Visualization of Volumetric Data

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1 Non-direct methods

Aortic aneurysm is enlargement of the aorta to greater than 1.5 times of normal size.

1.1 Finding aneurysm

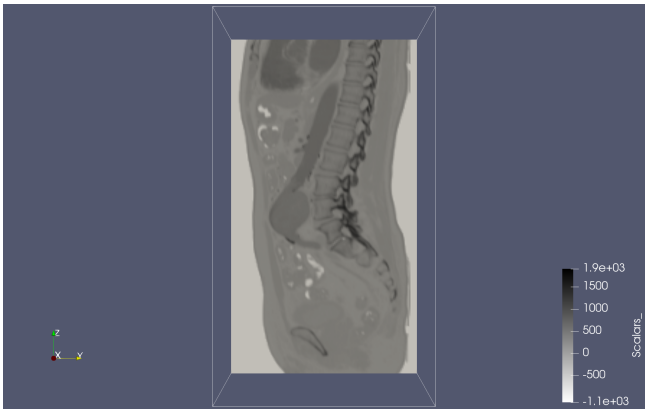

Figure 1: Localization of aneurysm on a slice

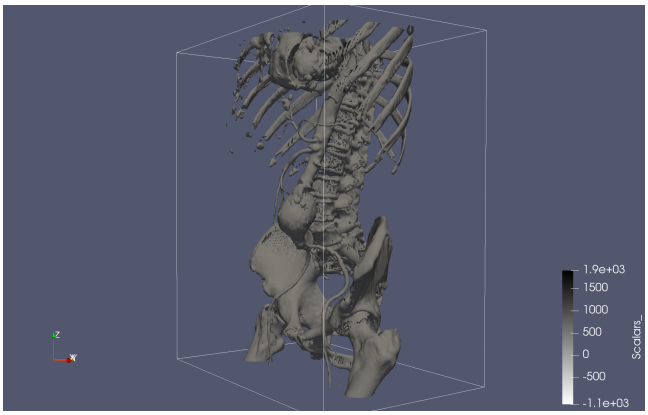

Figure 2: Localization of aneurysm on a contour

I wouldn't say that finding aneurysm with contours was better than with slice or vice-versa. To find a suitable contour firstly I needed to know the value of scalars for aorta, but to find it with slice I would need to know where aorta is in a volume. For both approach it's reasonable to start with top slice (normal to Z axis), and for contour than find needed values and for the slice method then create a side slice, such that it will cross aorta in top slice.

1.2 Histogram and threshold values

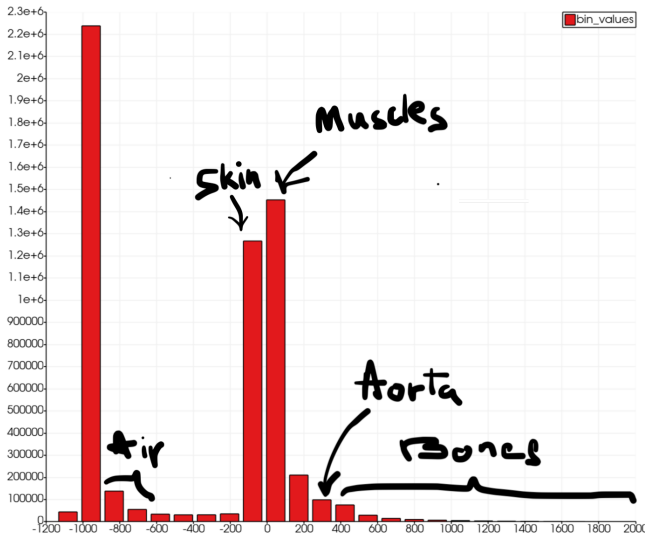

Figure 3: Histogram

The figure above shows a histogram with bins that are marked with body parts, meaning that, this body part is part of this bin.

Threshold values:

- Aorta: [250, 300]
- Bones: 400+
- Sin: [-100,0]
- Muscles: around 60-70
- Air: [-900, -800]

This threshold values are approximations as they may include other body parts or differ depending on where exactly in the body they are.

2 Questions

2.1 K získání barvy a průhlednosti vzorků podél paprsku existují dva přístupy. Jaké přednosti a jaké nedostatky má každý z přístupů?

2.2 Stínování volumetrických dat vyžaduje určit pro každý vzorek na paprsku normálu povrchu (z gradientu ve vrcholech mřížky). Jak takovou normálu získáme?

