Volume Edit: Lung Segmentation

In this exercise we will review lung segmentation from preclinical mouse data. We will cover additional segmentation and processing tools available in the module, including object separation and morphological operations dilation, erosion, and fill holes.

1. Download the mouse dataset **Mouse_Lungs** from **www.analyzedirect.com/data.**
2. Unzip the data and then use **File > Load** to load the Mouse data set into Analyze.
3. Next select **Process > Spatial Filters** to apply a **3 x 3 x 3** median filter to the data set. See Exercise 27: **Spatial Filters** for instructions on applying a filter to a data set.
4. Next select the filtered data set (**Mouse_Lungs_Med**) and open **Segment > Volume Edit**.
5. Click **Add Object**, change the name of the new object to **Lungs**.
6. Next select the **Semi-Automatic** tab and choose **Object Extractor** (figure 1).
7. Using the slider under the transverse image move to slice **210**, now click inside the lungs to set a seed point.
8. Use the threshold slider to define a threshold range with a **minimum** of **1200** and **maximum** of **1550** (figure 2). Then click the **Extract Object** button.
9. If necessary repeat the object extraction steps to add any missed regions to the Lung.
10. To separate the trachea from the lungs add a new object, click **Add Object** and name the object **Trachea&Bronchi** (figure 3).

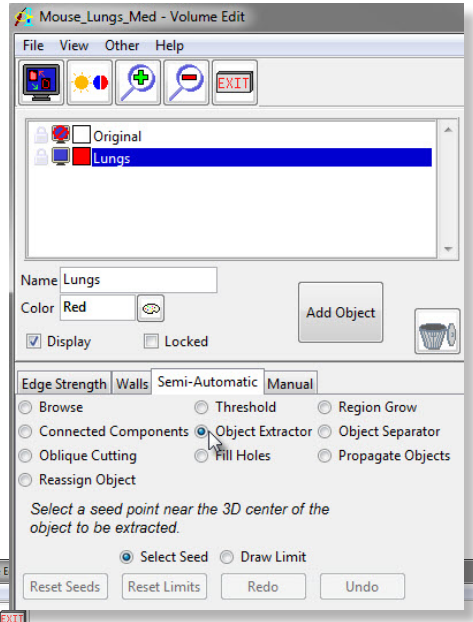

Figure 1

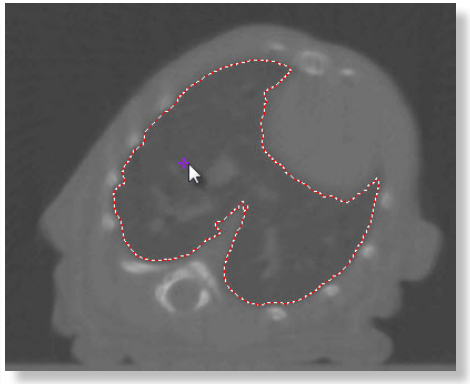

Figure 2

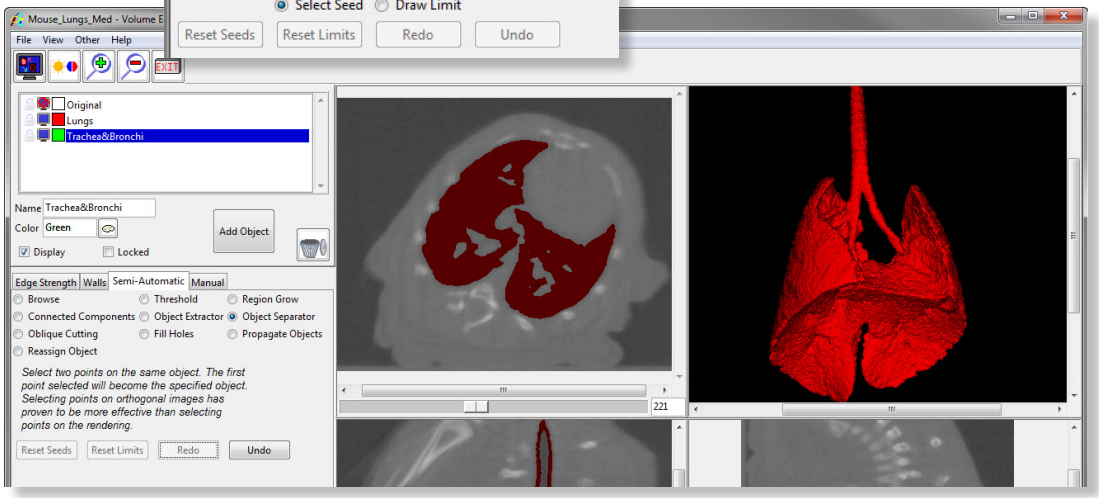

Figure 3

Volume Edit: Lung Segmentation

11. Next select **Object Separator**. Click on the trachea to set a seed point then click on the lungs to set a second seed point. Note you can click on either the 3-D rendering or the 2-D slices. Next click '**Separate**'.
12. Review the separation results. Repeat the object separation steps to separate any remaining areas of the trachea from the lungs (figure 3).
13. Select the **Trachea&Bronchi** object in the Object list and then click the '**Delete**' button to remove the object.
14. To obtain a total lung volume measurement it may be necessary to fill any holes in the lungs. To do this use the morphological tools in the Objects window. Select **View > Objects**, set Object to Lungs and then click on the Morph Objects button.

