: MCNP is a powerful Monte Carlo code, which is capable of modeling three-dimensional complex geometries and in the meanwhile provides high computational efficiency. However, as a general-purpose code, not all the issues in the specific application of Monte Carlo dose calculation in a patient geometry were fully addressed. The purpose of this study is to develop a modified version of the MCNP code to facilitate Monte Carlo dose calculations involving a large number of CT voxels and geometry change.
Method and Materials: A new type of BOX object is added to MCNP for being the container of a CT volume. Unlike the universe/fill structure in MCNP, this CT box is only filled with a single ordinary MCNP BOX object of the dimensions of a CT voxel. The location, dimensions, and material of the CT voxel box are allowed to change. Therefore, this voxel box is able to represent any CT voxel in the CT volume. Such a scheme has the advantage of saving computer memory. The material for CT voxels can be a Hounsfield unit (HU). The HU will be converted to a MCNP material on the fly. With the density effect ignored, the density of a material is allowed to change. Hence, each HU is associated with a unique mass density without defining a material for each HU. The geometry can also be changed in a simulation to enable simulations involving motions such as MLC leaf movement.
Results and Conclusion: A modified MCNP code is currently under development and debugging. The new code will one hand takes advantage of the great features in MCNP, and on the other hand facilitate and speed up the procedure of CT based Monte Carlo simulations. It will especially simplify motion-involved simulations such as those for IMRT.