# Segment Objects in CTAnalyzer
# Using a Threshold as a Region of Interest

Tip of the Month: February 2017

Micro-CT segmentation enables us to virtually separate and study a region of interest (ROI) contained within a sample, without destroying the sample. The process requires familiarity with using the custom processing tab in CTAnalyzer (CTAn) software. If you are new or need a refresher to CTAn, we encourage you to refer to the CTAn User Manual or to call our office at 610-366-7103 to arrange for training. Also, it is best to have the latest version of CTAn, which can be downloaded by Clicking Here.

### *When to use a Threshold as a Region of Interest?*

It can be quite tedious to draw a manual ROI over hundreds of slices for an object that is complex, especially if you have more than one sample to analyze. The threshold segmentation method is helpful because it makes tight boundaries between the object of interest and its surroundings, even when they are of the same density, and thus allows for precise ROIs that fit both areas closely.

### *How to Make an ROI with a Threshold*

The steps required to use a threshold as an ROI will depend greatly on what your object is and how tight the interface is between the two objects you are trying to segment. There are times when a manual ROI is required, but if an object has mostly air between the thresholded regions, then this method can be a time saver. In the following steps, we used a mouse jawbone and tooth to demonstrate this method of virtual separation.

1. Go to the custom processing tab and use the threshold that works for your object of interest (Figure 2). In our example, we thresholded the jawbone and the tooth.
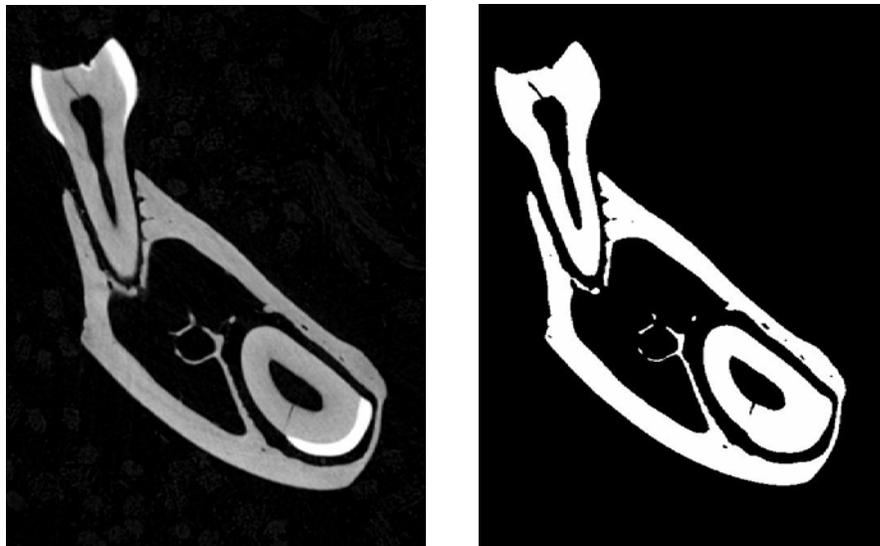


Figure 2. Raw Image (left), and threshold of the entire object, jawbone, and tooth (right).

2.  Perform any editing techniques to refine the threshold to just the object of interest. This usually involves despeckling and/or morphological operations to ensure the threshold best represents your area of interest. In our case, we were focused on segmenting the tooth. This was done through (1) a morphological operation, "Opening" of 1pixel to virtually disconnect the tooth from the bone, followed by (2) a despeckle, "Sweep" of the largest object in 3D space to remove the selection of the bone.
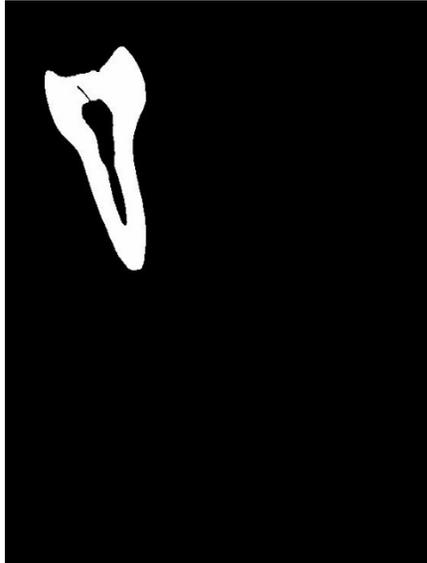


Figure 3. Area of interest after editing techniques were applied to select just the tooth.

