Gross Examination

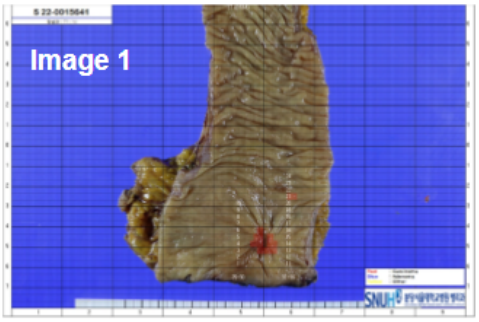
3D Volume Rendering

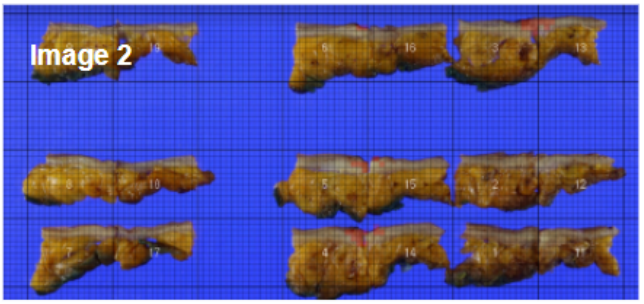
Objective:

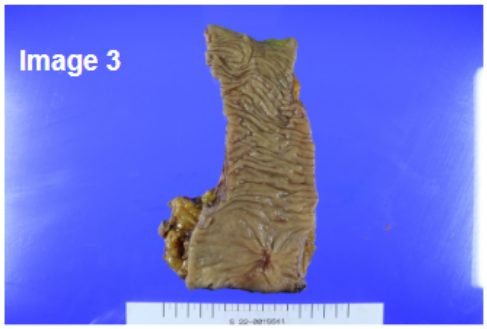
The goal is 3D rendering of the gross sample using interpolation techniques and scale information along with tumour segmentation and tumour quantification.

Data:

Following Data was provided:







Background:

Initially, the gross sample 3D volume was generated using the slice images as shown in Image 4. The details of which can be found in the attached report.

Scale Information:

The scale information was provided as:

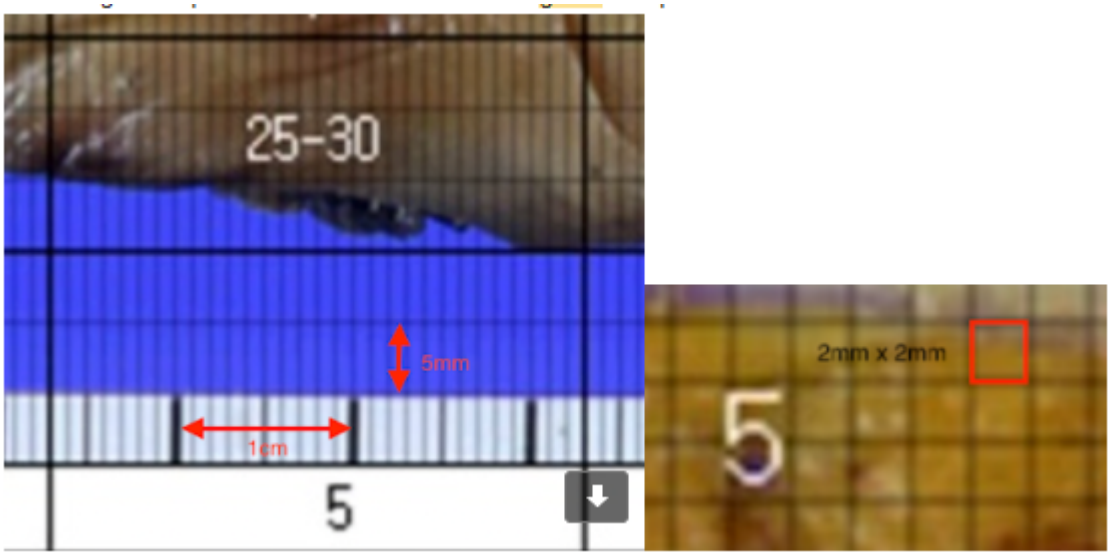


Fig3. Scale Information

The whole 3D volume can be seen as:

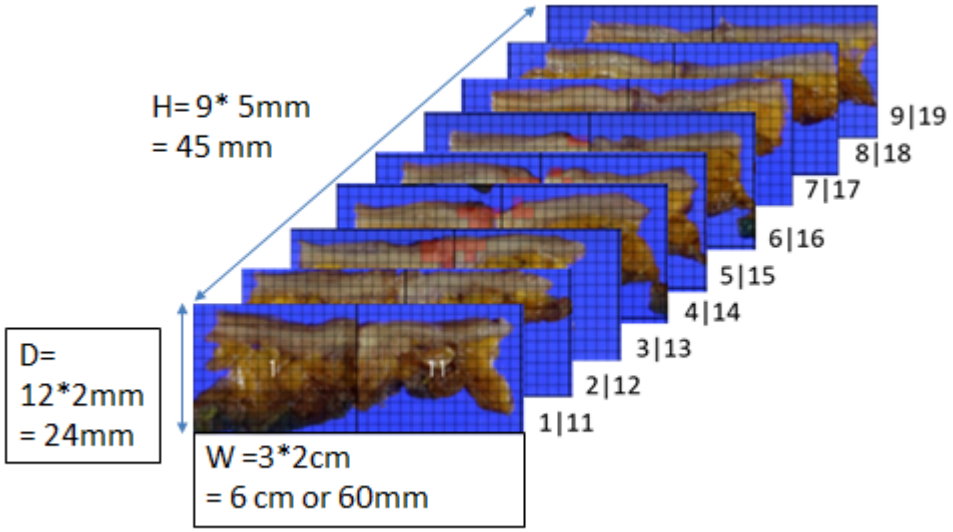


Fig4. Dimensions of 3D volume

Please note that the Fig 4 is to provide the rough idea of measurements. In actual, gross sample is slightly bigger than the dimensions described in Fig 4.

Pixel Spacing and slice thickness:

- Along the depth, slice thickness is 5mm.
- Each small box is 2mmx2mm and 10x10 pixels along the x y direction which implies that the original pixel spacing is 0.2mm.

Experimentation using scale information:

Following experiments were performed using the scale information:

- Upsampled the slice images by replicating the value of each pixel inside a small box, such that now the same small box represents 1mmx1mm. We replicated each slice 5 times so that the slice thickness is 1mm. The actual pixel spacing of 0.1mmx0.1mm and slice thickness of 1mm was used to render the results again as each small box represents 1mmx1mm now and the dimensions of a small box are 10x10 pixels.The rendering results can be seen in the grayscale video and colored video.

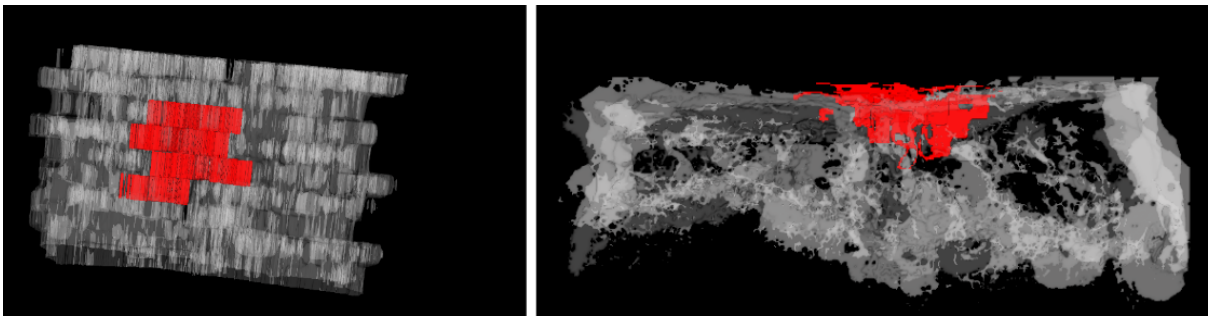


Fig 5. Rendering with pixel spacing of 0.1mmx0.1mm and slice thickness of 1mm (Grayscale)

