Monte Carlo Fast Dose Calculator for Proton Radiotherapy

TRAVIS BRANNAN, JESSIE HUANG, PABLO YEPES, Rice University, RICE - M.D. ANDERSON COLLABORATION — Monte Carlo methods used in proton radiotherapy are more accurate than commonly used analytical dose calculations, at the cost of being computationally intense. We intend to show the feasibility of the Fast Dose Calculator (FDC), a Monte Carlo track-repeating algorithm based on GEANT4, to perform dose calculations for a clinical proton beam. FDC was developed to retain the accuracy of the Monte Carlo approach while substantially decreasing the calculation time required. FDC uses a database of proton trajectories in water and extrapolates this data in order to calculate the dose in heterogeneous media by scaling the proton range and scattering angles. FDC has been extended to include all of the patient-dependent elements of a passive proton scattering treatment unit: aperture, range compensator, and voxelized patient geometry. Improved database packing provides additional computational efficiency in FDC, which speeds calculation by more than two orders of magnitude. In addition FDC shows no dependence on calculation times with the number of voxels, unlike GEANT4. The dosimetric accuracy of the FDC algorithm was validated by comparing the results with GEANT4.