3.  Now we need to save the threshold as an ROI. Click on the "Save Bitmaps" function, select which image view to apply to, and save the images as BMP with the "Convert to monochrome (1bit)" (Figure 4). The monochrome creates the images so they can be loaded as an ROI. The images will save automatically to an IMG folder unless you check the box for a "Custom subfolder" and rename it.
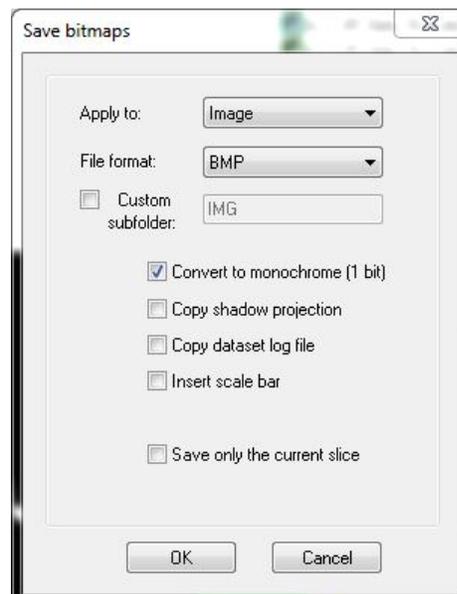
Figure 4. Save bitmaps with BMP and convert to monochrome (1 bit).

4. Now, reload the original images in CTAn.

5. Go to the "region of interest view" and click on the "load region of interest" (icon  ) in the top banner.

6. In the popup window, go to the bottom right and click the dropdown where it says, "ROI files (.roi)" and make sure to select "Bitmap files (.bmp)" (Figure 5). Go to the IMG folder that was created, select one of the images, and click "open."
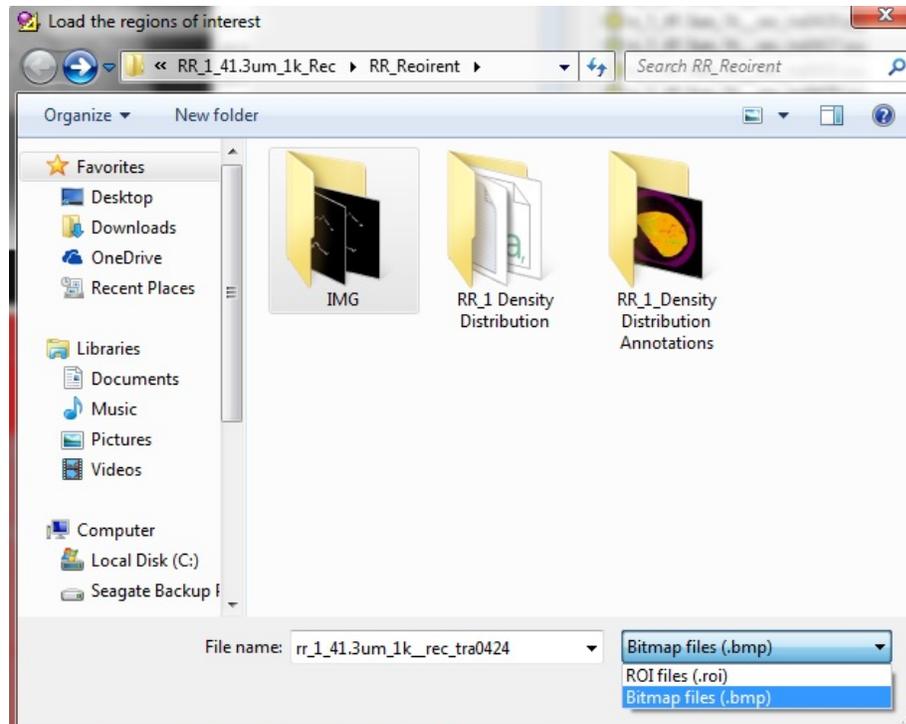


Figure 5. Loading BMP files as the ROI.

