A Comparative Study of Mipmapping Techniques for Interactive Volume Visualization - Appendix

A TRANSFER FUNCTION DESIGN

For each volume we use a transfer function that on the one hand represents interesting features that can be seen in the volume while also emphasizing intensity values in these volumes that plain mipmapping does not preserve well. For the 'Male' data set we show extreme points and also the multi-layered structure of the data. In the 'Brain' data set we have several peaks in the transfer function showing different regions of the brain. The 'Aneurysm' volume shows a very delicate sparse and high frequency structure that we visualize with a simple step-like transfer function. We tried to find a transfer function that preserves the layered structure of the seismic dataset ('SEGY') best. For the 'Spherical' volume we used a high frequency transfer function containing different colors similar to the ones used by Younesy et al. [1] to visualize the shift in values that occurs when using downsampling of the intensity data.

B RESULTS

Dataset	Non-Linear	Aniso.	Mipmaps	Linear
Aneurysm (ℓ_2)	76%	60%	122%	75%
Male (ℓ_3)	232%	51%	385%	225%
Brain (ℓ_2)	69%	16%	109%	70%
Spherical (ℓ_3)	138%	90%	207%	133%
SEGY (ℓ_2)	102%	16%	150%	97%

Table 1: Performance measurements of different techniques relative to rendering at the original resolution (ℓ_0).

REFERENCES

[1] H. Younesy, T. Möller, and H. Carr, "Improving the quality of multi-resolution volume rendering," in *IEEE VGTC '06*. Eurographics Association, May 2006, pp. 251–258.

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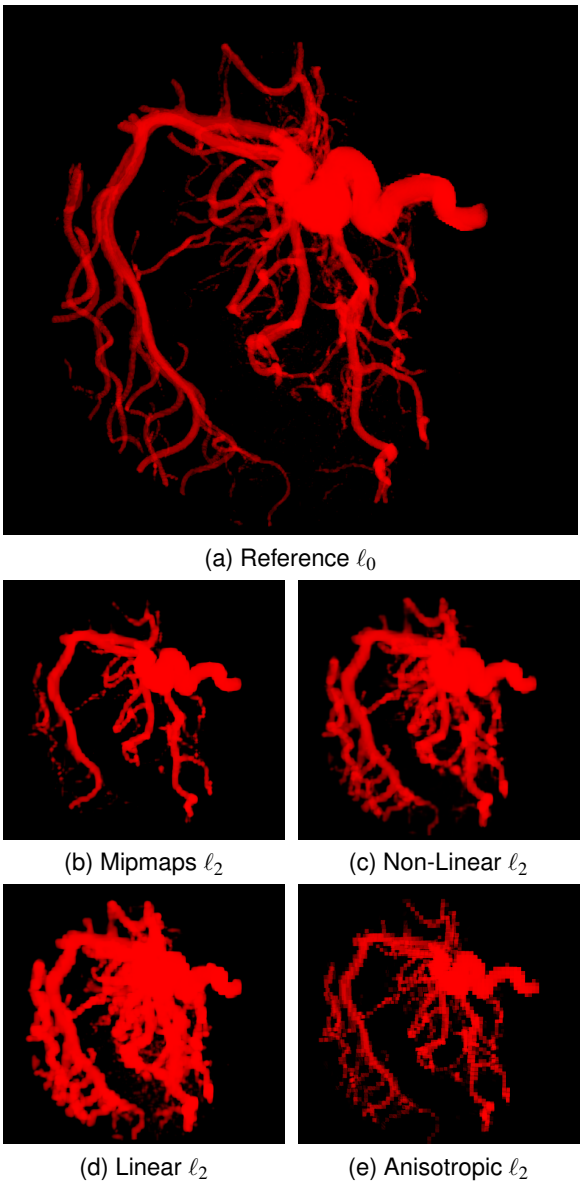
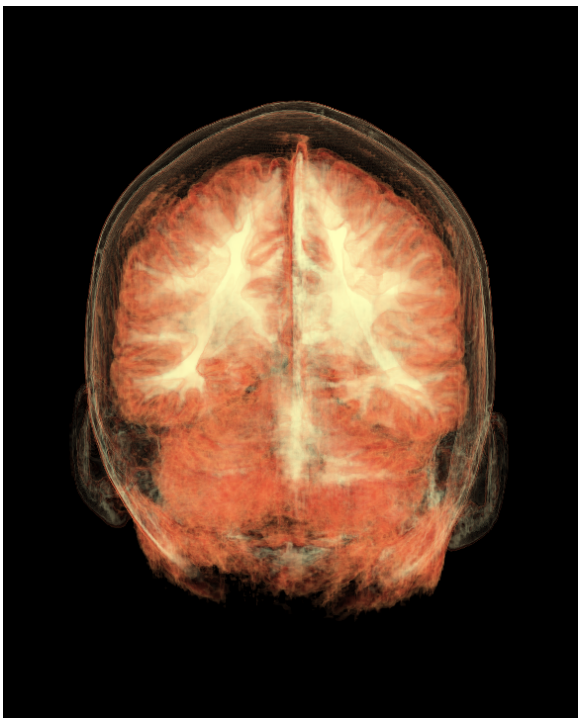


