CHIPS ANALYZER
MANUEL
&
TECHNICAL SHEET

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1. Overview

Figure 1 shows a working example of Chips Analyzer. Left side of the user interface shows 3D volume rendering of the chips data. On the right side there are settings before loading the data and interactive settings after the loading.

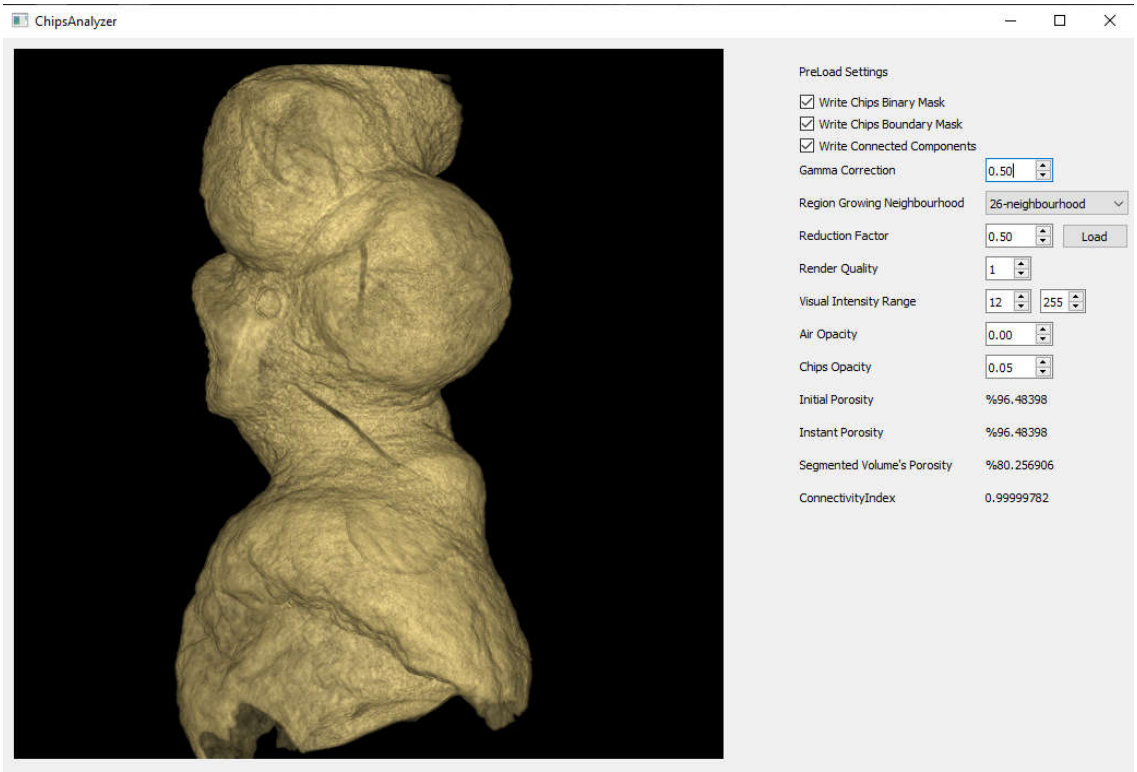

Figure 1. Chips Analyzer user interface.

1.1. Settings

Write Chips Binary Mask: writes the segmented chips as binary image for post processing. It does not effect the result.

Write Chips Boundary Mask: writes the boundary mask of chips, which defines the surface of the chips in 3d for post processing. It does not effect the result.

Write Connected Components: writes the connected components of the air inside chips for post processing. It does not effect the result.

Gamma Correction: is a preprocess to lower the noise before the processing. Further information: https://www.mathworks.com/help/images/gamma-correction.html

Region Growing Neighbourhood: Detail level of the region growing algorithm for connected component analysis of the void fractions. Further information: https://www.wikiwand.com/en/Pixel_connectivity, https://www.wikiwand.com/en/Region_growing, https://www.wikiwand.com/en/Connected-component_labeling

Reduction Factor: Reduces the detail of the volume for faster processing.

