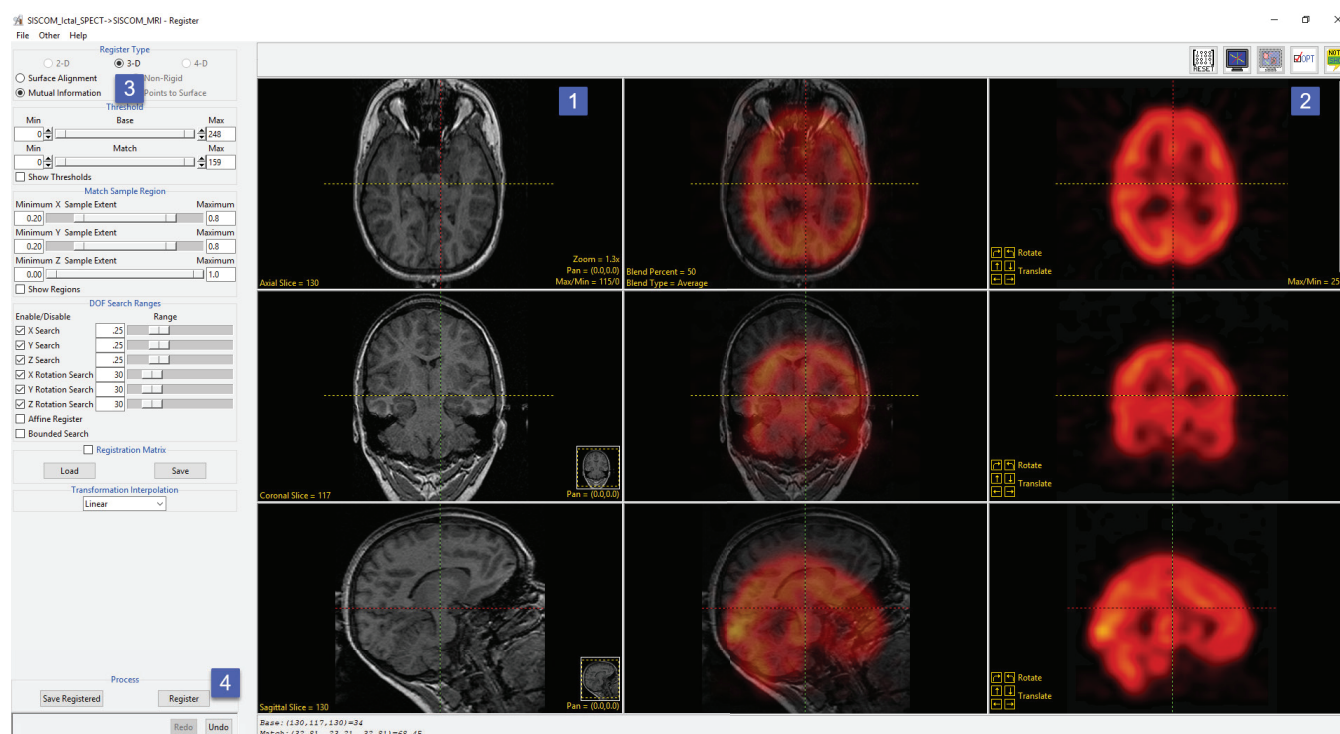# 3D Registration - Surface Alignment

Surface alignment is used to register image data that does not have enough or any mutual information, for example a functional SPECT scan and structural MRI scan. This exercise will provide the steps necessary to correctly register a SPECT scan and an MRI scan of the brain. However, first we will observe what happens when we try to register the image data set using Mutual Information.

To follow along, download data sets SISCOM_MRI.avw and SISCOM_Ictal_SPECT.avw from analyzedirect.com/data

- Open Input/Output and load both the SISCOM_MRI.avw and SISCOM_Ictal_SPECT.avw data sets into Analyze.

- Once loaded select the SISCOM_MRI data set then press and hold the Ctrl button on your keyboard and select the SISCOM_Ictal_SPECT data set and open Register. Note the order in which the data is selected is important. The first data set selected will be loaded

- as the base data set, in this example the MRI [1], while the second data set will be the match data set, in this example the SPECT [2].

