AbstractID: 9187 Title: Fast DRR and CBCT reconstruction on GPU

Purpose: To accelerate the synthesis of digitally reconstructed radiographs (DRRs) and the reconstruction of cone-beam CT (CBCT) data with the help of commodity graphics processing units (GPUs). The massively parallel architecture of GPUs allows significant improvements in execution speed for algorithms that present various levels of symmetry.

Method and Materials: We have implemented DRR synthesis and CBCT reconstruction algorithms on GPUs and have compared their execution speed and accuracy with those of traditional CPU implementations. DRRs were obtained with an incremental version of Siddon's algorithm, an exact raytracing routine, while CBCT reconstructions were based on the FDK algorithm. The benchmarking was conducted with a nVidia GeForce 8800 GTX graphics board hosted in a 2.4 GHz Intel Quad Core PC. The Cg shading language was used for GPU programming, and all calculations were performed in single precision.

Results: We have achieved execution speed improvement factors of 47x for DDR synthesis and of 100x for CBCT reconstruction with the GPU implementation. These figures, obtained with relatively large, clinically relevant datasets (512 Mb), could further be improved by using smaller datasets that fit entirely in the video memory. The DRRs obtained with the GPU implementation were identical to their CPU versions while the CBCT images presented slight differences (2% standard deviation), most likely due to discrepancies in the CPU-GPU floating-point rounding conventions.

Conclusion: We have implemented on a streaming architecture two algorithms relevant to many branches of medical physics. We have achieved significant speed increase factors while preserving the accuracy of the results. The rapid development of GPU products sporting more memory, supporting double-precision and running at higher clock speeds lets envision even faster execution and more accurate results, thereby opening the way to new, innovative applications in medical physics.