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IMPROVED CT-BASED VOXEL PHANTOM GENERATION FOR MCNP MONTE CARLO

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Introduction: CT-based, voxelized models are often used in Monte Carlo investigations. While such models can preserve detail, transport simulation through a high-resolution lattice is resource intensive. To improve simulation efficiency while maintaining accuracy, an investigator can optimize the model's spatial resolution, material conversion, tally definition, variance reduction applications, and more. A program with a graphic user interface (GUI) has been developed to perform and visualize these functions while generating voxelized Monte Carlo models in order to increase simulation efficiency while maintaining detail.
Methods: The programs were written in Information Data Language (IDL) for use in creating voxelized models within input files for the Monte Carlo N-Particle (MCNP) program. CT-scans are quickly acquired, translated, and formatted into a voxel-based phantom that preserves the CT information and geometry. Multiple lookup tables are available for greater flexibility in translating HU values into atomic compositions and densities for accurate material assignment. Re-sampling of the model is easily accomplished and visualized. This software allows the user to create a perfectly overlying energy deposition tally for an arbitrarily-sized region of interest as well as a corresponding density matrix for conversion of simulation results into dose deposition. Spatial localization is easily accomplished and visualized. Finaly, this software enables truncating the lattice extent in order to obviate Monte Carlo transport through extraneous surfaces, thus greatly increasing the efficiency of the simulation while maintaining resolution. Additional programs are used for post-simulation data processing, normalization with uncertainty considerations, and clinically-relevant analysis.
Results: This development can greatly decrease time required for a given uncertainty; judicious application of these tools has resulted in reduction of simulation times by over 60%.
Conclusion: This interface, combined with post-processing comparative analysis software and clinically accurate source models, provides a powerful tool for Monte Carlo investigations.

Keywords: Monte Carlo, MCNP, radiotherapy