



*NA-MIC*

*National Alliance for Medical Image Computing*

*<http://www.na-mic.org>*

---

## **Slicer3 Tutorial**

# **Manual Registration**

Dominik Meier, Ron Kikinis



# Overview

---

- |                                   | takes how long to do? |
|-----------------------------------|-----------------------|
| 1. Introduction                   |                       |
| 2. Prerequisites                  |                       |
| 3. Loading Example Dataset        | 10 sec                |
| 4. Creating New Transform         | 10 sec                |
| 5. Associate Transform with Image | 5 sec                 |
| 6. Move Image                     | 2 min                 |
| 7. Apply & Save                   | 15 sec                |

Note: contains animated GIFs, view in Presentation Mode

---

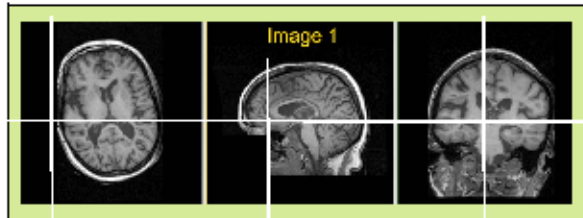
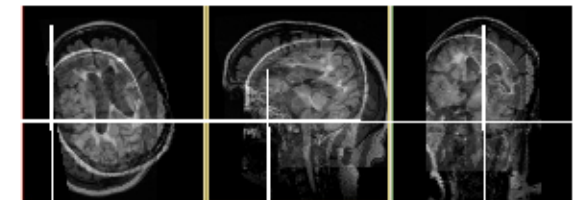


# Introduction / Background

## What is “Image Registration” or “Data Fusion” ?

- the **two** terms are often used synonymously. At a basic level they are the same thing.
- The goal is to bring **two** or more images into alignment such that corresponding content (anatomy, structure) appears in the same location and orientation when viewed together.
- In this tutorial example we have **2 MRI scans** of the same subject, acquired with **different head positions**, so that when they are viewed simultaneously, they do not show matching anatomy. In other words they are “shifted” and “rotated” relative to each other.
- Because the image is a digital representation, registration involves a reformatting of the stored image data. The common practice is to leave one image as is and reformat the other in the orientation of the first.
- You could think of it as a second re-scan of the subject, along the same orientation as the reference image.
- When you manually adjust the “display” of one image such that both images roughly show the same location, you are performing a type of registration.
- Because images are 3-dimensional, there are complex ways in which the **two** images can differ in orientation. For the brain example shown here we have relative shifts in any of 3 directions and 3 possible rotations (yaw, pitch & roll). This means as many as 6 parameters must be adjusted to register the **two** images.
- 3D Slicer offers both manual and automated ways to do this task. This tutorial explains the manual procedure.

### Before Registration



### After Registration

animated GIFs: view in Presentation Mode



# Prerequisites

---

- [Slicer 3.6 release](#)
- **Example Dataset:** download and extract the dataset for this tutorial: `Slicer_ManualRegExample.zip`. It should contain:
  - » `ManualRegistrationExample_SlicerScene.mml` Slicer Scene File to load
  - » `ManualRegistrationExample_fixed.nrrd` file of first MRI image
  - » `ManualRegistrationExample_moving.nrrd` file of second MRI image to be aligned with first
- **Tutorials to complete first** (helpful but not required):
  - » *'Slicer3Minute Tutorial'* - Sonia Pujol, PhD
  - » *'3D Data Loading and Visualization'* – Sonia Pujol, PhD

<http://www.slicer.org/slicerWiki/index.php/Slicer3.6:Training>





# Loading Example Dataset

To get the Example Dataset loaded into Slicer:

1. **File** Menu: File: Load Scene...