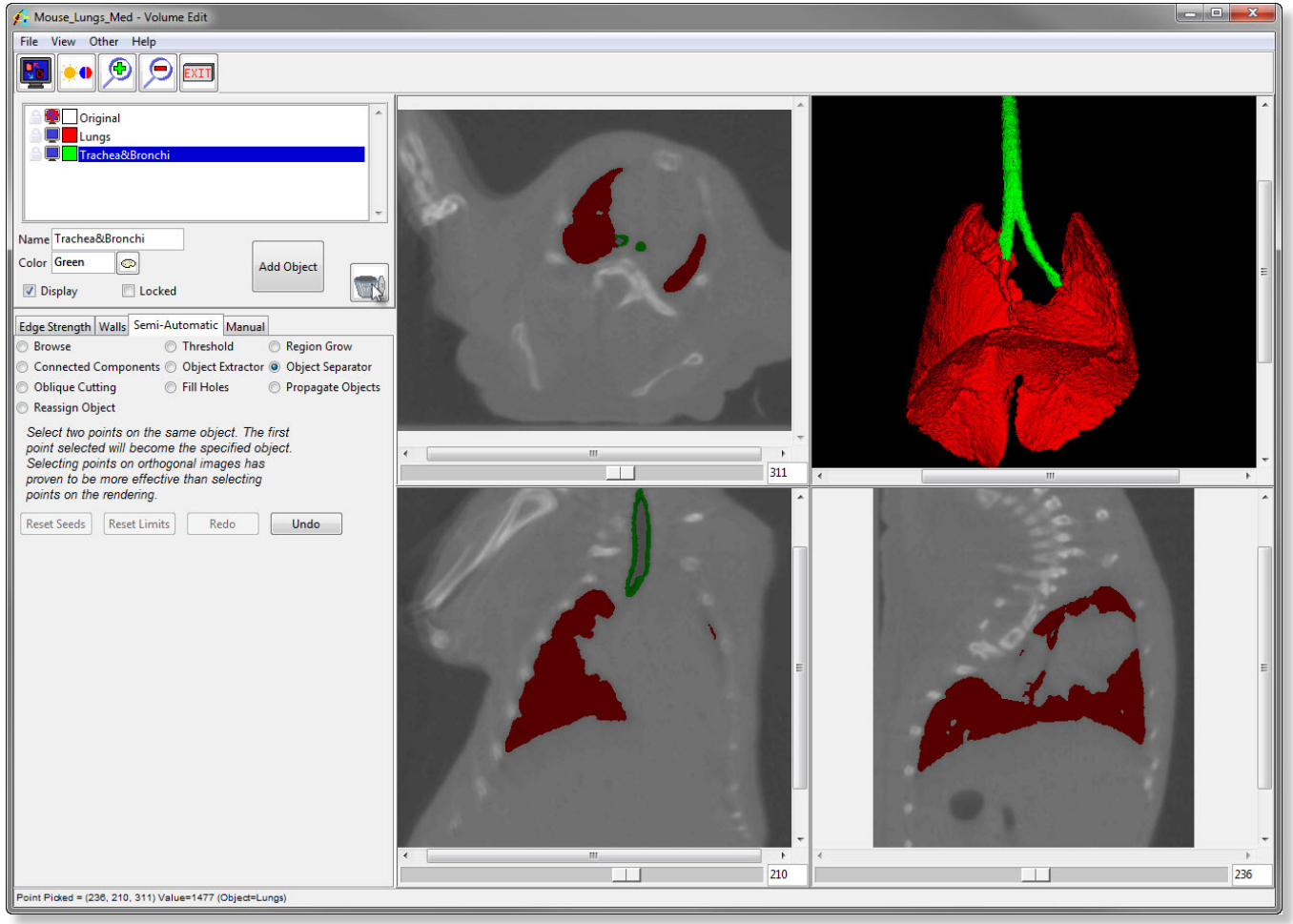

Figure 3

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15. In the Morph Objects window set the following parameters (figure 5):
    - **Objects** to **Lungs**
    - **Operation** to **Dilate**
    - **Element Shape** to **Jack**
    - **Element Size** to **5 by 5 by 5**
    - **Defined Object** to **Lungs**
16. Click **Morph**. The Lungs object will be dilated. Now, set the following parameters (figure 6):
    - **Objects** set to **Lungs**
    - **Operation** to **Fill Holes**
    - **Fill Type** to **3 pass 2D; Transverse;** and **4-connected**
    - **Defined Object** to **Lungs**
17. Click **Morph**. The Lungs object will be filled.
18. Finally set (figure 7):
    - **Objects** to **Lungs**