Furher information: http://www.ldv.ei.tum.de/fileadmin/w00bfa/www/content_uploads/Vorlesung_3.4_Resampling.pdf

Load: Opens up a folder selection pop up, then initiates the loading, segmentation and analysis.

Render Quality: Defines the quality of interactive 3d volume rendering.

Visual Intensity Range: Lets user decide which intensity interval to be rendered on 3d view. It only effects the instant porosity calculation.

Air Opacity: Lets user decide opacity of the air-noise segment on 3d view.

Chips Opacity: Lets user decide opacity of the chips segment on 3d view.

Furher information:

https://www.researchgate.net/publication/279427081_Overview_of_Volume_Rendering

Initial Porosity: The ratio between total void and total volume considering the initial segmentation.

Instant Porosity: The ratio between total void and total volume considering visual intensity range defines chips.

Segmented Volume's Porosity: The ratio between total void and total volume considering the initial segmentation. The calculation is done after the surface extraction of the chips so that the external air could be ignored.

Connectivity Index: The ratio between largest void fraction and total void.

2. Processing Pipeline and Algorithms

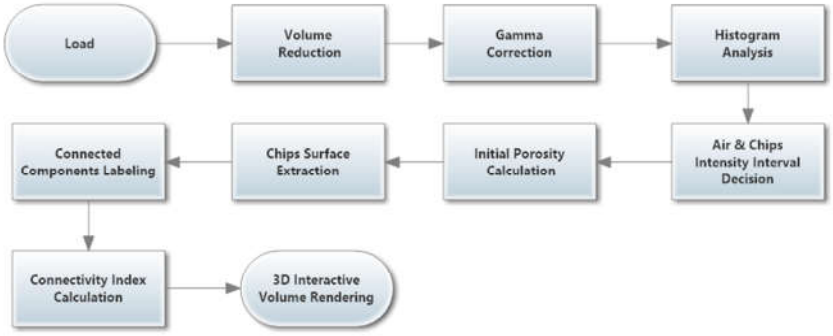

Figure 2. Processing pipeline of the Chips Analyzer.

This section will be detailed later.

3. Usage

3.1. Opening the Chips Analyzer

Before you open the program, you must install Microsoft Visual C++ 2017 redistributable package once, which can be downloaded from https://aka.ms/vs/16/release/vc_redist.x64.exe.

To open Chips Analyzer, navigate through Chips Analyzer build folder, right click to ChipsAnalyzer.exe and click to “Run as administrator” as shown below.