First we need to compute gradient

$$G = [G_x, G_y, G_z]$$

$$G_x = f(x-1, y, z) - f(x+1, y, z)$$
$$G_x = f(x, y-1, z) - f(x, y+1, z)$$
$$G_x = f(x, y, z-1) - f(x, y, z+1)$$

To obtain a normal vector we interpolate gradients at the sample point using tri-linear interpolation and then we normalize this vector.

2.3 Může být stínování aplikováno na všechny typy funkcí (ray function) používaných pro kompozici vzorků podél paprsku (maximum intensity projection, average intensity projection, first hit, apod.)?

3 Direct Methods

Note: this part of task was harder to finish since my ParaView continued to freeze or crash, so I couldn't change color of color mapping or add slice to final combination of visualization techniques.

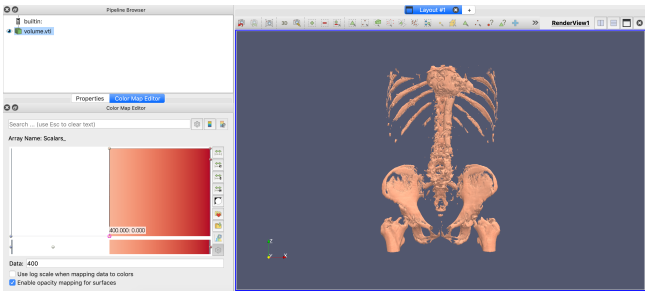

Figure 4: Bones fully visible

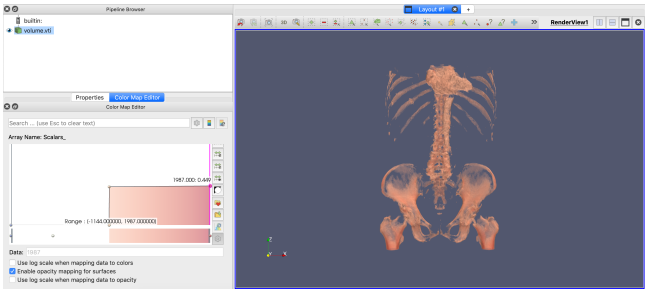

Figure 5: Bones, opaque

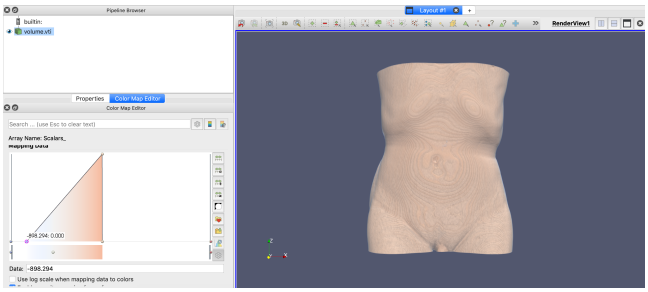

Figure 6: Skin not opaque

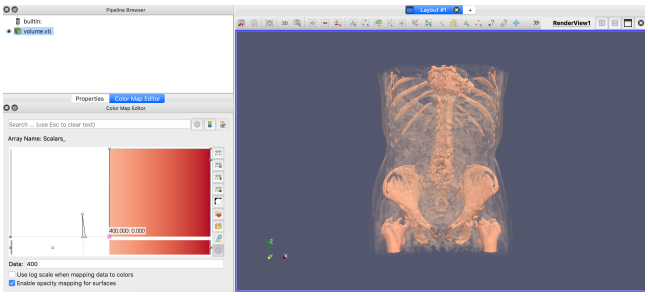

Figure 7: Skin with bones

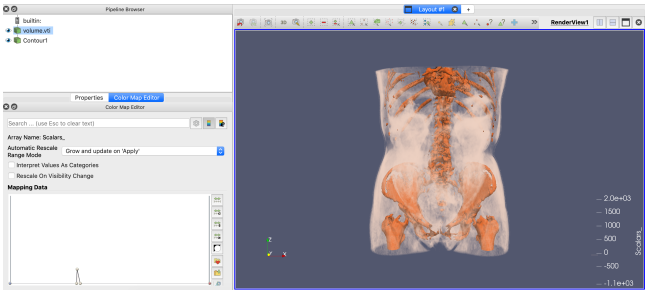

Figure 8: Combinations of techniques