7. Now your ROI should be in the shape of the object selected.

Figure 6. ROI fit to the shape of the tooth

8.  Since the ROI is now fitted tightly around the image, when you save the bitmaps based on the ROI you will end up with the grayscale images of just that section. These steps can be done with other areas of the image as well. When you have all the individual grayscale images, it is easy to load all these segmented image sets into CTVox for comparison. Below is an example where we segmented both the jawbone and tooth and then loaded both grayscale datasets into CTVox for separate coloring and imaging (Figure 7). If you need help loading multiple grayscale images in CTVox, please refer to the "December 2014 Tip of the Month".
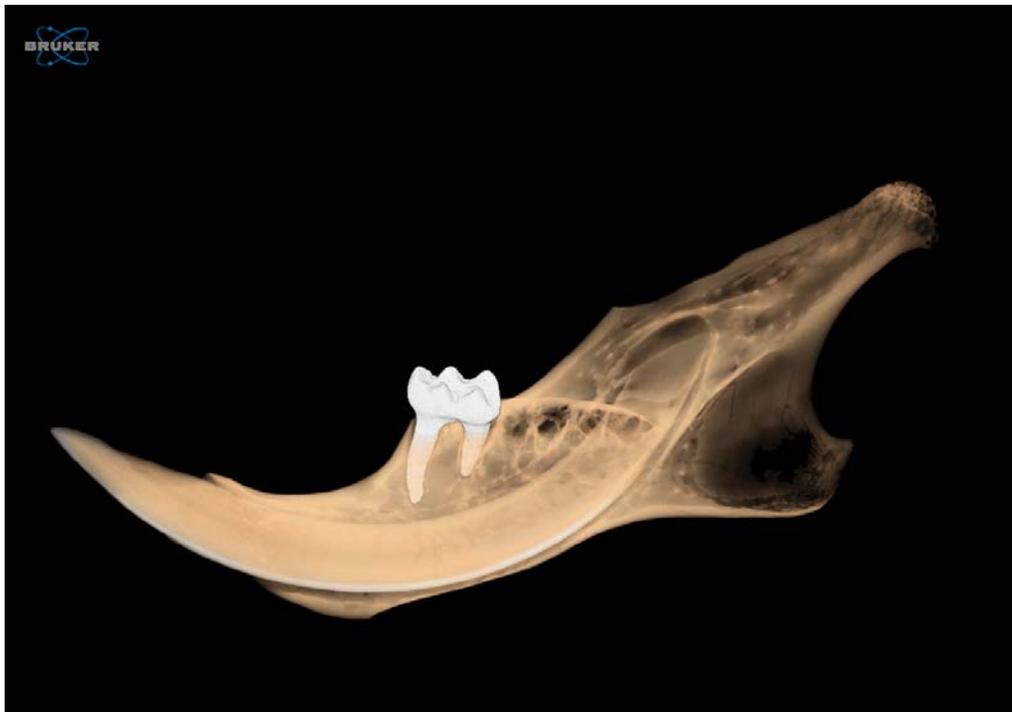


Figure 7. CTVox image of jawbone and tooth, separated and color coded.

*Conclusion*

The jawbone and tooth segmentation is just one of the many applications where this thresholding method can be used. We hope this tip will help you with your research and we welcome you to contact us at 610-366-7103 if you have any questions. You may also e-mail Brandon Walters at brandon@microphotonics.com if you need any help.