Purpose: To develop a Graphics Processing Unit (GPU) based Monte Carlo (MC) code that accelerates dose calculations on a dual-GPU system.

Methods: We simulated a clinical case of prostate cancer treatment. A voxelized abdomen phantom derived from 120 CT slices was used containing 218—126—60 voxels, and a GE LightSpeed 16-MDCT scanner was modeled. A CPU version of the MC code was first developed in C++ and tested on Intel Xeon X5660 2.8GHz CPU, then it was translated into GPU version using CUDA C 4.1 and run on a dual Tesla M2090 GPU system. The code was featured with automatic assignment of simulation task to multiple GPUs, as well as accurate calculation of energy- and material-dependent cross-sections.

Results: Double-precision floating point format was used for accuracy. Doses to the rectum, prostate, bladder and femoral heads were calculated. When running on a single GPU, the MC GPU code was found to be 19 times faster than the CPU code and 42 times faster than MCNPX. These speedup factors were doubled on the dual-GPU system. The dose result was benchmarked against MCNPX and a maximum difference of 1% was observed when the relative error is kept below 0.1%.

Conclusions: A GPU-based MC code was developed for dose calculations using detailed patient and CT scanner models. Efficiency and accuracy were both guaranteed in this code. Scalability of the code was confirmed on the dual-GPU system.