- Each small box is 2mmx2mm and 10x10 pixels which implies that the original pixel spacing is 0.2mm. To make the pixel spacing 1mm, we downsampled the slice images.
  The rendering results can be seen in the grayscale video and colored video. Pixel spacing used for rendering: 1mmx1mmx1mm. The actual pixel spacing was also 1mmx1mmx1mm

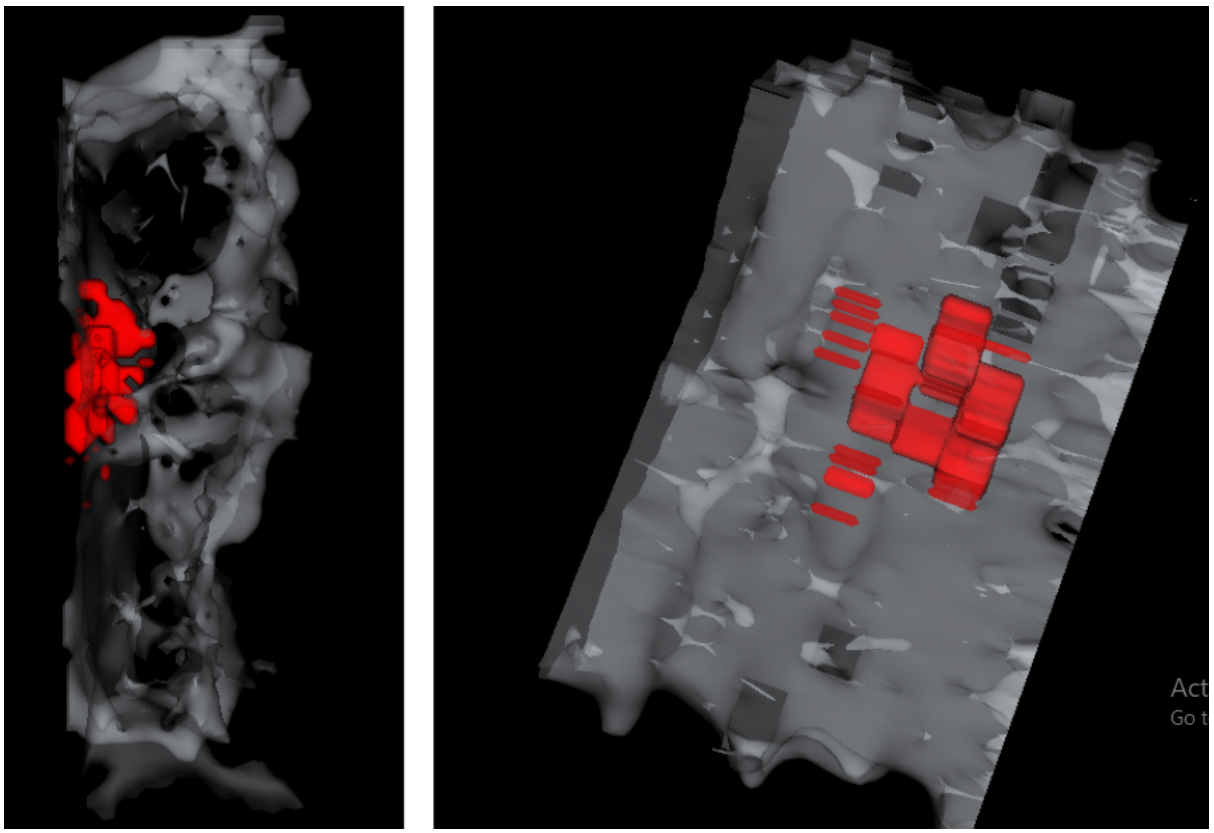


Fig6. Rendering with pixel spacing of 1mmx1mmx1mm (Grayscale)

- Replicated each slice 25 times along depth to get a slice thickness of 0.2 mm instead of the original 5.0 mm. Rendered the results using original pixel spacing of 0.2mm in the x y dimension and the post-processing slice thickness of 0.2 mm in the z dimension. The rendering results can be seen in the grayscale video and colored video.

