AbstractID: 8287 Title: Deterministic photon kerma distribution based on the Boltzmann equation for external beam radiation therapy

Purpose: There has been rising interest in the medical physics community to calculate the dose with a deterministic transport approach by solving the Boltzmann transport equation (BTE). The purpose of this work is to develop a photon transport algorithm based on the discrete ordinates (S_N) solution of the Boltzmann equation for fully three-dimensional radiotherapy treatment. **Method and Materials:** The Boltzmann equation was solved in the S_N spatial, energy and angular discretization form on an adaptive mesh so that multiresolution can be achieved wherever large gradients occur. An octree-like data structure has been implemented for generation of the adaptive mesh. Ray-effects inherent with the discrete ordinate method are mitigated by evaluating the source term in the spherical harmonic expansion and through use of the first collision method. The integral form of the BTE is solved with the method of characteristics along each discrete direction in the Gaussian quadrature for a given energy group. **Results:** The total group cross sections and Legendre moments of group-scattering cross sections were calculated using our code MGCS. To validate the algorithm, several examples were employed to calculate the photon flux distribution. The results were compared with Monte Carlo (MC) calculations using EGSnrc. Comparison shows that the agreement for kerma distribution is within the MC uncertainties. **Conclusions:** The discretization of the space, angle and energy phase space associated with the S_N solution of the Boltzmann equation requires large memory storage space. However, with careful implementation such as using adaptive mesh, the deterministic method can provide an alternative approach for computation of accurate radiological quantities.

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