AbstractID: 11251 Title: Fast GPU-based raytracing dose calculations for brachytherapy in heterogeneous media

Purpose: To develop a fast dose calculation algorithm for permanent implant brachytherapy in heterogeneous media based on raytracing. **Method and Materials:** We have implemented a modified version of the TG-43 dosimetry protocol based on an incremental version of Siddon's raytracing algorithm that accounts for tissue composition and interseed attenuation. Raytracing along straight lines from sources to dose calculation points is used to evaluate the length traveled in each voxel, for which the density and composition are known. The water-equivalent distance corresponding to this radiological length is then used to compute the dose with the TG-43 formalism. The raytracing being numerically intensive, we have implemented the algorithm on a Graphics Processing Unit (GPU) in order to exploit its parallel processing features and therefore reduce the overall dose computation time. For this purpose we used a NVIDIA 8800 GT GPU and the CUDA programming language. The algorithm was tested with a simple voxelized phantom and the results were compared to regular TG-43 dose calculations. **Results:** Tissue composition and interseed attenuation were shown to impact significantly the dose calculation in a simple scenario. The GPU version of the modified TG-43 algorithm was up to 34x faster than its Central Processing Unit (CPU) version. The accuracy of the results was the same on the GPU as on the CPU**. Conclusion:** Brachytherapy dose calculations can potentially be more accurate by accounting for heterogeneities with raytracing-based algorithms. These algorithms are numerically intensive but can exploit the parallel architecture of stream processors such as GPUs for acceleration. The GPU implementation presented here allows for execution times that are more acceptable for a clinical use. Future work will include the evaluation of the accuracy of the algorithm with Monte Carlo simulations. **Conflict of Interest:** Research sponsored by Varian Medical Systems Inc.