

Rapid Vascular Rendering using 4D Cluster Visualization

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Introduction: We present a system to interactively target the rendering and viewing angle of large time-resolved set of 3D image volumes (4D) using a computer cluster [1]. The system, demonstrated in the attached animation of vascular flow in the torso, exploits the power of graphics cards to offload CPU resources necessary for real-time imaging.

Methods: A 4D Cluster Visualization (4DCV) system is implemented on a Linux-based PC cluster using commodity graphics cards, OpenGL, sockets, QT, and an internally-developed token-scheduling protocol in a master-slave configuration. Rendering is currently performed with one frame per node, but the technique can be extended to support multiple frames per node.

Results and Discussion: The system can manipulate a large 256^3 voxel volume with roughly a 170 ms response time and an animation rate of 8 frames/s. The thickness, orientation, and viewing angle of a targeted MIP volume can be interactively specified to isolate the relevant structures of interest for the interventionalist. Aside from the QT GUI on the master, 4DCV uses mainly graphics card resources, freeing CPU cycles for MRI image reconstruction. Token scheduling and sockets are used to reduce response time from user manipulations to viewing images. Our visualization engine is available to the public.

[1] M.J. Redmond et al. SPIE Symp. on Medical Imaging p. 28-38, 2004.