- Set the Register Type to Mutual Information [3] and then click Register [4].
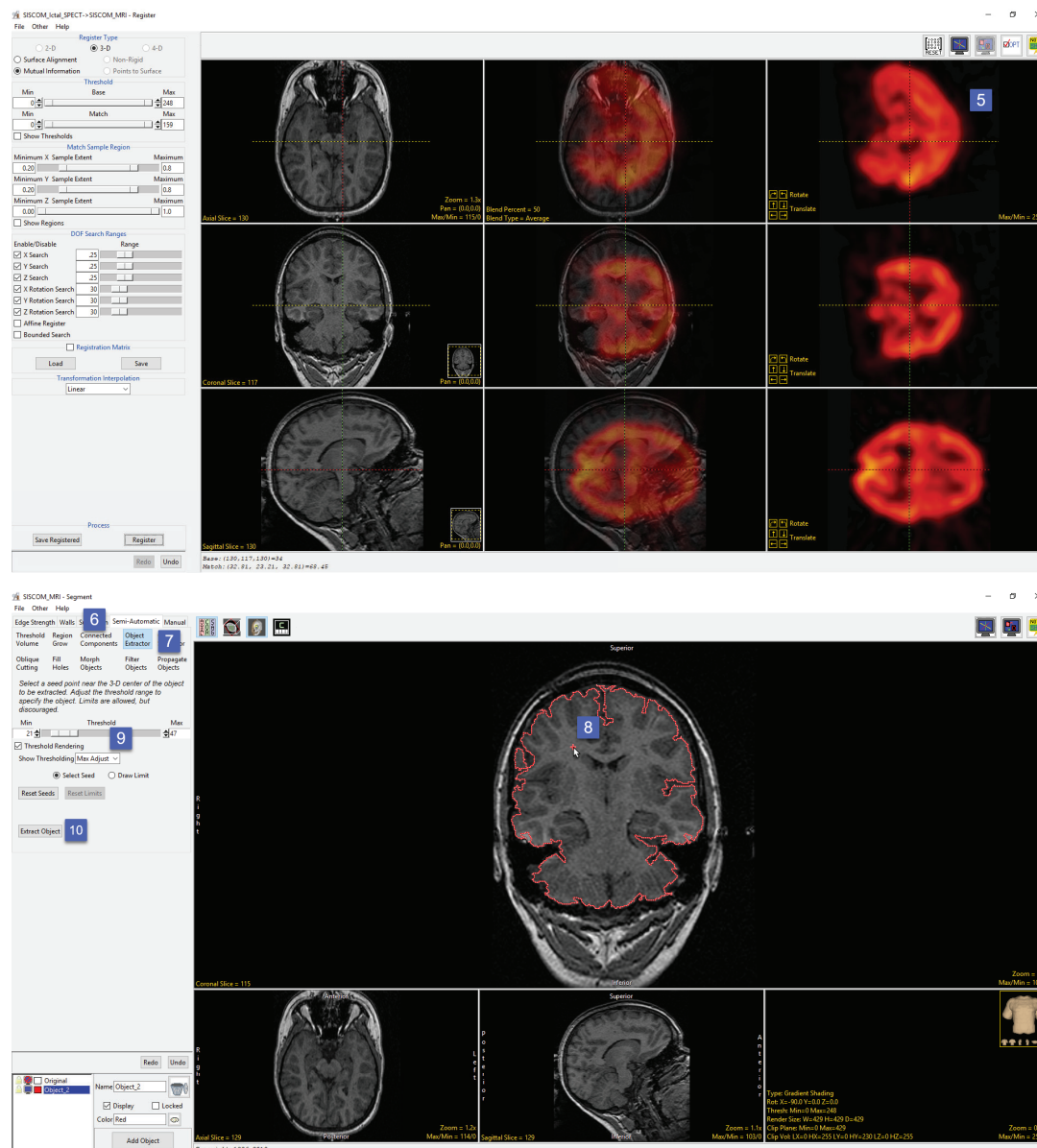
3D Registration - Surface Alignment (continued)

Due to the lack of mutual information between these two modalities the registration will fail. Note the incorrectly positioned SPECT [5] with respect to the MRI.

