

## AbstractID: 13110 Title: A Hybrid Approach for Rapid and Accurate Kilovoltage Radiation Dose Calculations in CT Voxel Space

**Purpose:** To develop and validate a novel fast and accurate method that uses computed tomography (CT) data to estimate absorbed radiation dose at a point of interest (POI) from a kilovoltage (kV) imaging procedure.

**Method and Materials:** We develop an approach that computes absorbed radiation dose at a POI by numerically solving the Boltzmann transport equation (BTE) using a combination of deterministic and Monte Carlo (MC) techniques. Our approach accounts for material heterogeneity with a level of accuracy comparable with general analog MC algorithms. Also, calculation times are fast compared with analog MC methods, and the calculations are performed using CT voxel data making it flexible and feasible for clinical applications. To validate our method, we construct and acquire a CT scan of a heterogeneous block phantom consisting of the following succession of slab densities: tissue (1.29cm), bone (2.42cm), lung (4.84cm), bone (1.37cm), and tissue (4.84cm). Using our hybrid transport method, we compute absorbed doses at a set of points along the central axis of the phantom for a 125 kVp photon spectral point source situated 100cm above the phantom surface. The results are compared to those computed with MCNP, which serve as the benchmark for validation.

**Results:** The percentage error in the doses computed from our method compared with the MCNP range from 0% to 3.7% with an overall mean percentage error and standard deviation of 0.4% and 1.2%, respectively. In contrast to the 213 million particles required to compute the average dose in 663 voxels of a MCNP cell with precision 0.5%, the number of photons required to achieve the results with our method is 2 million.

**Conclusion:** We demonstrate a fast and accurate numerical solution to the BTE that uses CT voxel data to estimate absorbed x-ray dose at a POI from a kV imaging procedure.