Focus and Context—Visualization without the Complexity

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ABSTRACT

Attempting to display the entirety of a large volumetric dataset at one time would result in an overwhelming amount of information. Furthermore, visualization tools based on volume rendering present the user with a host of confusing options. We present ClearView, which provides a simplified volume visualization tool with a focus on doing what matters most: looking at your data. Users frequently want to direct the viewer's attention to a particular region of their volumes. With many volume rendering tools, this means setting up complex transfer functions to highlight the region of interest, with the unfortunate side effect of potentially affecting the larger image. ClearView allows the user to focus their visualization efforts on the area of their choice, while separating parameters for visualizing of surrounding data. This provides not only a simplified user interface, but finer-grained control over the final publication-quality visualization. Through advanced GPU rendering techniques, ClearView presents all of this to the user at highly interactive frame rates.

Index Terms— focus, context, volume, visualization

1. INTRODUCTION

As data sizes grow, the amount of information resident in those data grows proportionally. Visualizations of these large datasets are correspondingly dense in their complexity, causing the viewer to be lost in a sea of data. This can cause important features to be drowned out by surrounding data, making the viewer focus on aspects of the data which are relatively unimportant.

'ClearView' is a reaction to the complexities of the images generated by modern volume rendering tools. It was designed to follow the 'focus and context' model of visualization, in which we focus our attention on an area of interest while maintaining the relevant context of spatially related data [1]. The result is a very simple tool which users can grasp, manipulate, and use to understand their data quickly and easily.

Images are generated based on the ClearView lens, which the user moves through the dataset to look inside at values of interest. Even though context information is dissolved to allow viewing inner portions of the dataset, small scale structures of the context data are preserved to allow one to easily infer the relationship between the 'focus' and 'context' data.

Fig. 2. ClearView rendering of the visible human male torso.

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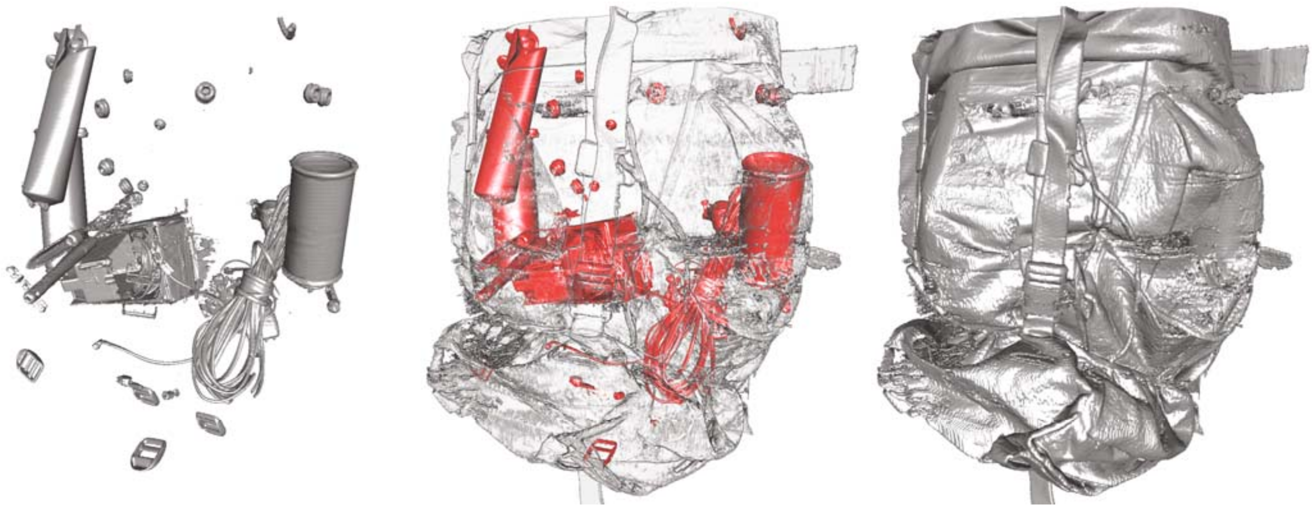

Fig. 1. Internal (left) and external (right) views of a backpack, with the ClearView rendering in the center.

2. Methods

At its core, ClearView is a rendering mode which allows the simultaneous viewing of two isosurfaces: an inner, or 'focus' isosurface, and an outer, or 'context' isosurface. ClearView renders the two surfaces independently and then composites them together based on the position of the ClearView lens. The lens dictates the behavior of the compositing: near the center of the lens, the 'focus' isosurface dominates the rendering. As the distance increases radially from the center of the lens, the 'context' isosurface is weighted more prominently. Thus it appears as if the 'focus' isosurface is gradually occluded by the 'context' isosurface.

Yet ClearView provides more than just a rendering of two isosurfaces. To better highlight the important context information available in the dataset, distinct features in the context isosurface are preserved even if the lens is focused on those features. In the depicted implementation, areas of high curvature are preserved. This is represented well in Figure 2; note that one can still recognize creases in the neck, as well as the location of the ears, despite the ClearView lens being centered around the jaw.

Real time feedback of malleable rendering parameters is critical for exploratory visualization systems [2]. Due to the importance of this style of interaction, ClearView is implemented to take advantage of the advanced parallel computation capabilities of modern graphics processing units [3, 4, 5]. This design choice, coupled with an appropriate out of core renderer [2], allows ClearView to render data of immense sizes at hundreds of frames per second.

