AbstractID: 11424 Title: Comparing a grid-based Boltzmann solver with Monte Carlo simulation for voxel-based therapeutic radionuclide dose calculations.

Purpose: To compare the accuracy and speed of a deterministic grid-based Boltzmann solver (GBBS) with Monte Carlo (MC) simulations for calculating voxel-based absorbed dose rates from SPECT/CT imaging. **Methods:** A SPECT/CT image of a breast cancer patient with metastatic osteosarcoma was obtained using a tracer administration of ^{153}Sm EDTMP. The therapeutic activity administered was determined from MIRD estimates. DOSXYZnrc and the GBBS Acuros were used to calculate dose rate maps from the activity distribution over the full CT grid. The GBBS photon dose rate was calculated using the collisional KERMA approximation rather than explicitly transporting the generated electrons; an energy cutoff was used to neglect spatial transport of electrons below a threshold of 200 keV for Acuros and 189 keV for DOSXYZnrc. The photon, beta-particle, and total absorbed dose rates calculated using GBBS were compared with the gold standard MC simulations using the gamma index. Gamma index parameters evaluated were 3%/3mm and 5%/5mm; both used a step size of 0.5mm with a 10 mm search distance. A patient mask was created from the CT to report pixels within/near the patient. The gamma failure points (γ>1.0) within the patient mask were viewed overlaid on the activity map and on the CT for the calculated beta, photon, and total dose rates. **Results:** For total dose rate, 90.1% and 99.6% of pixels within the patient mask had $\gamma \leq 1.0$ for 3%/3mm and 5%/5mm respectively. γ failures were noticed at the edges of the activity distribution for beta-particles, and at various interfaces for the photons. For Acuros, the beta-particle and photon transport required about 10 minutes each. DOSXYZnrc took approximately 15,000 times longer. **Conclusions:** GBBS has the potential to provide accuracy similar to MC in a much shorter time; this could be useful for voxel-based radionuclide absorbed dose estimates in a clinical setting.