Image Processing Guideline for TMU 7T MRI

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< Section 1: Installation of ImageJ software >

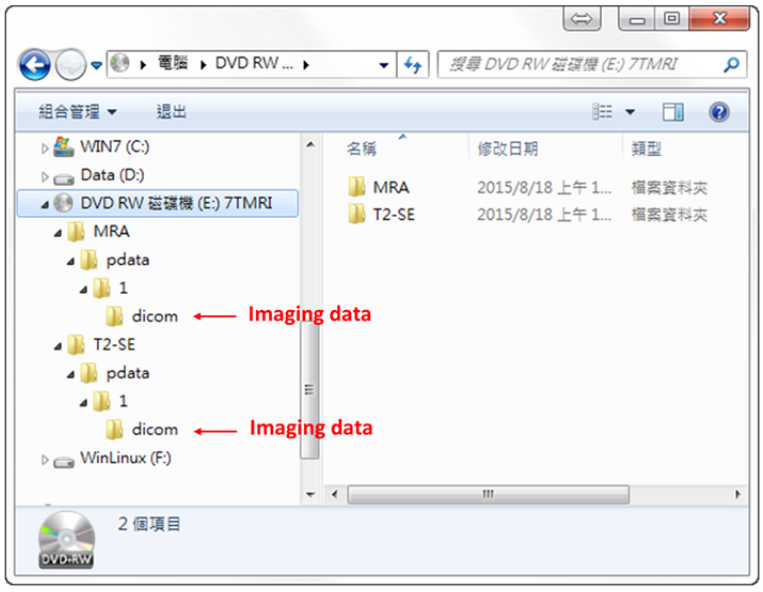
✓ Download **ImageJ** software and demanded Java version from the official website and install on your PC.
http://imagej.nih.gov/ij/ (Support Windows 7/8, Max OS X, and Linux)

ImageJ
Image Processing and Analysis in Java

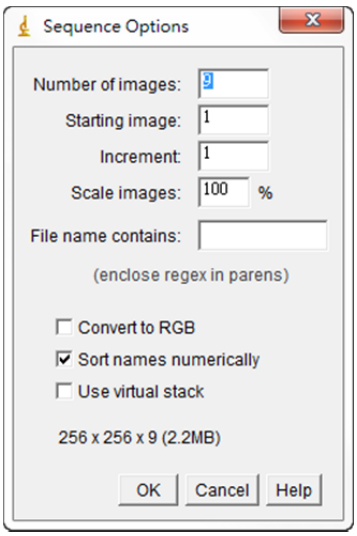
< Section 2: Import and adjustment of image sequence >

✓ Once MRI scan is done, a disc containing separated directories for each image sequence is given (Sequences of T2-SE and MRA are demonstrated in this guideline).

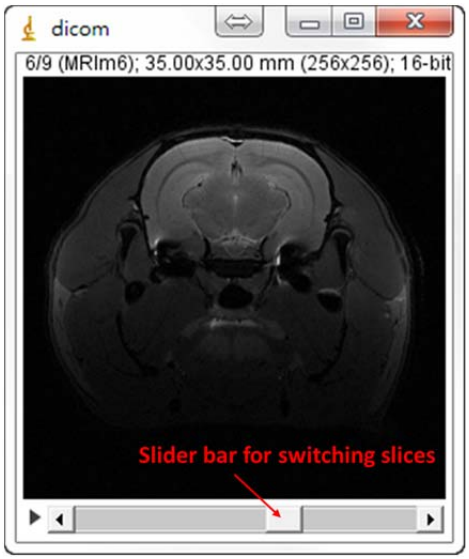
✓ Imaging data are saved as DICOM format and located at **SequenceName\pdata\1\dicom**.



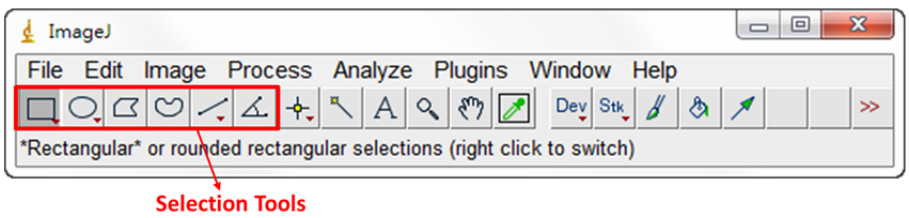
- ✓ Execute ImageJ and import image sequence by selecting **[File] → [Import] → [Image Sequence…]** on the menu bar. Please load the first image within a dicom folder.
- ✓ A window of **Sequence Options** will pop out. **Number of images** is automatically set as the file number within the selected dicom folder. Normally, keep the original value will be fine. Press **[OK]** to proceed.