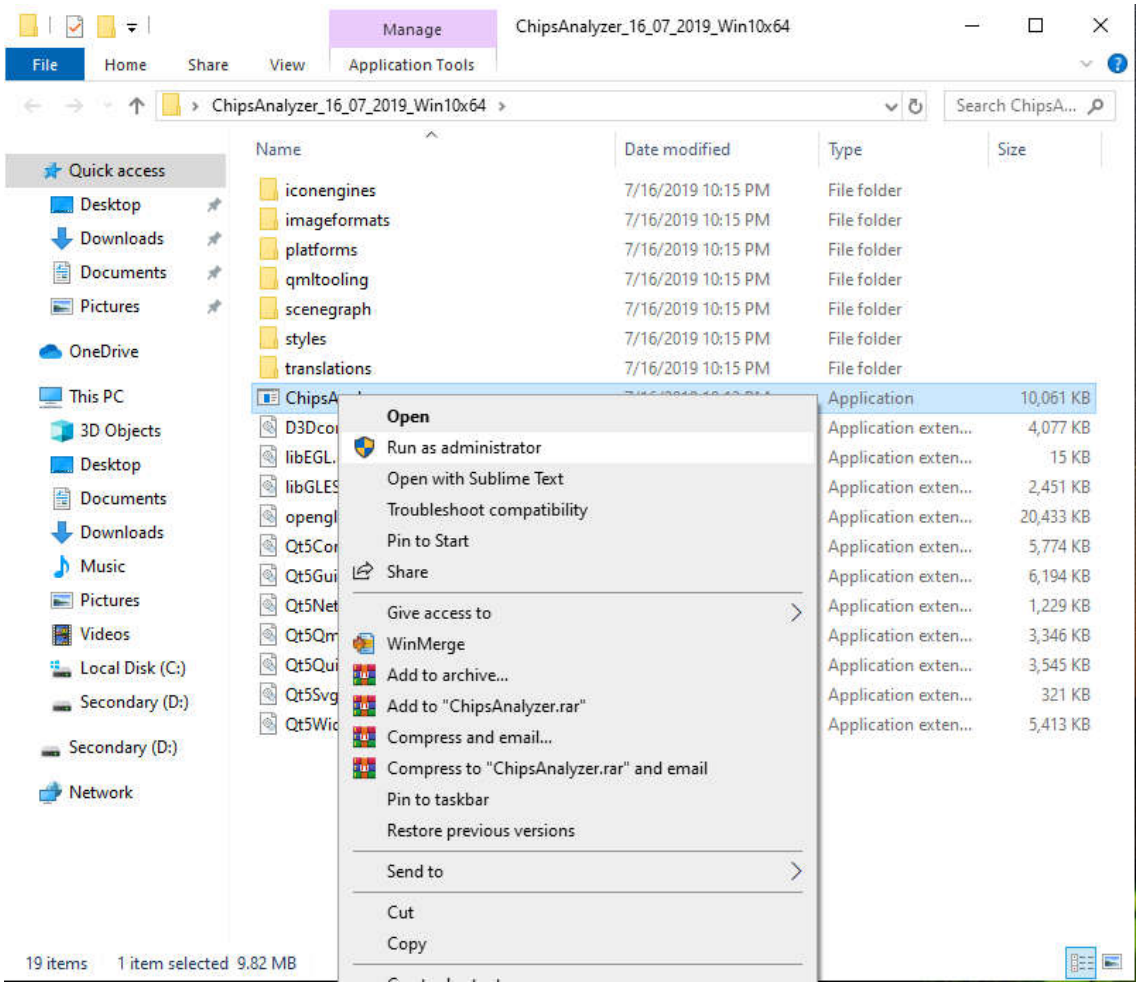

Figure 3.

3.2. Loading the Chips Data

As shown in figure 1, there are some settings before the load button. Checking ‘Write Chips Binary Mask’, ‘Write Chips Boundary Mask’, ‘Write

Connected Components' are not necessary for the analyzing. They are just for post processing if needed.

It is suggested to set 'Gamma Correction' to 0.5, which will lower the noise for chips segmentation but any value between 0.5 and 1.0 is okay.

There are two options for region growing neighbourhood. These options are 6-neighbourhood and 26-neigbourhood. 26-neigbourhood is suggested for more connectivity while analyzing void fractions.

'Reduction Factor' reduces the volume of the chips data to increase processing speed. 0.5 is suggested.

After those setting, click to Load button and select the chips data folder as shown below:

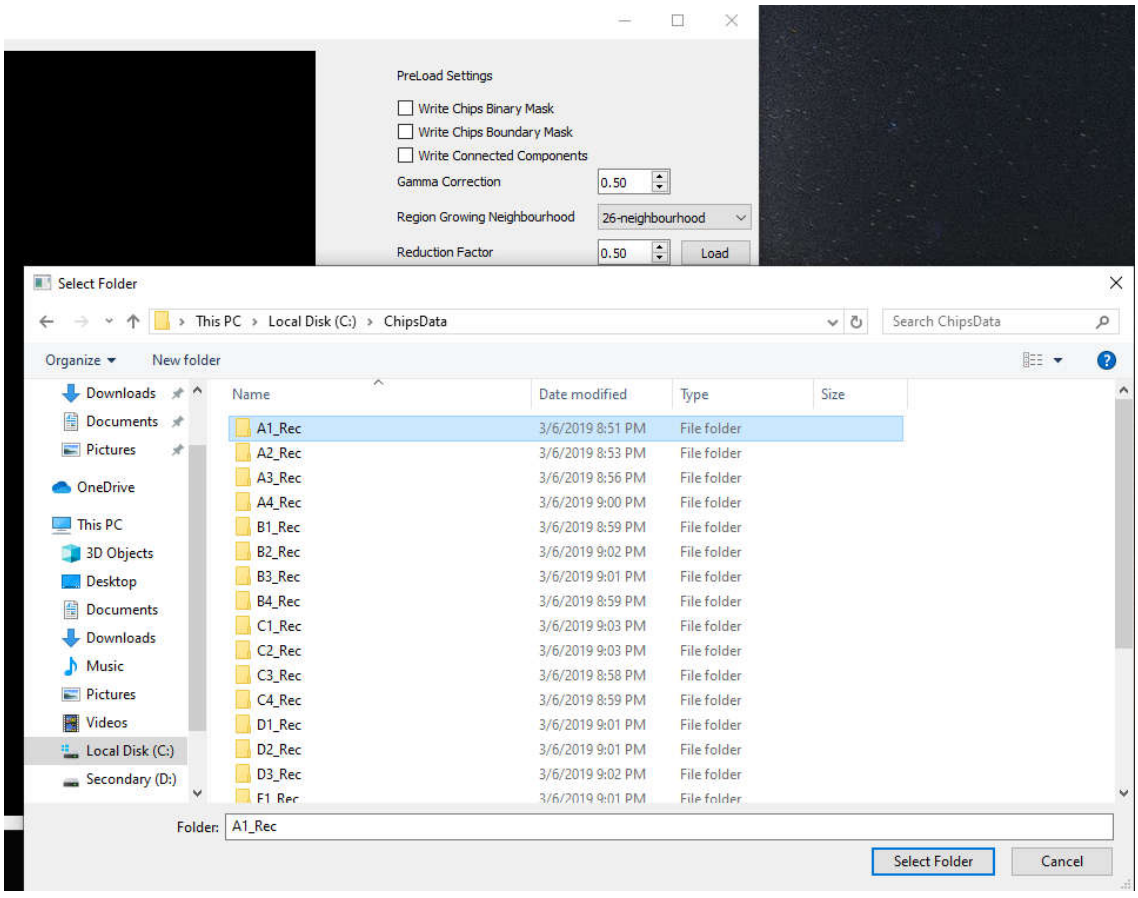

Figure 4. Folder selection

After loading, you should see something like this:

