Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

Accelerating Computed Tomography on Graphics Hardware

By

Fang Xu

The task of reconstructing an object from its projections via tomographic methods is a time-consuming process due to the vast complexity of the data. For this reason, manufacturers of equipment for medical computed tomography (CT) rely mostly on special ASICs to obtain the fast reconstruction time required in clinical settings. Although modern CPUs have gained sufficient power in recent years to be competitive for 2D reconstruction, this is not the case for 3D reconstructions, especially not when iterative algorithms must be applied. The recent evolution of commodity programmable PC computer graphics boards (GPUs) has the potential to change this picture in a very dramatic way. In the thesis proposal, we show that many types of CT algorithms, both iterative and non-iterative, can greatly benefit from the high degree of SIMD (Same Instruction Multiple Data) parallelism these platforms provide. By doing so, high-fidelity results can be obtained at speedups of over an order of magnitude. In addition to describing the theories and implementation details, we show our own solutions of resolving various challenges presented in cone-beam reconstruction using Feldkamp's method, which frequently arise in practical application settings. We also proposed optimization techniques specifically targeting on the latest GPU architecture that enables the implementation of streaming-CT notion. Next, we use the electronic microscopy tomography application as an example to show the power of GPU's computational capability due to its extensive usage of iterative algorithms. Here a sinogram-based method was designed to achieve the maximum speedup and ease the implementation of system scalability. Last, a new rendering method D2VR that can produce higher visualization quality than traditional volume rendering algorithms but suffers from high computational complexity, is accelerated by our rendering-driven rapid-CT framework to obtain a near-interactive framerate.

Date: September 18, 2007 **Program**: Computer Science
Time: 2:00pm **Dissertation Advisor**: Klaus Mueller
Place: Computer Science Department, Room 2311