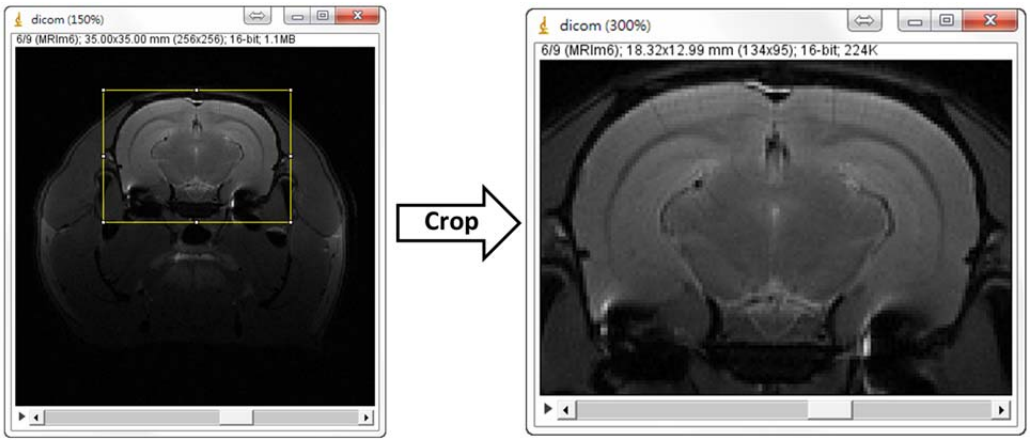


- ✓ Scroll the **mouse wheel** or use the **slider bar** beneath the Image to switch different image slices. Use **[Image] → [Zoom] → [In]** or **[Image] → [Zoom] → [out]** on the menu bar to zoom in or out the image.

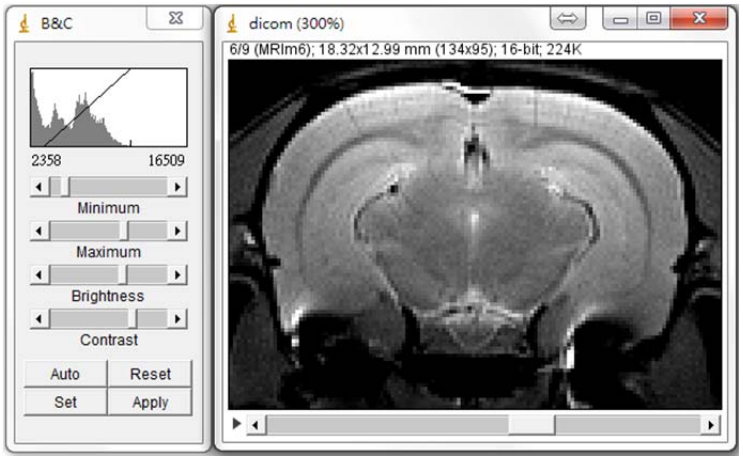


- ✓ To crop images, use the **Selection Tools** to select a region on the image slice. Use **[Image] → [Crop]** to crop whole image series.





✓ To adjust image contrast, press **[Image] → [Adjust] → [Brightness/Contrast…]** to open the B&C window for the contrast adjustment.



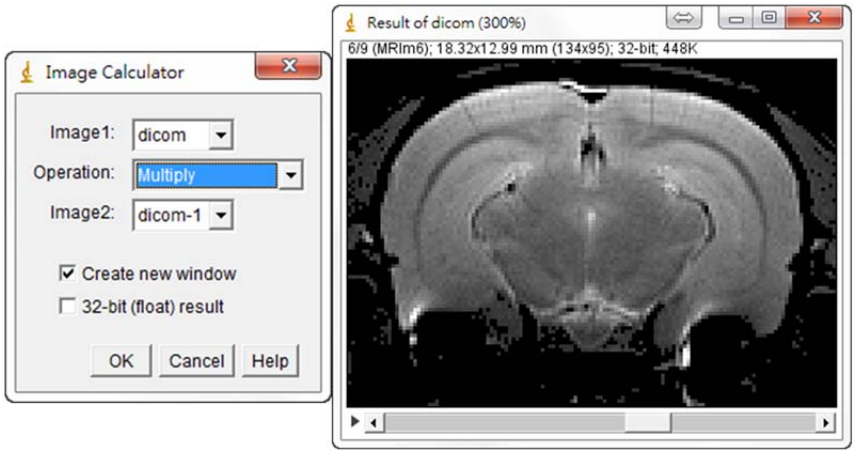
✓ To clean up the background intensity, two steps are recommended though the first step is optional but helpful.