3. Discussion

To use ClearView, the user selects an outer isovalue, which determines the surface rendered for the 'context' isosurface. Then the user places a lens over the data which depicts the location where the inner surface will show through. Finally, the user customizes a second isovalue, in turn selecting the inner or 'focus' isosurface. This makes an intuitive interface to create informative visualizations, as has been shown in previous work [6, 7].

The ease of explanation is one of the strengths of ClearView. Unlike some volume rendering tools, users can immediately grasp the concept behind ClearView and focus on looking at their data. Further, users do not need to become volume rendering experts to explain to a colleague what a ClearView visualization is conveying—in many cases, no explanation is required, as the focus of the image is self-evident.

4. Conclusions

Advances in state of the art visualization can enable and empower users to create new and informative visualizations. However non-experts may lack the time required to penetrate the background material needed to under-

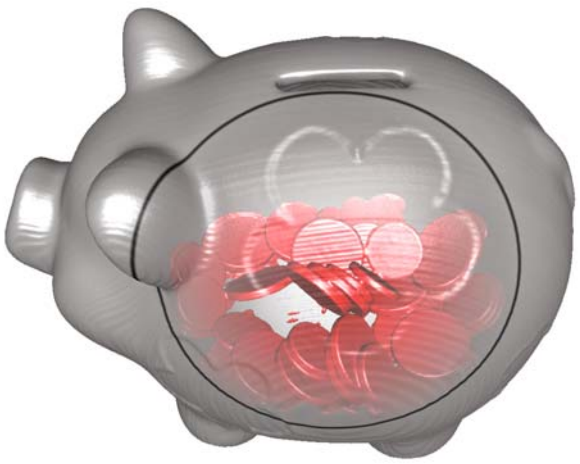

Fig. 3. The rendering provided by ClearView allows us to count the change in this piggy bank, saving the fortuitous piggy from untimely destruction.

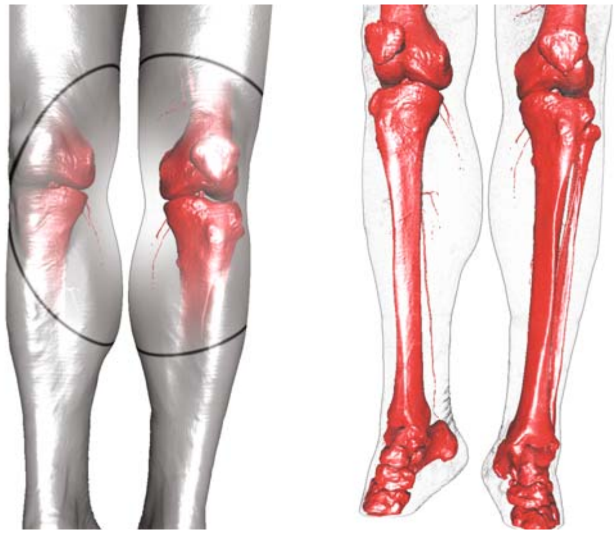

Fig. 4. ClearView renderings of the knee area clearly show the relative size and alignment of bone and flesh.

stand a new method. For the most part, researchers should not be expected to become experts in visualization technologies if they only desire to use a specific tool. In the end, what matters most is the ability to create informative media with minimum effort.

ClearView provides a simplified rendering mode which sacrifices complexity to focus on what the majority of users require: a method to highlight a feature of interest without removiing potentially relevant context information. In contrast to typical volume rendering tools, ClearView has few parameters, and the default settings work surprisingly well; this allows users to rapidly discern the interesting features of their data.

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References

[1] Jens Krüger, Jens Schneider, and Rüdiger Westermann, "ClearView: An interactive context preserving hotspot visualization technique," *IEEE Transactions on Visualization and Computer Graphics (Proceedings Visualization / Information Visualization 2006)*, vol. 12, no. 5, September-October 2006.

[2] Thomas Fogal and Jens Krüger, "Size matters—revealing small scale structures in large datasets," in *International Union for Physical and Engineering Sciences in Medicine World Congrees 2009*, September 2009, To Appear.

[3] Brian Cabral, Nancy Cam, and Jim Foran, "Accelerated volume rendering and tomographic reconstruction using texture mapping hardware," in *VVS '94: Proceedings of the 1994 symposium on Volume visualization*, New York, NY, USA, 1994, pp. 91–98, ACM.

[4] Timothy J. Cullip and Ulrich Neumann, "Accelerating volume reconstruction with 3D texture hardware," Tech. Rep. TR93-027, University of North Carolina at Chapel Hill, 1994.

[5] Jens Krüger and Rüdiger Westermann, "Acceleration Techniques for GPU-based Volume Rendering," in *Proceedings IEEE Visualization 2003*, 2003.

[6] Milan Ikits and Charles D. Hansen, "A focus and context interface for interactive volume rendering," May 2004.

[7] Eric A. Bier, Maureen C. Stone, Ken Pier,

William Buxton, and Tony D. DeRose, "Toolglass and magic lenses: The see-through interface," in *SIGGRAPH '93: Proceedings of the 20th annual conference on Computer graphics and interactive techniques*, New York, NY, USA, 1993, pp. 73–80, ACM.