(a) Reference ℓ_0

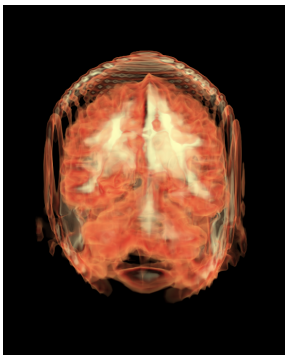
(b) Mipmaps ℓ_2 (c) Non-Linear ℓ_2

(d) Linear ℓ_2 (e) Anisotropic ℓ_2

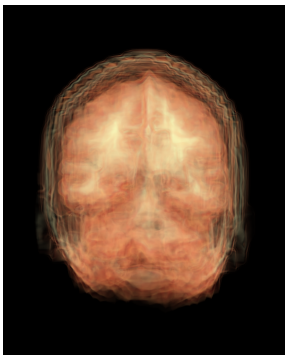
Figure 1: The Aneurysm dataset, rendered at its original resolution ℓ_0 (a) and at resolution ℓ_2 for the downsampled methods. It shows a vascular structure with high frequency details. The plain mipmapping (b) looses a lot of the details in these areas whereas the Anisotropic Mipmaps (e) preserve these best. The Non-Linear (c) and Linear (d) reconstructions exaggerate these high frequency areas.