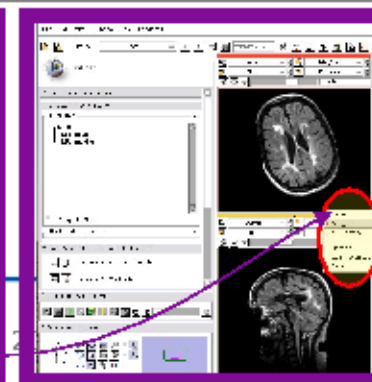
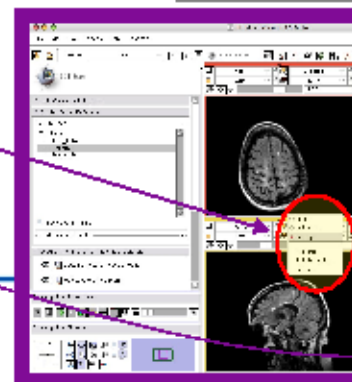
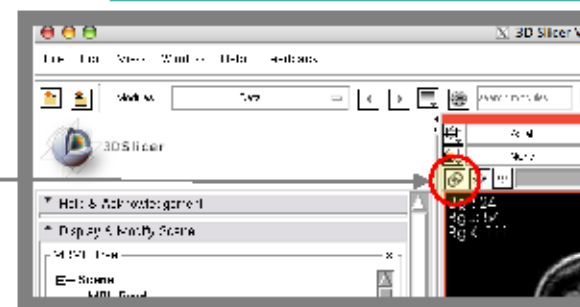
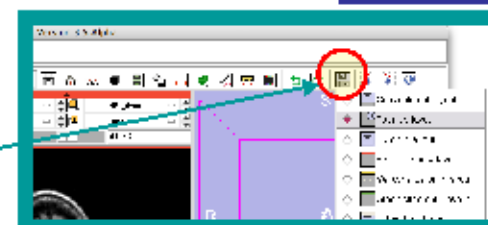
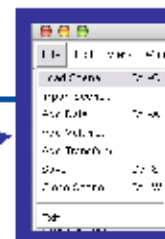
- Select the Slicer Scene file that comes with the downloaded example dataset, called: `ManualRegistrationExample_SlicerScene.mrml`
- This will load all the associated images

1.  **Select Layout:** From the icon bar, click on the Layout menu and select "Four-up Layout".

2.  **Link Views:** Click on the Ring Icon in any of the slice views to link all the views together. This will save you the work of making selections for each slice window separately.

3.  **Choose Foreground:** MRI\_moving

4.  **Choose Background:** MRI\_fixed.

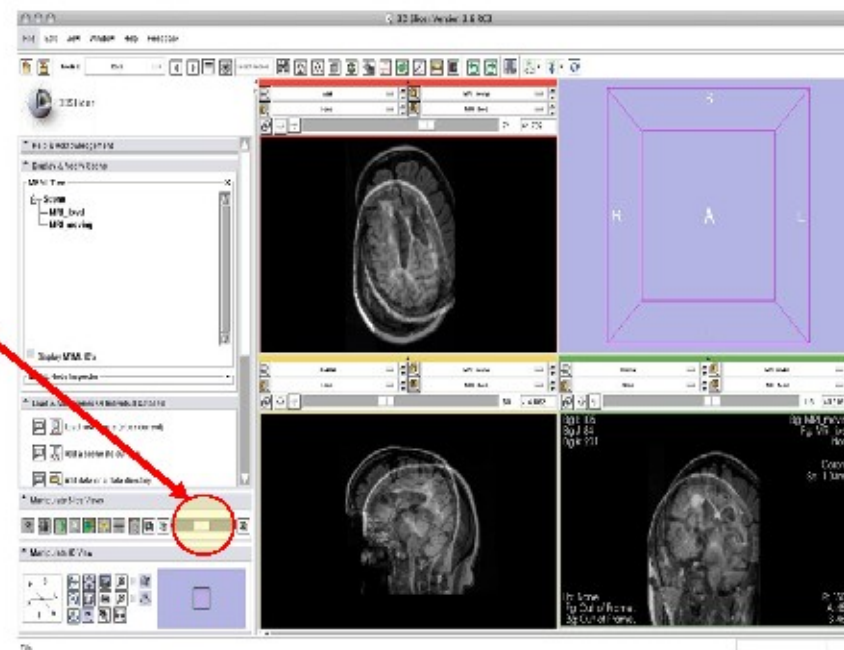




# Adjust Slice Views

- To interactively align images, we need to see them both at the same time:
- Set **Visibility Slider** to halfway between foreground and background. This allows you to see both images.
- Note how the display changes as you move the slider.

