

AbstractID: 14005 Title: Implementation of a Geant4 based GPU Monte Carlo algorithm and benchmarking of an IMRT patient plan.

Purpose:

To calculate the Monte Carlo based dose distribution of an IMRT prostate case on the GPU and thereby significantly increase the computation speed.

Method and Materials:

A Geant4 based head simulation of an Elekta Synergy accelerator head was utilized to calculate a phase space plane between the head and the patient geometry. An NVIDIA CUDA implementation of the GEANT4 low energy transportation algorithm was programmed validated for regular field shapes and then used to calculate the IMRT dose distribution of one prostate patient. The dose distribution was also calculated using GEANT4 on the same patient geometry. In the GPU implementation as well as in GEANT4 no variance reduction techniques were used. The IMRT patient was optimized with the Corvus treatment planning system (NOMOS).

Results:

The results showed a good agreement (gamma criteria 4%/3mm > 97 %) between Geant4 CPU based simulations and the GPU based simulations. The computation time was approximately the same (12 minutes) for a 256 node cluster and 2 NVIDIA GTX 295 GPUs installed on one Intel quad core computer. This compares very well to time modern Voxel Monte Carlo based treatment planning systems need for one recalculation.

Conclusion:

This implementation proves the possibility to calculate complex IMRT plan simulations with a Monte Carlo dose engine on GPUs. This work is the starting point for future investigations leading to new variance reduction techniques suitable for GPUs and improving the speed of Monte Carlo simulations on standard workstations.