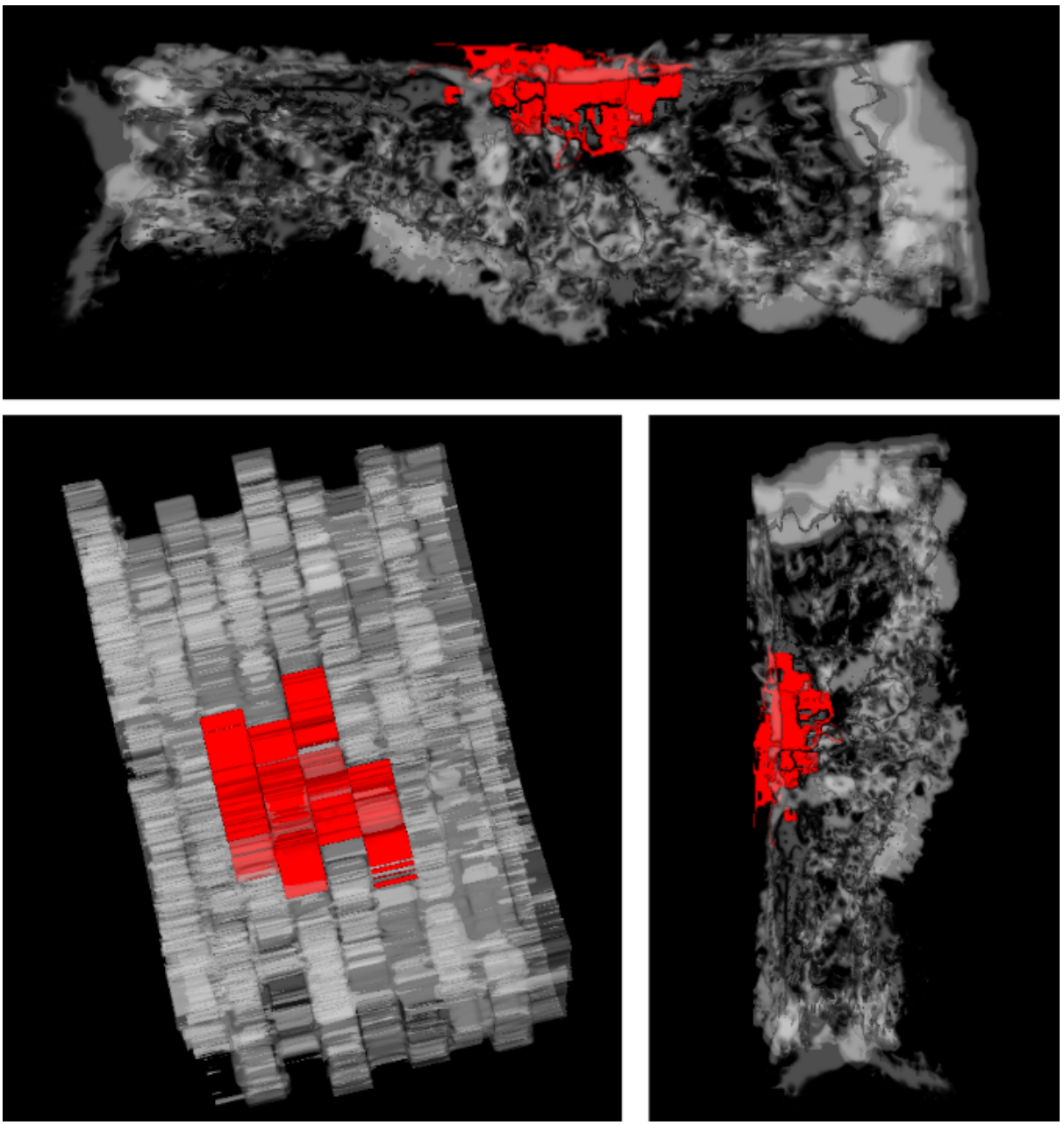


Fig 7. Rendering with pixel spacing of 0.2mmx0.2mmx0.2mm (replicating values)