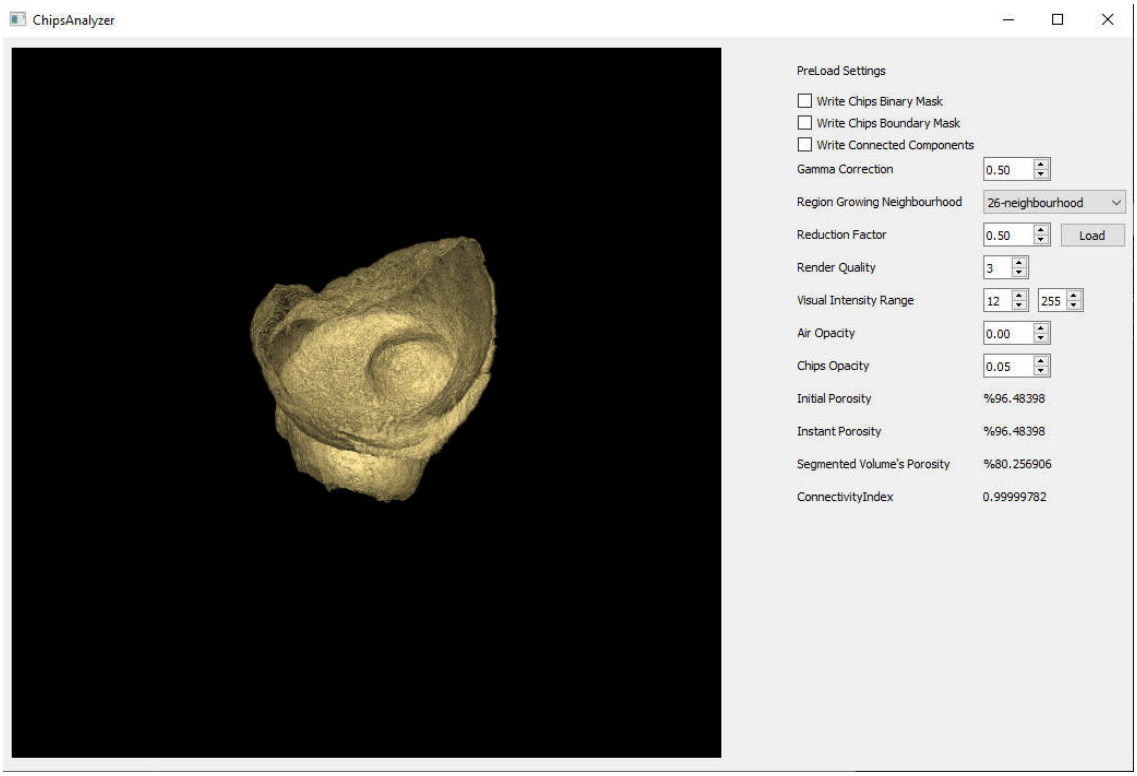

Figure 5. Chips Analyzer

And the command line view:

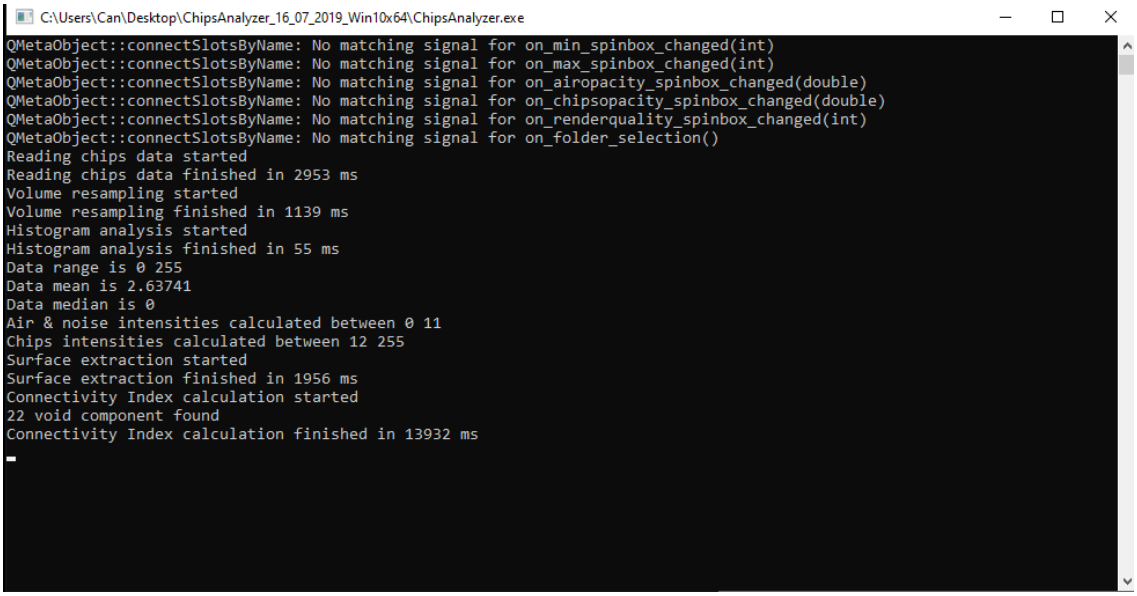

Figure 6. Command Line View

As you may have seen, some values are changed in the user interface. Visual intensity range is setted to the range calculated for the chips segment. Initial

Porosity, Instant Porosity, Segmented Volume's Porosity and Connectivity Index are calculated and shown.

The command line view informs you about what's happening currently, which may be useful.