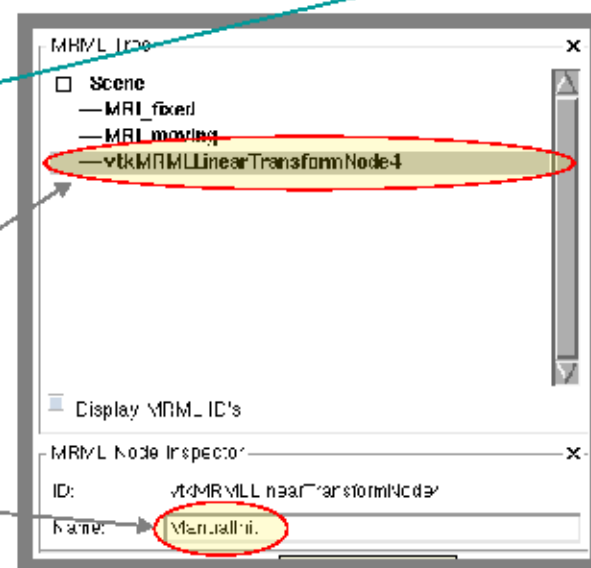
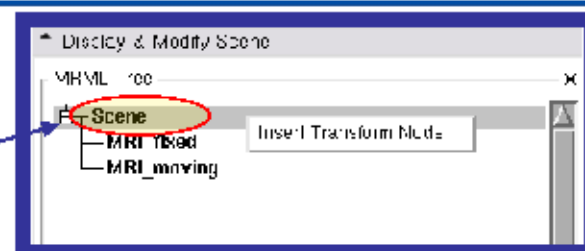
Note: For your own dataset, you may need to adjust the level as well as each image's Window & Level settings to comfortably see both images.






# Create New (blank) Transform

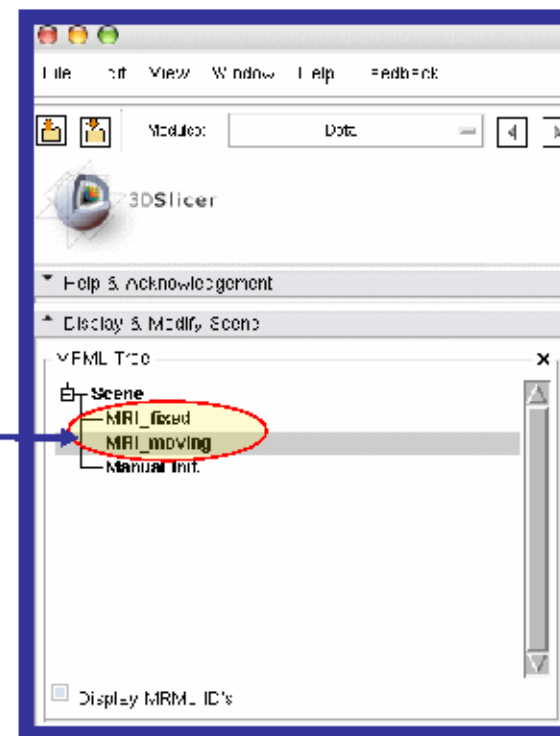
1. You can create a new Transform in the Data module directly:
2. Right-click on the "Scene" node in the MRML tree. From the pull down menu select: "Insert Transform Node"
3. We change the name of the new transform:
  1. Click on the little triangle to expand the "MRML Node Inspector" tab at the bottom of the panel
  2. select the new node ("vtkMRMLLinearTransformNode")
  3. type the new name, e.g. "ManualInit"
  4. hit "ENTER"





# Link Image to New Transform

- 1  You see the newly created transform listed along with the two image volumes. We now associate the moving image with the transform:
2. In the MRML tree window, select the node for the “MRI\_moving” image and drag it on top of the “Manual Init” transform. You should now see the diagram updated with the volume listed within the transform