- Applied linear interpolation using a regular grid interpolator to get 0.2mm slice thickness. The rendering results can be seen in the grayscale video and colored video.

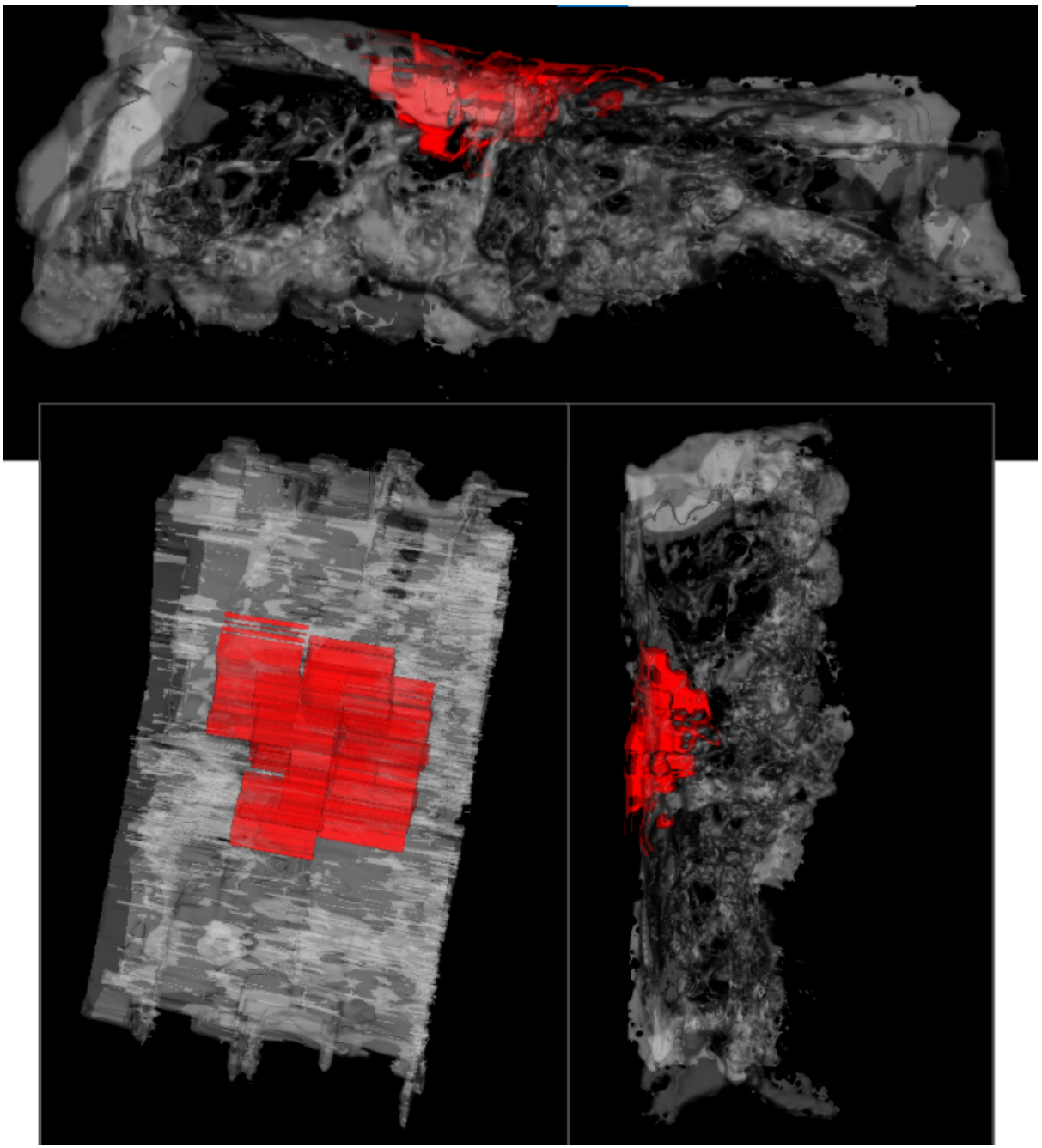


Fig 8. Rendering with pixel spacing of 0.2mmx0.2mmx0.2mm (Linear interpolation)