3.3. 3D Interactive Volume Rendering

You can zoom, pan and rotate the volume in the 3D view. For rotation, hold down the left mouse button on 3d view and move the mouse. You can zoom in and out by scrolling the mouse's wheel. To pan, hold down the wheel and move the mouse.

The 'Render Quality' setting defines you 3d render quality which is between 1-5 where 1 is the best and 5 is the worst. It is set to 3 in default but depending your gpu power you may want to increase or decrease it. Quality comparison is shown below:

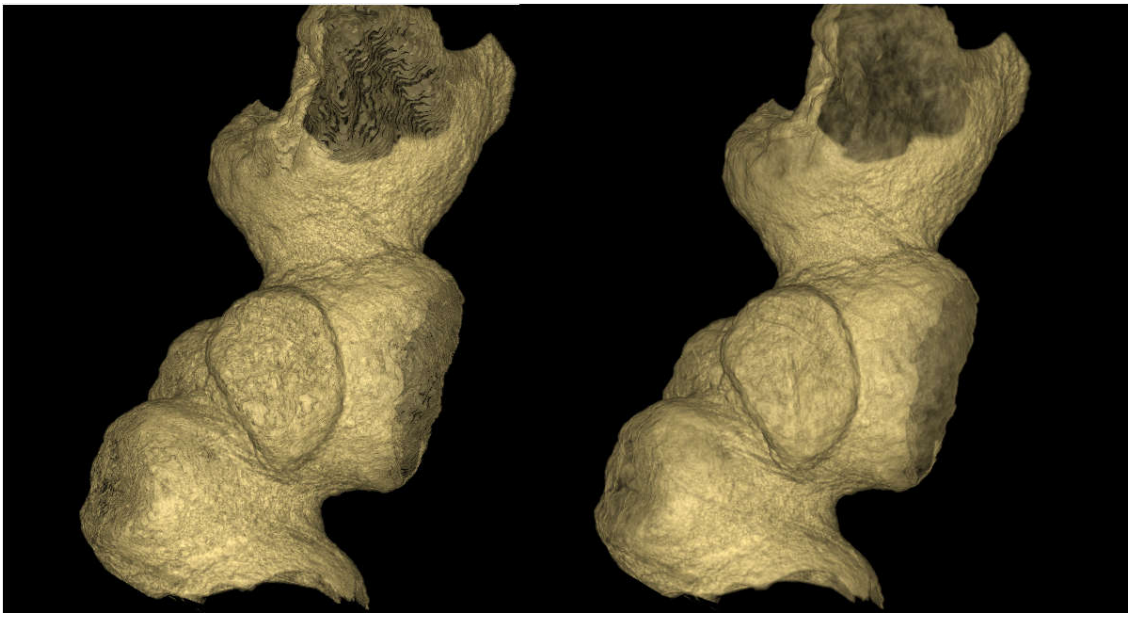

Figure 7. Render Quality from left to right is 5, 1.

In volume rendering, there is a transfer function which transfers the intensity of the image data to colors. You can tweak it by playing with 'Visual Intensity Range', 'Air Opacity' and 'Chips Opacity' settings.

Visual Intensity Range is the intensity range that will be rendered on the 3d view. Air Opacity defines the opacity of the air segment and Chips Opacity defines the opacity of the chips segment.

An example of tweaking Visual Intensity Range:

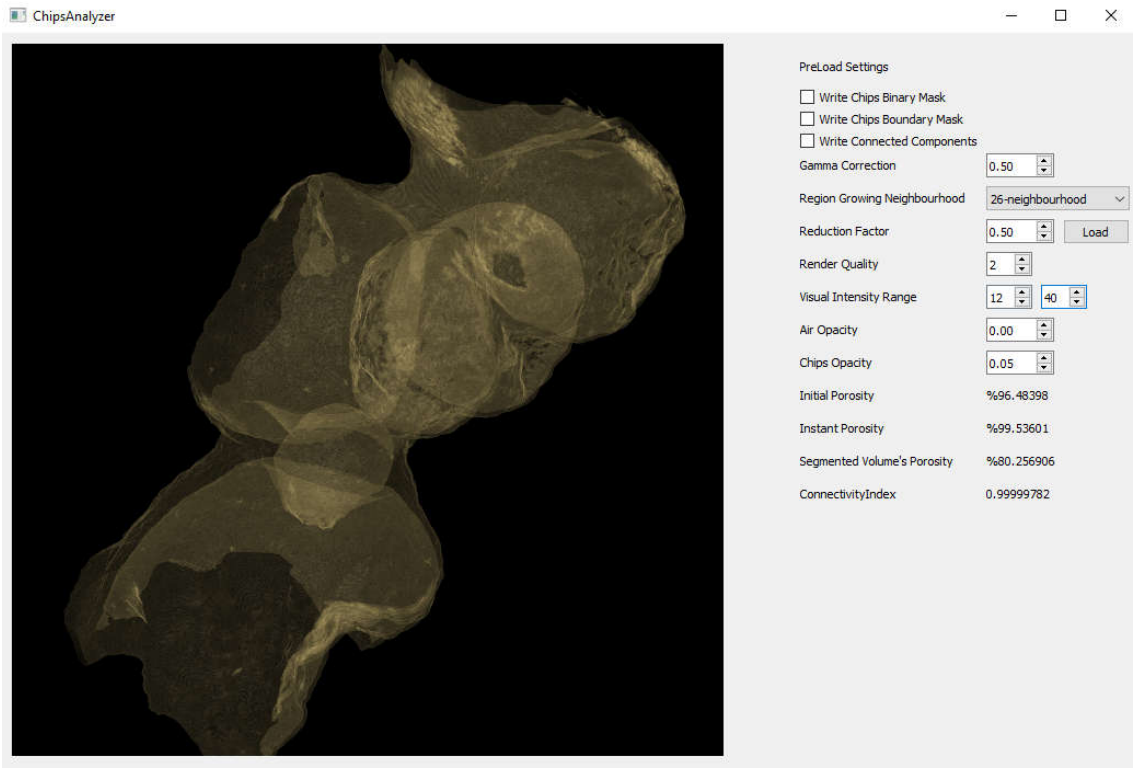

Figure 8. Visual Intensity Range is changed to [12,40]

Now we rendered only the intensities in the range [12,40]. Let's increase Chips Opacity so that we can get more opaque render. Here is the result:

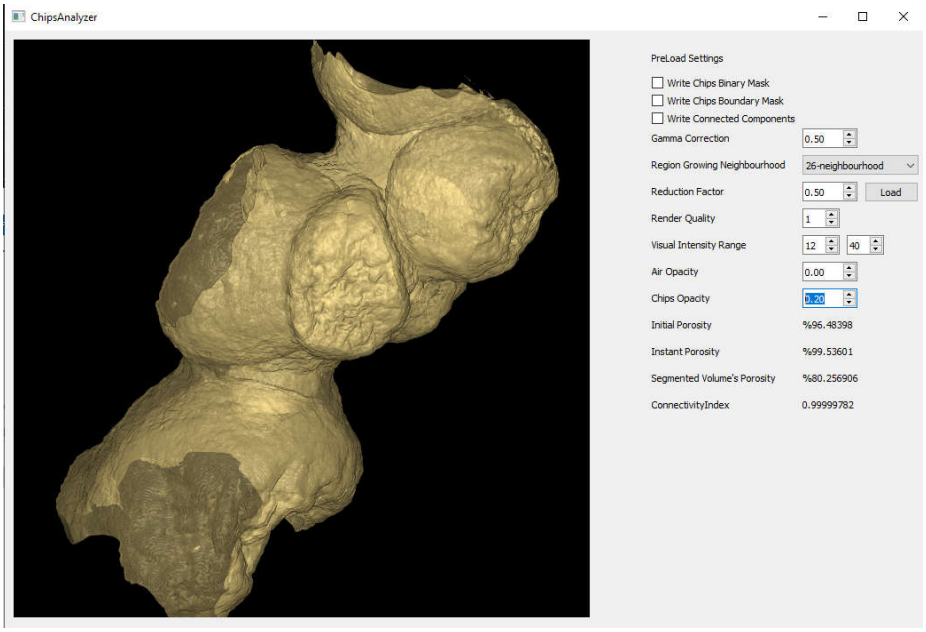

Figure 9. Chips Opacity is changed from 0.05 to 0.20

Notice that Instant Opacity value is changed too, recalculated as the current intensity interval.

