AbstractID: 10484 Title: Acceleration of photon Monte Carlo dose calculation using multi-resolution voxel transport geometry

Purpose: A multi-resolution voxel geometry transport scheme was introduced to improve the efficiency of Monte Carlo dose calculation for photon beams. **Method and Materials:** Dual resolution voxel geometries were established with the coarse voxel size defined as a multiple of the finest voxel dimension. For each sub-step of secondary photons, if the step size is greater than the nearest coarse voxel boundary, the particle is transported in coarse resolution voxel geometry. When the residual step size is less than the nearest coarse voxel boundary, the transport of the particle is switched back to the fine resolution voxel geometry. Electrons are always transported in fine resolution geometry. Timing was compared with the full Monte Carlo carried out on the fine voxel geometry, using fine voxel size of 4, 2, 1 mm and different coarse voxel size up to 2 cm. This multi-resolution scheme was implemented in our in-house photon Monte Carlo code (pMC2) and was assessed for accuracy using three heterogeneous phantom test cases. **Results:** For the 4-mm, 2-mm and 1-mm voxel resolutions, the calculation time for the same particle histories can be decreased by 14%, 26%, and 42% respectively by using the dual resolution voxel transport geometry (for coarse voxel dimension of 2 cm). For the inhomogeneous test problems, the multi-resolution transport scheme agrees with the analog Monte Carlo dose calculation within 1%, even when there is high density material such as iron involved. The inter-resolution transport geometry swapping over head is negligible. **Conclusion:** This multi-resolution transport scheme proposed in this study is more efficient than regular photon Monte Carlo dose calculation. The efficiency gain is more significant when the finer calculation resolution is required. This acceleration scheme doesn't affect the accuracy and can be applied in any Monte Carlo dose calculation system.