AbstractID: 13290 Title: Cone beam computed tomography reconstruction on graphics processing units: Flat3D texture techniques

Purpose: Graphics processing units (GPUs) can shorten cone-beam volume reconstruction time significantly in comparison to CPUs. We evaluated *Flat3D* texture techniques to further enhance calculation efficiency.

Methods: Typical reconstruction involves processing of a set of 2D projection images, and filtered backprojection of them onto volume slices. We implemented three different back-projection algorithms on GPUs. The first method, *BP_tex2d*, represents the volume as a set of 2D textures and backprojection onto the texture occurs one slice at a time. The second method (*BP_flat3d*) represents the volume using a *Flat3D* texture. *Flat3D* texture is a 2D texture that maps volume slices onto 2D texture surface side-by-side. Therefore, for a given projection image, the back-projection is accomplished in a single rendering pass. The third approach (*BP_flat3d_multitex*) back-projects multiple projection images (16 here) onto a *Flat3D* texture in a single rendering pass using multi-texture support. We reconstructed a 3D Shepp-Logan phantom (256x256x256 $pixel^3$) from a set of 360 projection images (512x384 $pixel^2$) using each method. Back-projection time was estimated by subtracting the image load and filter time from the total reconstruction time. Ten measurements were performed for each method and the mean time determined. Host computer: 3.6 GHz Intel Pentium 4 CPU with 2 GB memory. GPU: Nvidia_GeForce_210 (512 MB)+PCIe.

Results: The mean back projection times of *BP_tex2d, BP_flat3d, and BP_flat3d_multitex* were 51, 16, and 8 seconds respectively. The image loading and filtering time was 24 seconds. The reconstructed volumes had identical pixel values.

Conclusion: *Flat3D* texture approach improved the back-projection time by a factor of 3.2, compared to regular 2D texture based method. The utilization of multi-texture improved the speedup by a factor of 2 (thus, 6.4 total). High quality iterative reconstruction may be possible in the clinical setting given such improvements on multiple GPUs.