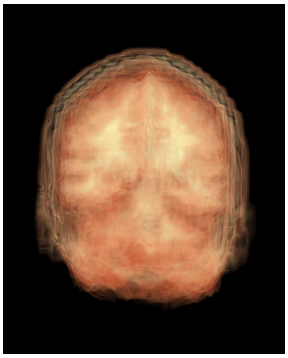
(a) Reference ℓ_0



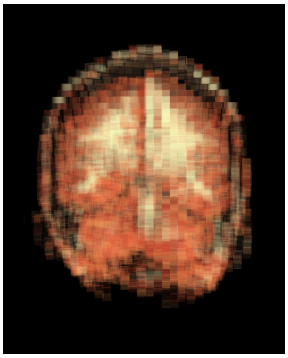
(b) Mipmaps ℓ_2



(c) Non-Linear ℓ_2

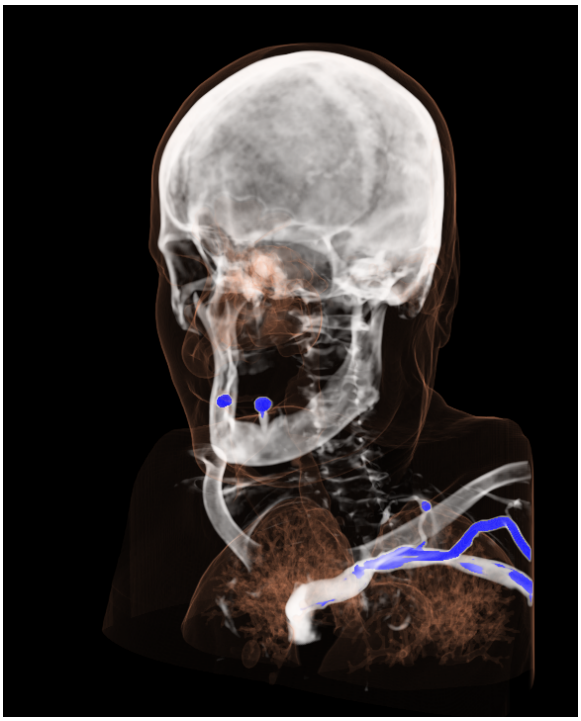


(d) Linear ℓ_2



(e) Anisotropic ℓ_2

Figure 2: The Brain dataset, rendered at its original resolution ℓ_0 (a) and at resolution ℓ_2 for the downsampled methods. The plain mipmapping (b) provides a visually similar result to the reference whereas the Anisotropic Mipmaps (e) just seem to add 'blocks' on top of the plain mipmapping. The Non-Linear (c) and Linear (d) are visually similar and produce a blurrier image as small white structures in the brain are exaggerated.



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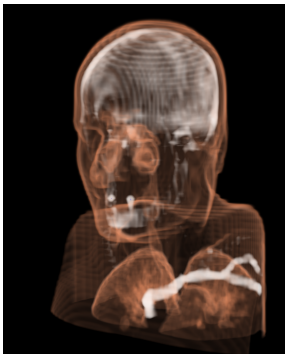
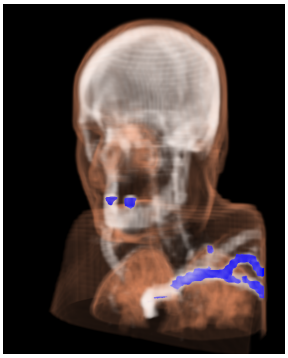
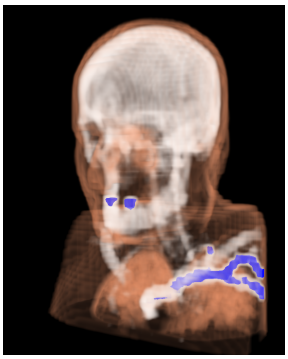


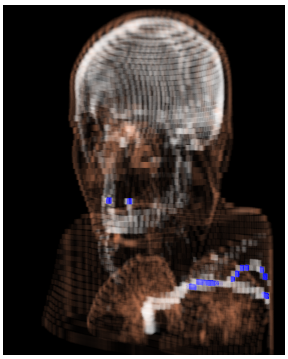
(b) Mipmaps ℓ_3



(c) Non-Linear ℓ_3

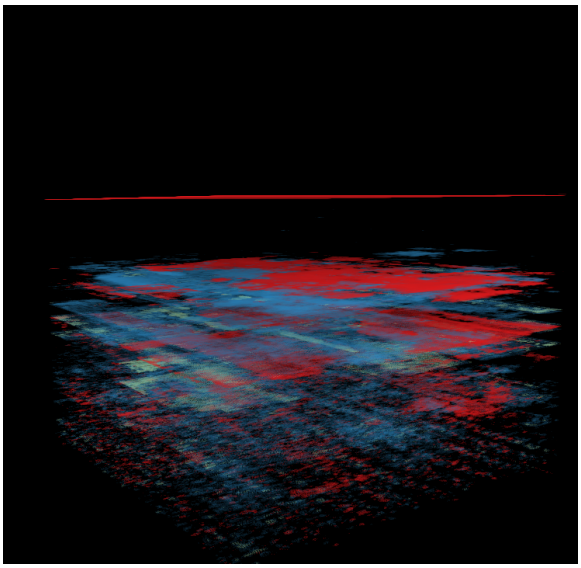


(d) Linear ℓ_3



(e) Anisotropic ℓ_3

Figure 3: The Male dataset, rendered at its original resolution ℓ_0 (a) and at resolution ℓ_3 for the downsampled methods. The high intensity values in this volume are colored in blue. The plain mipmapping (b) can not preserve these values as well as the bone structure of the jaw. The Non-Linear (c) and Linear (d) reconstructions clearly show all of the original volumes details. The Anisotropic Mipmaps (e) preserve the overall colors best but also miss some of the high intensity regions.



