AbstractID: 3658 Title: Application of a Heterogeneous Coarse-Mesh Transport Method to a Radiation Therapy Benchmark Problem

Purpose: To apply a new particle transport method that combines coarse-mesh transport and the Monte Carlo (MC) method to photons in radiation therapy to determine dose deposited and to quantify the increased speed and comparable accuracy of this method to the current pure MC methods.

Method and Materials: A highly accurate and fast heterogeneous coarse-mesh transport method developed for neutrons in 2D geometry is extended to photon transport for radiation therapy. Its accuracy and speed for energy deposition estimation is shown in a benchmark phantom made of water. The phantom is modeled using a grid of coarse meshes to perform the transport calculation using a heterogeneous response function technique. MC calculations are used to precompute all of the material property dependent response functions that characterize the mesh. These functions that make up the data library are used in the deterministic transport calculation by sweeping through the grid to compute the angular partial currents at each coarse-mesh edge, and the energy deposited in the phantom.

To test the method, a comparison of the energy deposition in the benchmark phantom was performed by modeling the entire phantom directly with the MC code MCNP5.

Results: The comparison over 150 meshes revealed an average relative error of the deposited energy of 2.25% between the two methods. However, the new method performed the calculation in 45 minutes, while MCNP5 required 2 hours.

Conclusion: The work indicates that this new transport method has the potential to provide similar results as those obtained by using a pure MC method while reducing the amount of time required in obtaining these results. With further optimization of the heterogeneous coarse-mesh code, it is expected to further decrease the run time. The eventual 3D extension will allow calculating the actual dose deposited.