    - **Operation** to **Erode**
    - **Element Shape** to **Jack**
    - **Element Size** to **5 by 5 by 5**
    - **Defined Object** to **Original**
19. Click **Morph**. The Lungs object will be eroded. Click **Done** to dismiss the Morph Objects window.
20. Save the object map by selecting **File > Save Object Map**.
21. Note that the lung volume can be measured using the **Measure > Region of Interest** module. For more information please refer to **Exercise 55: Region of Interest - Measuring Objects in Object Maps**.
22. Exit the Volume Edit module.

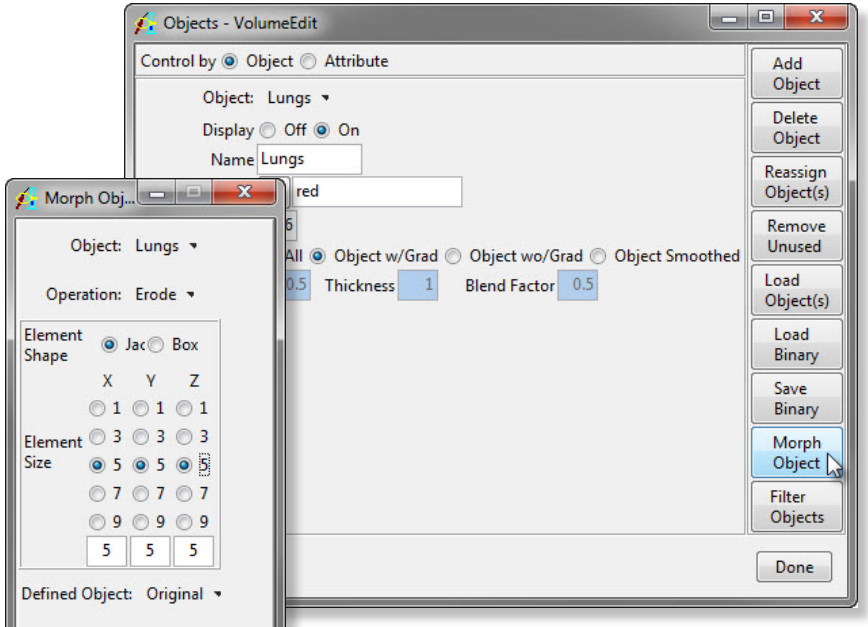

Figure 4

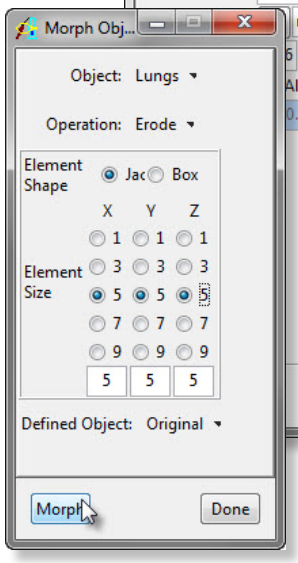

Figure 5

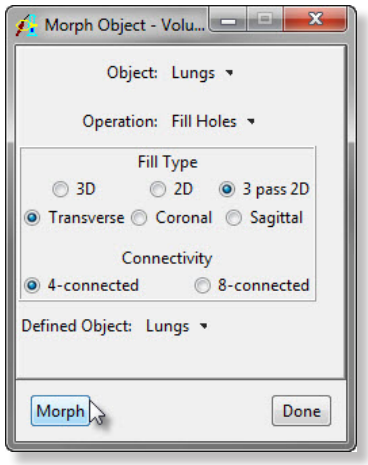

Figure 6

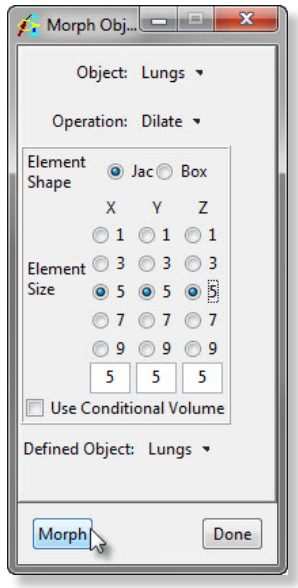

Figure 7