

Exercise 38 : Image Registration 3-D Registration using MRI and PET

The 3-D Voxel Registration module is an implementation of the Normalized Mutual Information algorithm and allows users to spatially register two volume images. The module contains several unique and powerful algorithms that will allow the precise alignment of 3-D data to be achieved, both quickly and efficiently. This exercise will demonstrate how to register two images of different modalities.

1. Load both the **MRI_Head.avw** and **PET_Head.avw** data sets from the **\$(BIR)\images\TutorialData** directory.
2. In the main Analyze workspace, first select the **MRI_Head** data set. Then, while holding down the **<Ctrl>** key, select the **PET_Head** data set (resulting in both being selected).



3. Open the **3-D Voxel Registration** module (**Register > 3-D Voxel**).
4. Choose **File > Input/Output Ports** to ensure that **MRI_Head** is assigned as the 'Base Volume' and **PET_Head** is assigned as the 'Match Volume'.

Main Interface Features

5. The main interface contains nine image display panes (figure 1).
 - First Column: Displays the 'Base' volume (MRI_Head)
 - Last Column: Displays the 'Match' volume (PET_Head) pre-scaled to the size of the base volume
 - Middle Column: Displays the base and match volumes fused together
 - Rows: Display the volumes in the transverse, coronal, and sagittal orientations
6. By default, the volumes are displayed with cubic voxels. To turn off the cubic display press the **Toggle Cubic** PowerBar button. For this exercise leave cubic display on.

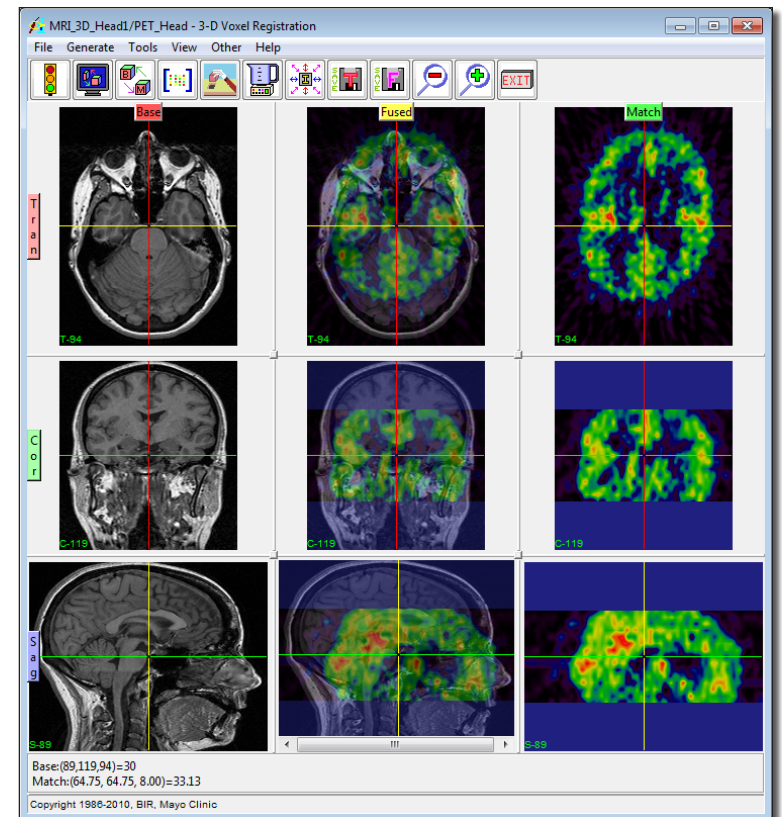


Figure 1

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7. Open the **Blend** window (**Generate > Blend**). The Blend window provides different settings to help visually evaluate the registration. Experiment with the different blend options (figure 2) and then click Done to dismiss the window.
8. The crosshair in each of the image display panes can be used to move through the volumes. When the crosshair is moved in any of the panes, the other panes automatically update to display the same volume coordinate. Note, the base and match coordinates are reported at the bottom of the window.
9. Right-click on any of the image display panes to view options for controlling individual tiles, reference lines, image sizes, annotations, and interactivity.

Registration



10. For this exercise, no parameters need to be changed for a successful registration, the default settings are appropriate. Press the **Register** PowerBar button or choose **Generate > Register**.
11. After registration is complete you will see that the PET volume has been scaled, rotated, and translated to match exactly the sagittal MRI. To evaluate the registration, move the crosshair in any of the panes and change the 'Blend' type to 'Average'.