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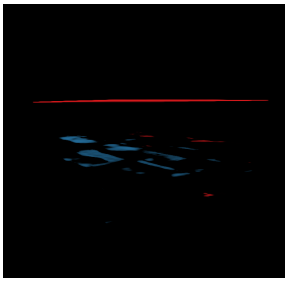
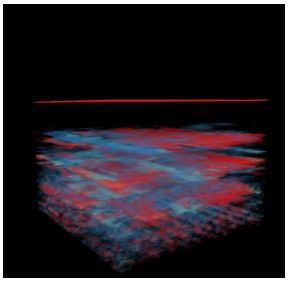
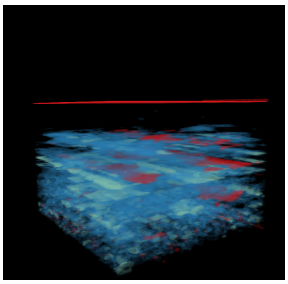


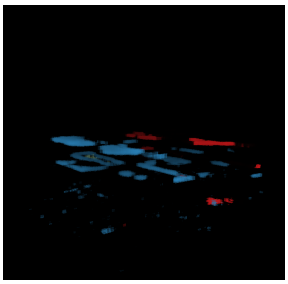
(b) Mipmaps ℓ_2



(c) Non-Linear ℓ_2

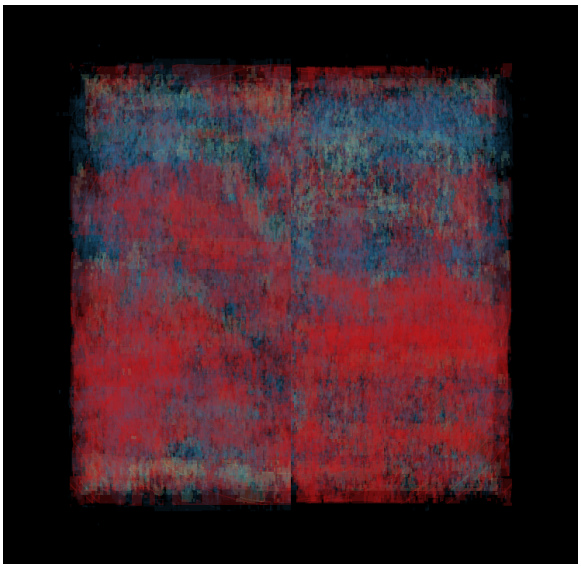


(d) Linear ℓ_2

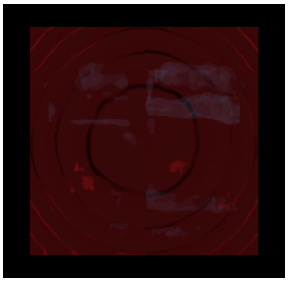


(e) Anisotropic ℓ_2

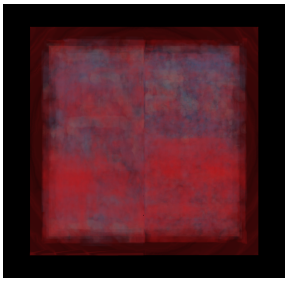
Figure 4: The SEGY dataset, rendered from a perspective view at its original resolution ℓ_0 (a) and at resolution ℓ_2 for the downsampled methods. The plain mipmapping (b) nearly looses all information of the geological layers. The Anisotropic Mipmaps (e) also loose most of the details due to the perspective viewing direction. Using Linear Reconstruction (d) a shift in values can be observed while Non-Linear Reconstruction (c) produces a convincing image.



