Volume Visualization: Individual Extension

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1 Motivation

Given the stent dataset, I wish to observe the organs, the rib cage,its structure within the body and it's orientation with respect to each other. Additionally, finding complex transfer functions and the colours to be assigned to various regions can be time consuming, hence I want to incorporate algorithms that provide good visualizations for simple linear transfer functions.

2 Algorithms

2.1 Maximum intensity difference accumulation(MIDA)

MIDA[1] is method which aims to combine the advantages of DVR and MIP. It allows us to use the feature of MIP to show the most relevant structures and the feature of compositing to incorporate depth information, while using simpler transfer functions. The algorithm modifies the behavior of Compositing to prevent local maxima from becoming completely occluded while still preserving opacity-based accumulation. It does so by finding regions along the ray where there is a jump from a smaller to higher value, and increasing the opacity of such regions proportional to the height of the jump. The technique also incorporates a parameter gamma that allows us to linearly interpolate between MIP and Composting, helping us adapt the technique to our dataset.

2.2 Tone shading and boundary enhancement

While MIDA along with normal Phong shading can provide clearer visualizations, I wanted to improve the depth cues of the visualization. While this can be done using more complex transfer functions, Tone shading[2] allows us to get similar effects by having surfaces facing the light a warm cast while surfaces not facing the light get a cool cast. This improves the realism of the visualization and improves depth perception though chromostereopsis. Tone shading forms the final surface color by by interpolation between the warm and cool color based on the signed dot product between the surface normal and light vector. We finally use the boundary enhancement mentioned by [2] to increase the "surfaceness" of the visualization. This technique use the magnitude of the gradient to enhance opacity to improve boundaries between regions.

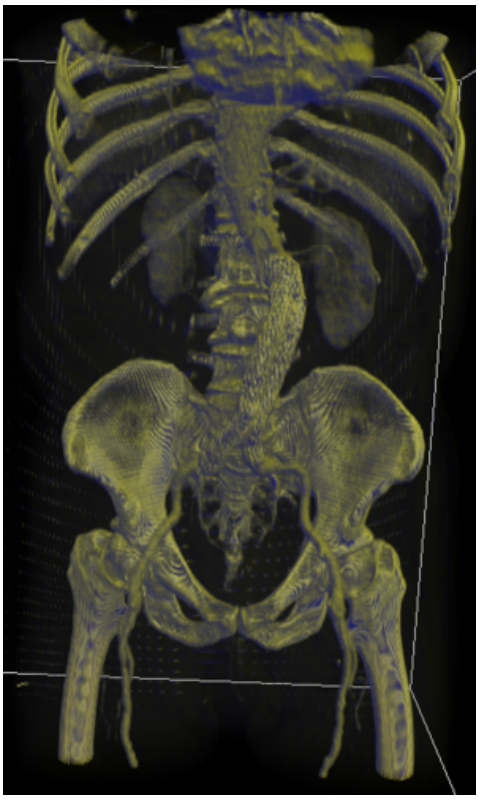
3 Results

In Figure.1.c we see that structures are more clearly separable and have better opacity per structure overall as compared to 1.b and 1.a(See green boxes). The shape of the hip bone and the ribs behind the cloudy material can be seen more clearly in 1.c. In 1.d we see an overall improvement in depth perception, structure boundaries and surfaceness allowing us to clearly separate different structures such as bones veins and organs and understand their spatial organization.

(a) Maximum intensity projection

(b) Compositing with volume shading

(c) MIDA with Phong shading



(d) MIDA with tone shading and boundary enhancement

Figure 1: Visualization using different render modes

References

[1] Stefan Bruckner and M. Eduard Gröller. Instant Volume Visualization using Maximum Intensity Difference Accumulation. *Computer Graphics Forum*, 2009.

[2] P. Rheingans and D. Ebert. Volume illustration: nonphotorealistic rendering of volume models. *IEEE Transactions on Visualization and Computer Graphics*, 7(3):253–264, 2001.