In order to facilitate successful registration of the MRI and SPECT data we need to establish surfaces for common objects in both data sets, this means the explicit segmentation of the brain from the MRI and SPECT data sets.

- Close the Register module.
- From the main Analyze window select the SISCOM_MRI data set and then open Segment.
- From the Semi-Automatic tab [6] select Object Extractor [7].
- On Coronal slice 115 click in the white matter to set a seed point [8]. Adjust the threshold range [9] to define the brain, a minimum value of 21 and a maximum value of 47 works well for this data set.
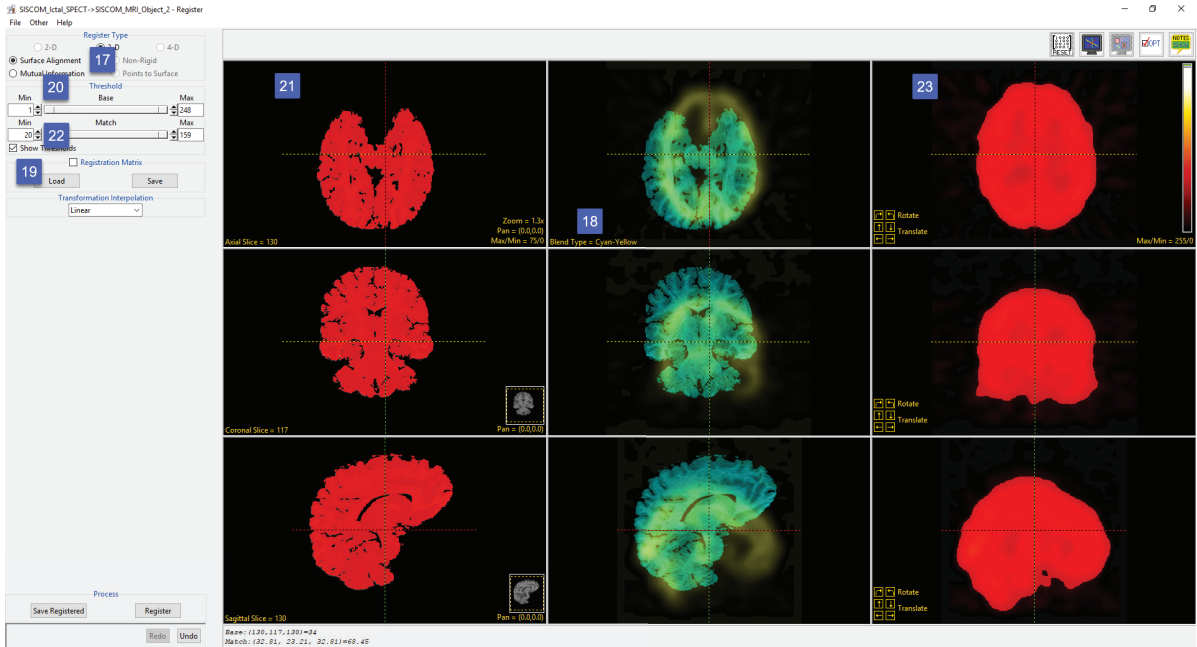- Click Extract Object [10].

3D Registration - Surface Alignment (continued)

- After segmentation is complete notice that the brain object contains some minor holes. To correct for these holes, choose Fill Holes [11], set the Fill Type to 3-Pass [12], click on the brain object [13] to initiate the fill process.

- Once the fill process is complete the brain will no longer contain any holes. Right-click on the brain object in the object list and then choose Save Grayscale from the menu [14].

- In the Save Grayscale window retuned change the name of the output file to SISCOM_MRI_Brain [15] and click Save Grayscale [16]. A grayscale version of the segmented brain object will be saved to the workspace, this will provide the surface of the brain for surface alignment with the SPECT data set.