- Applied spline interpolation to get 0.2mm slice thickness instead of 5mm and rendered results again. The rendering results can be seen in the grayscale video and colored video.

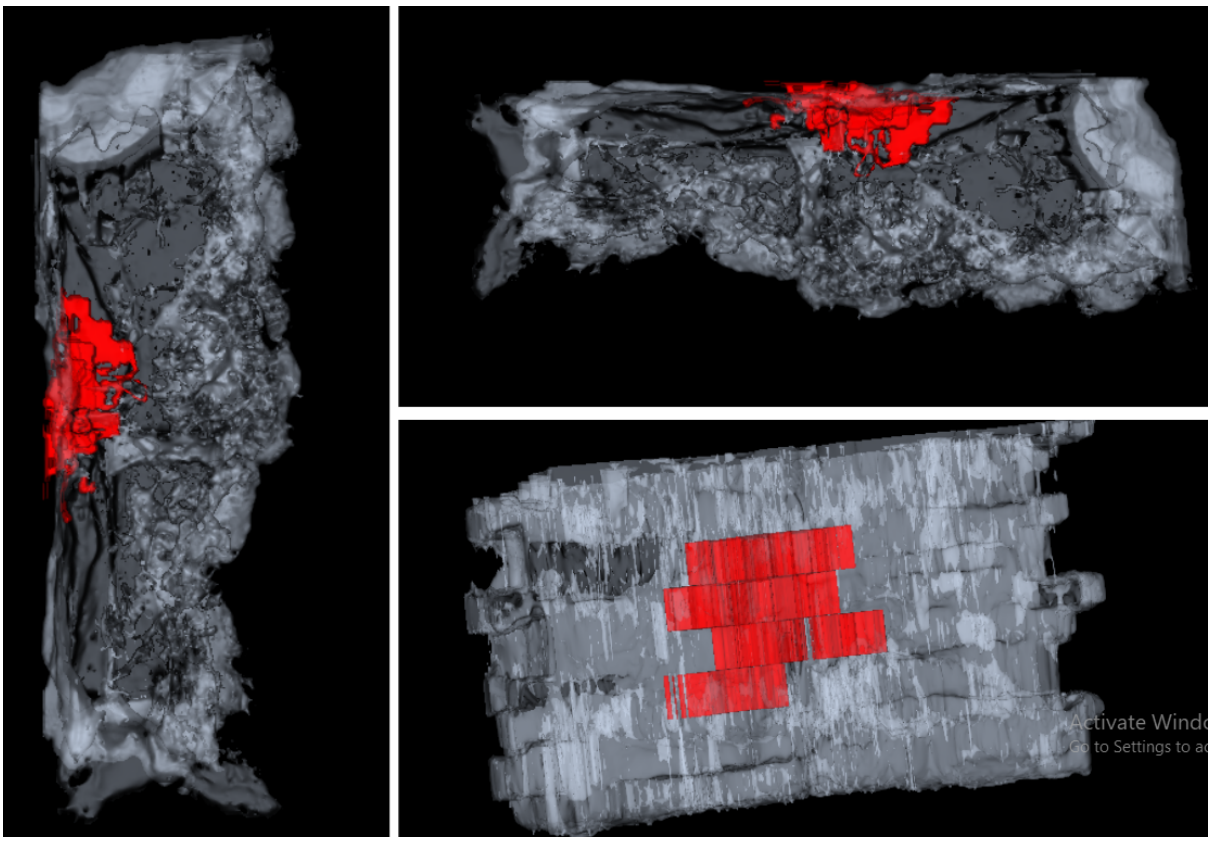


Fig 9. Rendering with pixel spacing of 0.2mmx0.2mmx0.2mm (Spline interpolation)