As opacity decrease, transparency increase. If you want more transparent rendering, lower the opacity.

Back to figure 6 which is command line view, there is a line like “Air & noise intensities calculated between 0 11”. Which means air segment has the intensity interval [0, 11]. Be careful this segment is not just air but noise also. In the 3d view, 0 intensities are not visualized because you would just see rectangular prism due to frequency of the 0 intensity which covers most of the volume. But you can visualize the intensities between [1,11] to see air&noise segment. You should also increase Air Opacity from user interface and also set Chips Opacity to 0 in order to isolate air & noise from chips. Here is the result:

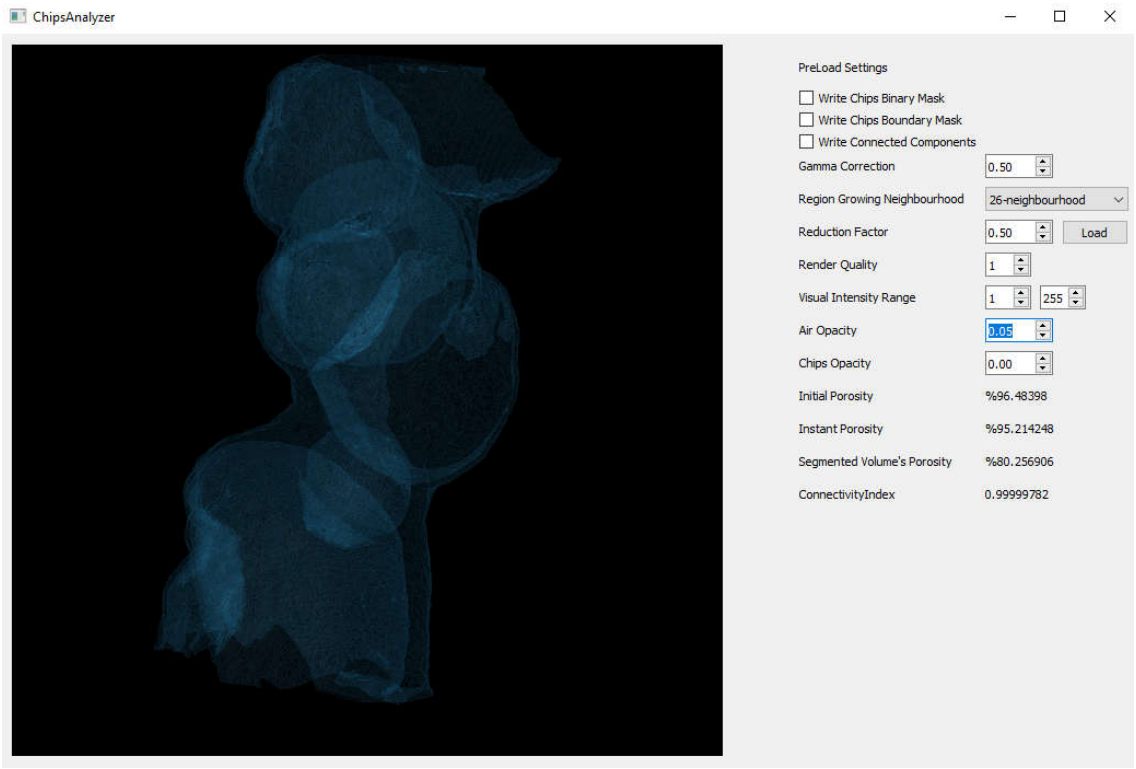

Figure 10. Air & noise segment rendered.