12. To view the current transformation matrix open the **Matrix Tool (Tools > Matrix)**. You may manually enter rotations, translations, and scaling to the matrix by selecting an option and increment (figure 3). You may also save the current matrix as an ASCII floating-point file or load a previously saved matrix.



13. You may also use manual correction buttons in the **Manual tool (Tools > Manual)** to incrementally change the registration matrix. The buttons move the match volume section in the directions indicated, and then adjust the 3-D matrix depending upon the orientation selected.

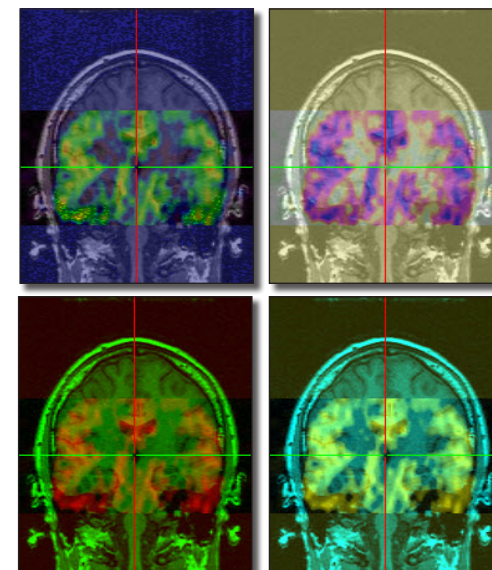


Figure 2

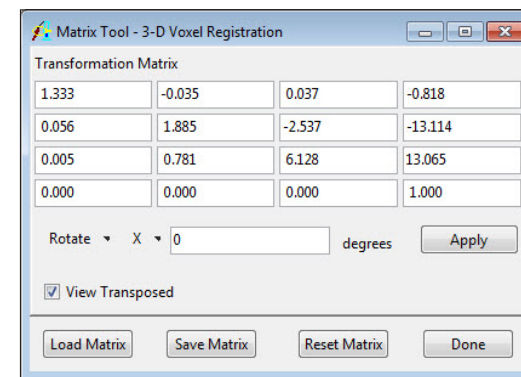


Figure 3

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Saving Transformed and Fused



14. To save a copy of the transformed match volume (PET_Head), choose **File > Save Transformed**; the transformed volume can be saved to disk or to the main Analyze workspace (figure 4).



15. To save the fused volume, choose **File > Save Fused**; the fused volume can be saved to disk or to the main Analyze workspace.

16. Close the 3-D Voxel Registration module before proceeding to the Additional Task.

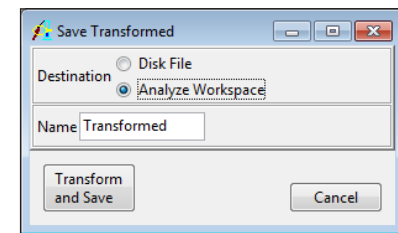


Figure 4

1. Manual Scale Adjustment

The Manual Registration tool in both the 3-D Voxel and Surface Registration modules now provides the ability for users to manually adjust the scale of the Match data prior to registration. This task will demonstrate how to access and use the new Adjust Scale tool.

1. Select the **MRI_Head.avw** data set. Then while holding down the **<Ctrl>** key, select the **PET_Head.avw** data set (resulting in both being selected).
2. Open the **3-D Voxel Registration** module (**Register > 3-D Voxel**).
3. To access the Adjust Scale tool, open the **Manual Registration** tool from the **Tools > Manual** menu (figure 1). Check the **Adjust Scale** option, the Manual Registration tool will update with X, Y, and Z scale tools.
4. Adjust the scale of the Match data up and down in each orientation by click on the arrow up and arrow down keys. Note the display of the Match data each time the scale is adjusted.
5. Close all windows associated with the 3-D Voxel Registration module before proceeding to the next exercise.

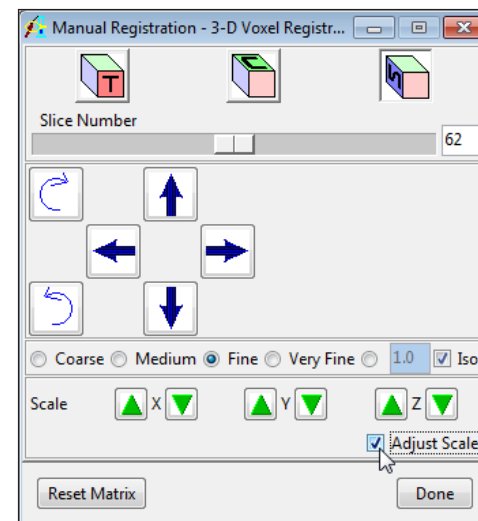


Figure 1