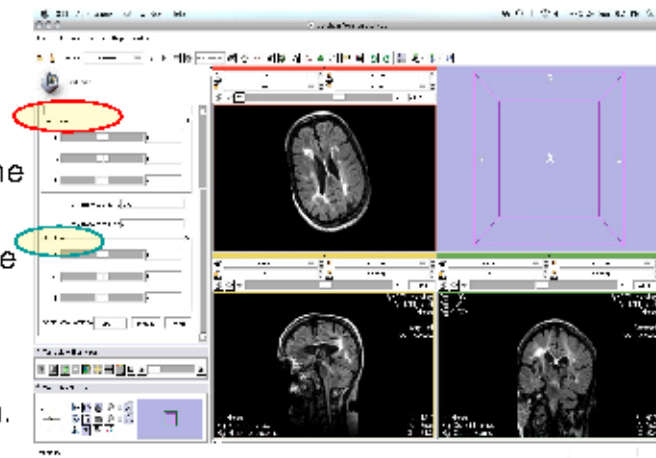
animated GIF: view in Presentation Mode



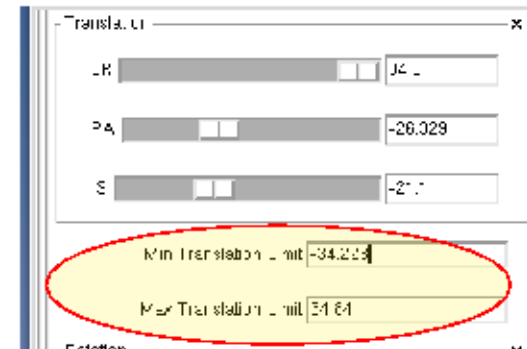


# Move Image

1.  Return To the Transforms module
2.  Move the sliders to align the two images:
  1. Move the **translation sliders** labeled "IS" to the left until it reads about "-21". Watch the display update as you move the slider
  2. Move the "PA" translation slider to the left while watching the display until the two brain roughly align. The "PA" slider should read around "-24"
  3. Move the "IS" **rotation slider** to rotate the volume clockwise until the axial planes have roughly the same orientation. (ca. 14 degrees).
  4. Move the "LR" translation slider to the right to compensate for the shift that occurred from the rotation. Reading now is ca. "+26".
  5. If you get stuck you can easily start over by clicking the "Identity" button at the bottom, which will reset the transform.
  6. You can tune the sensitivity of the translation sliders by setting the min and max. Setting smaller range allows more precise changes.
  7. You can also move by entering the numbers in the text fields and the hit the "TAB" or "Return" key.



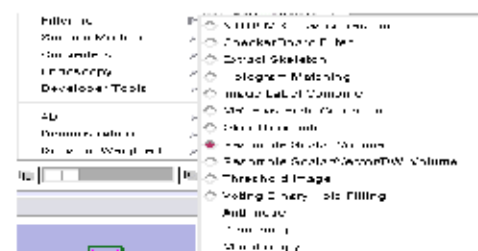
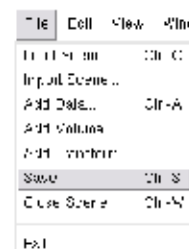
animated GIF: view in Presentation Mode





# Apply Transform


- You can now **use** this transform as input to an automated registration: In most automated registration modules you will find a menu called “Load Transform” or “Initial Transform”. To use simply select from the pulldown menu.
- You can **save** the transform to apply elsewhere. This is done via the “File/Save” menu.
- You can **apply** the transform to other volumes. You can drag any other volume inside the transform to apply it and then select “Harden Transform” (see next page) to finalize, or you can use the “Resample Volume” module for more options.