- Close Segment.

- As the brain surface in this SPECT data set can be easily isolated via thresholding in Register there is no need to segment the data set using Segment. However, if the SPECT image data contained extracranial signal that prevented a clear representation of the brain surface via thresholding the data set could be segmented to isolate the brain using Segment prior to use in Register.
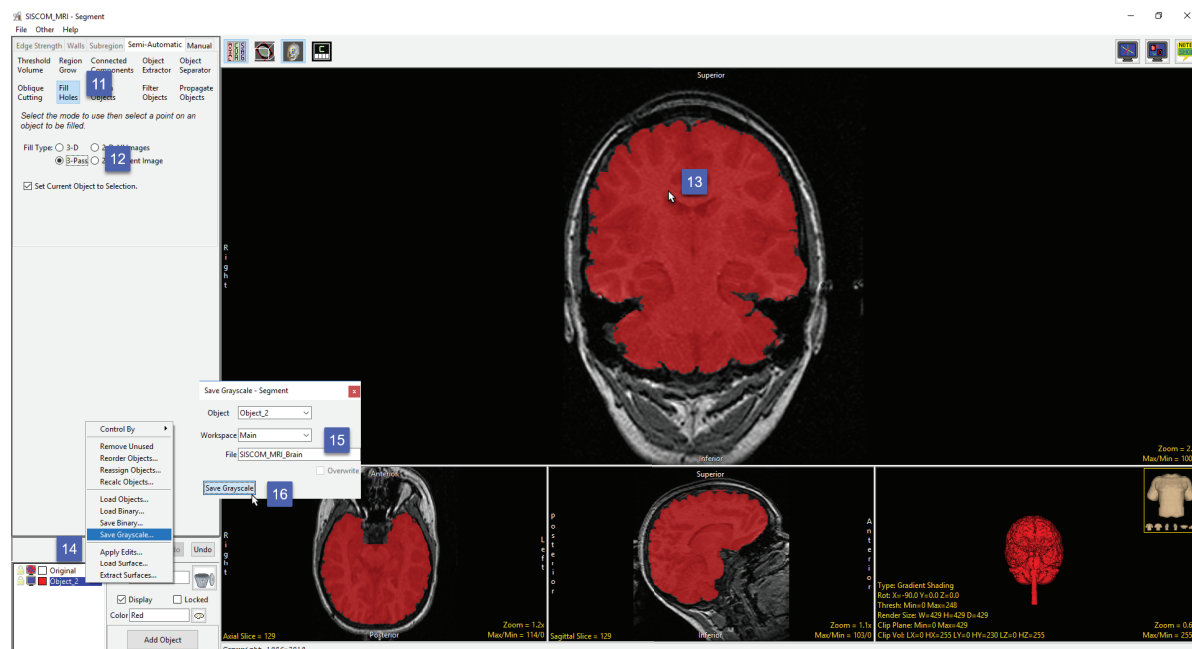
3D Registration - Surface Alignment (continued)

- Select the SISCOM_MRI_Brain data set then press and hold the Ctrl button on your keyboard now select the SISCOM_Ictal_SPECT data set and open Register.

- Set the Register Type to Surface Alignment [17].

- If desired modify the blend type [18].

- Next click the Show Threshold check box [19].

- Note that all voxels for both the base and match data sets are currently selected. To exclude the background voxels from the base volume set the Base minimum threshold level to 1 [20] by entering the value in the text field or by adjusting the slider. Note the update on the base display [21], only the voxels within the red mask will be considered for registration.

- Adjust the threshold range for the match data set to remove the background voxels and all non-brain voxels. Set the minimum threshold value to 20 [22] by entering the value in the text field or by adjusting the slider. Note the update on the match display [23], the voxels within the red mask represent the brain and will provide the match surface to facilitate a successful registration.

3D Registration - Surface Alignment (continued)

- Uncheck the Show Threshold option [24].

- To register the data click Register [25].

- After the registration is complete visually review the transformed and fused image data [26].

- Click Save Registered to save the Transformed SPECT data to the workspace and then close Register.