Quantification of tumour:

Calculated the volume of tumour by calculating the number of pixels which turned out to be **717.6mm^3 whereas the overall volume of gross sample is 92,818.8mm^3. Each slice had the dimensions of 173x408 pixels. And thus the overall 3D array was 173x408x225 in pixels and (173x408x225x0.2x0.2x0.2=) 127,057.2mm^3.**

The results of spline interpolation from above mentioned experimentation were used where the pixel spacing is 0.2mmx0.2mmx0.2mm.

Displayed the volume of tumour at the bottom as shown below and in the rendering video:

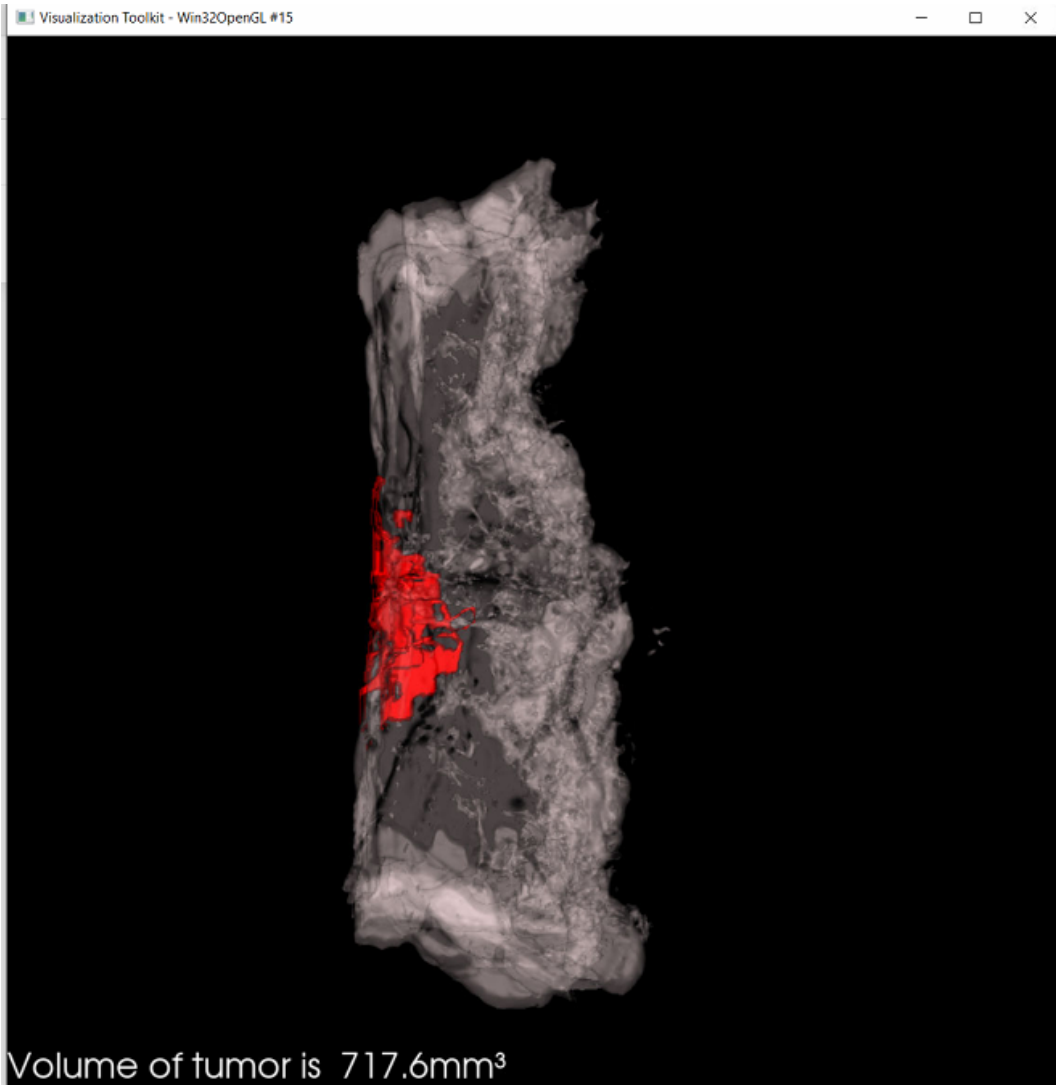


Fig 10. Rendering with pixel spacing of 0.2mmx0.2mmx0.2mm (Spline interpolation) along with tumour quantification

Tumour was rendered separately as well and can be seen as:

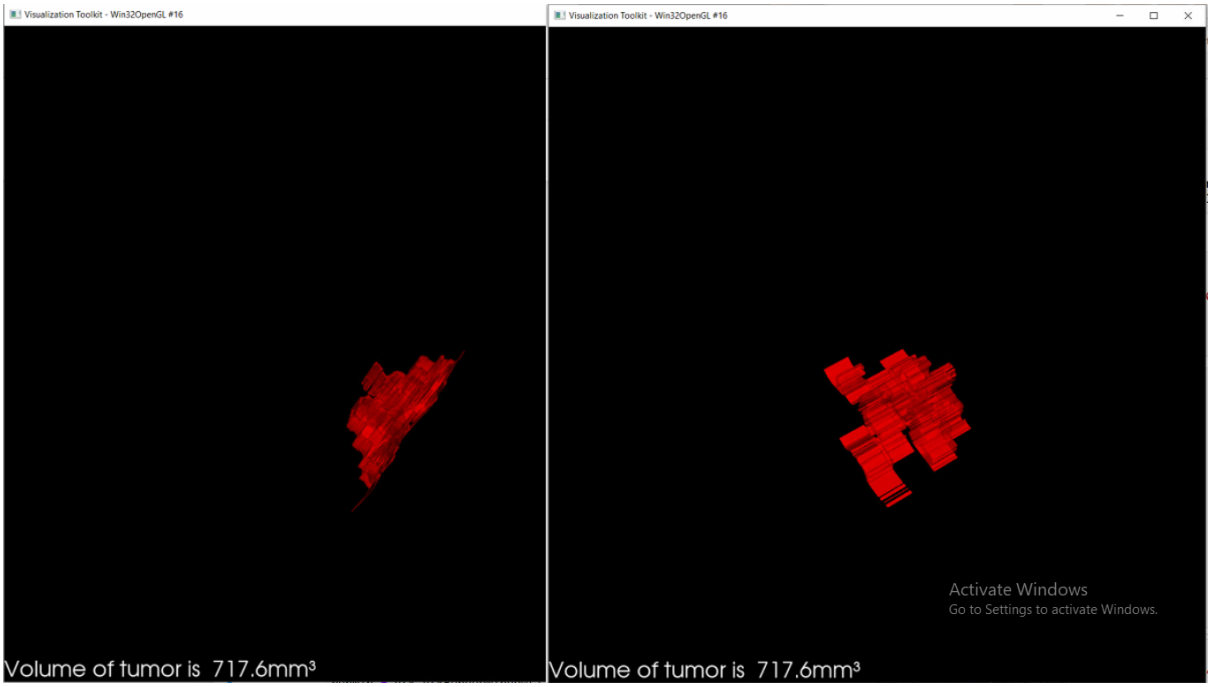


Fig 11. Tumour Rendering with pixel spacing of 0.2mmx0.2mmx0.2mm

Conclusion:

Based on our experimentation, it can be concluded that the 3D gross volume can be successfully rendered along with tumour segmentation and quantification.