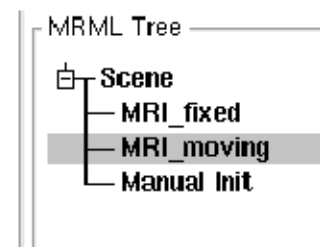
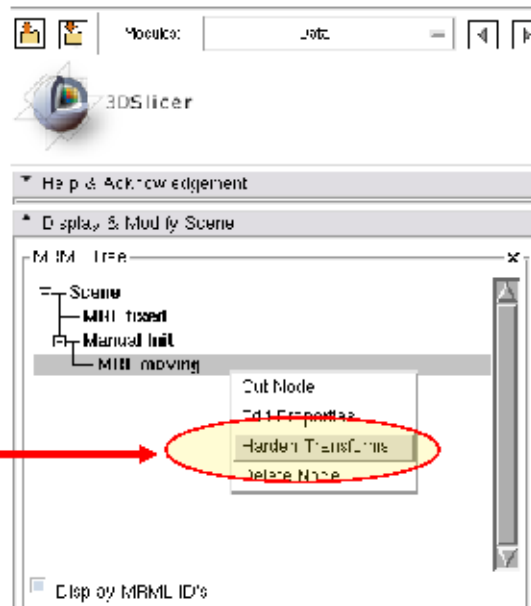




# Apply & Save

We apply the transform to the moving image and save the result volume:

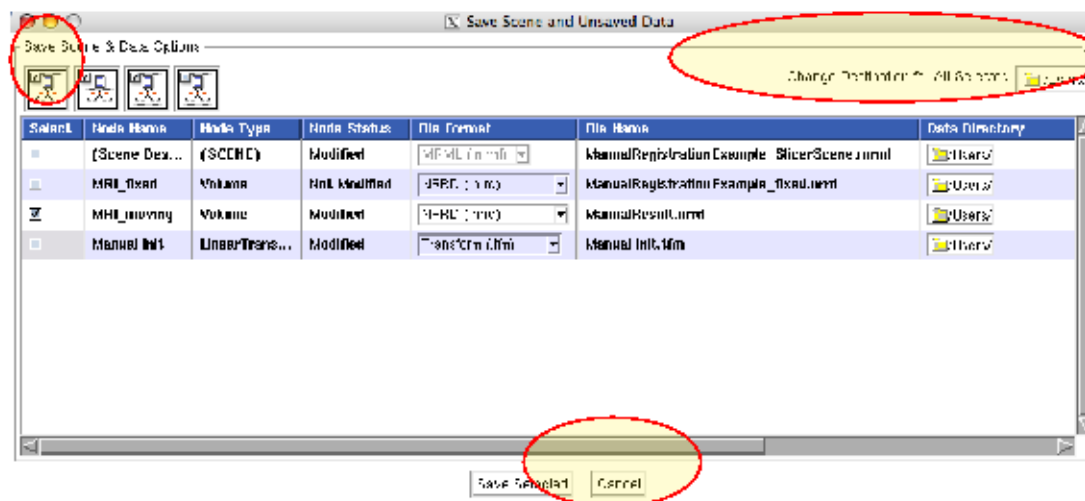
1.  Go back to the “Data” module
2. Right-click on the “MRI\_moving” image. From the pulldown menu, select **“Harden Transform”**. This finalizes the transform and resamples the volume in the new orientation. You will see the “MRI\_moving” node moved back out into the main hierarchy level.





# Save

1. Select “Save” from the File Menu. In the Dialog uncheck all lines except for “MRI\_moving”. In the “FileName” field, double click and select a new filename, e.g. “ManualResult.nrrd”
2. To also save the transform, check the box next to “Manual Init”. The transform will be saved as a small text file containing all the necessary parameters.
3. click “Save”.





# What Next

---

- Try the automated Registration Tutorial or one of the tutorials from the Registration Case Library.

<http://na-mic.org/Wiki/index.php/Projects:RegistrationDocumentation:UseCaseInventory>

<http://www.slicer.org/slicerWiki/index.php/Slicer3:Registration>

Feedback: anything amiss? If you have suggestions on how we can improve this and other documentation, please let us know: visit:

<http://na-mic.org/Wiki/index.php/Projects:RegistrationDocumentation>



# Acknowledgments

---



National Alliance for Medical Image Computing  
NIH U54EB005149



Neuroimage Analysis Center  
NIH P41RR013218 -12S1 (ARRA Suppl)