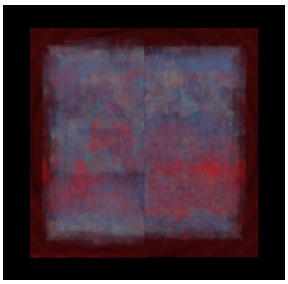
(a) Reference ℓ_0



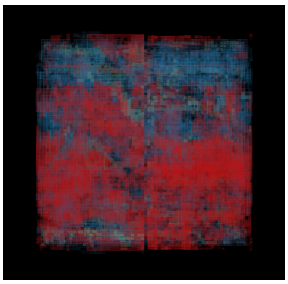
(b) Mipmaps ℓ_2



(c) Non-Linear ℓ_2

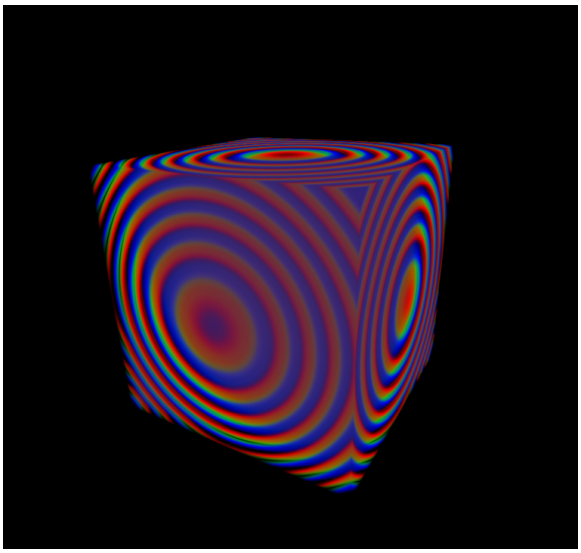


(d) Linear ℓ_2



(e) Anisotropic ℓ_2

Figure 5: The SEGY dataset, rendered from a top view at its original resolution ℓ_0 (a) and at resolution ℓ_2 for the downsampled methods. As in Fig. 4 plain mipmapping does not preserve the structure of this dataset. Also the Non-Linear (c) and Linear (d) reconstructions provide images similar to Fig. 4 with an overestimation of the top layer. From this perspective the Anisotropic Mipmapping (e) provides results that are very similar to the reference image.



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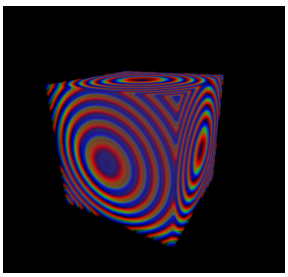
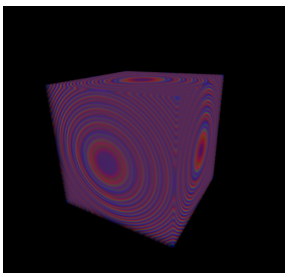
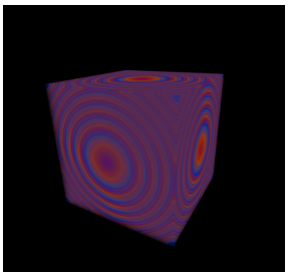


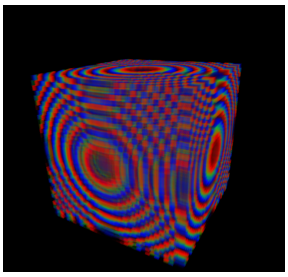
(b) Mipmaps ℓ_3



(c) Non-Linear ℓ_3



(d) Linear ℓ_3



(e) Anisotropic ℓ_3

Figure 6: The Sphere dataset, rendered at its original resolution ℓ_0 (a) and at resolution ℓ_3 for the downsampled methods. At first glance the plain mipmapping (b) looks best but when looking at the center a shift in colors due to intensity changes can be observed. The Anisotropic Mipmaps (e) have similar errors, whereas the fading to grey in Non-Linear (c) and Linear (d) reconstructions are an expected artifact to avoid aliasing.