➢ **Step 1:** Perform thresholding on images as the following procedure:

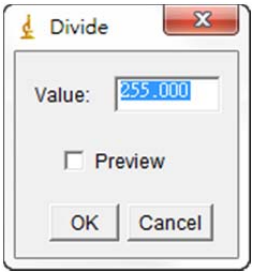
1) Duplicate image by **[Image] → [Duplicate…],** ensure the **Duplicate stack** is checked, and then press **[OK]**;

2) Select **[Image] → [Adjust] → [Threshold…]**, adjust lower and higher threshold values, ensure **Dark background** and **Stack histogram** are both checked, and press **[Apply]** and **[OK]**;

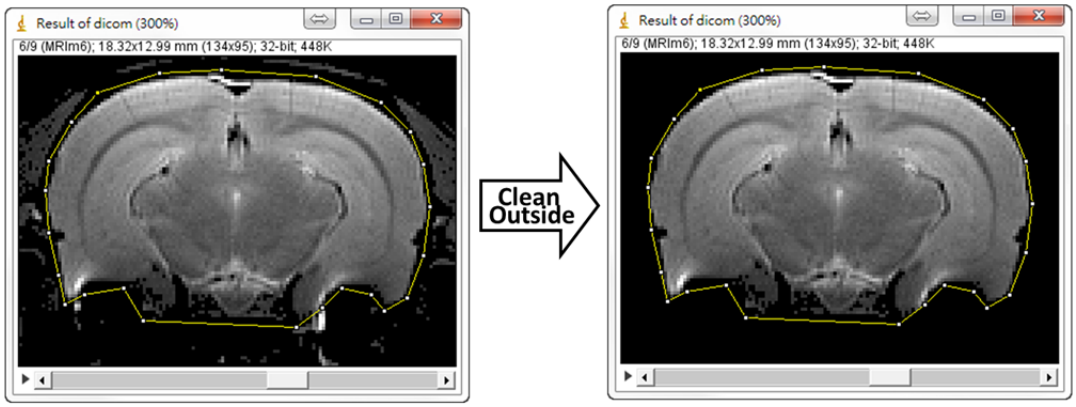
3) Use **[Process] → [Image Calculator…]** to multiply Image1 by Image2;



4) Use **[Process] → [Math] → [Divide…]** to correct the image intensity of the resultant image from procedure 3). Set the value as **255**.

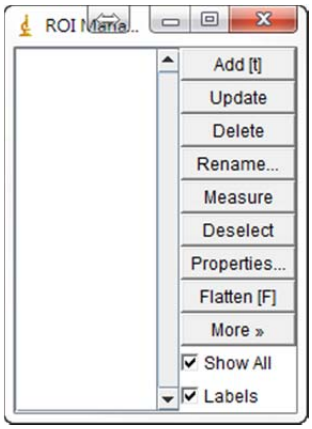


- **Step 2:** Clean up the background slice by slice. Use either **Freehand** or **Polygon selection tool** to create the region of interest (ROI) and then select **[Edit] → [Clean Outside]** to eliminate the intensity outside the ROI. This process must be repeated slice by slice.



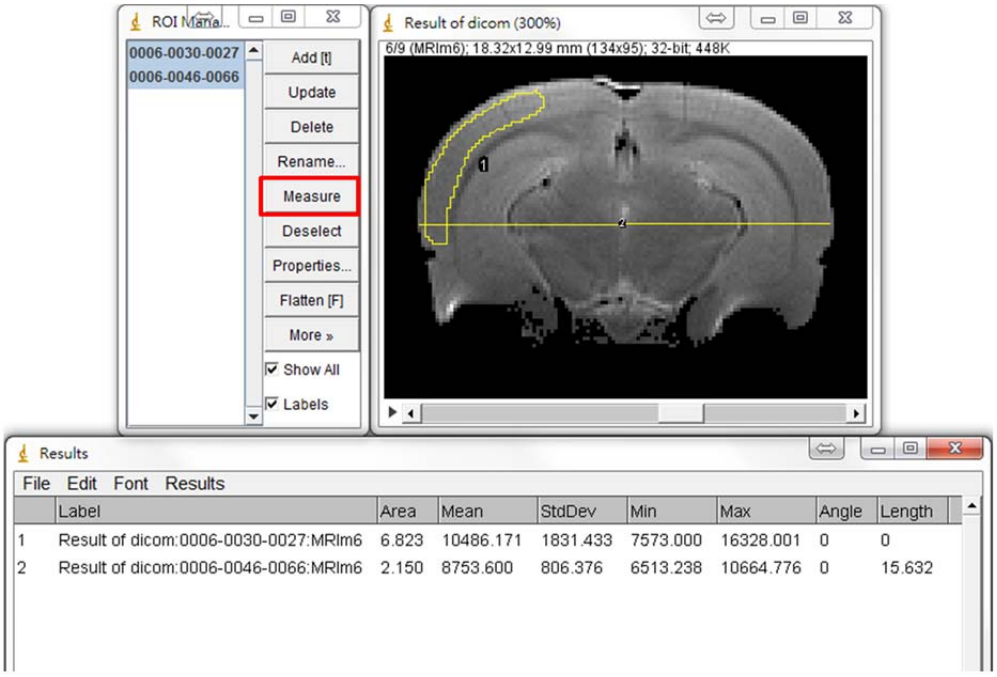
< Section 3: Measurements in ROI >

✓ Open **ROI Manager** window by selecting **[Analyze] → [Tools] → [ROI Manager…]**.



✓ To measure the intensity, area, length, and angle of ROIs, create an ROI using one of the **Selections Tools** (rectangular, oval, polygon, freehand selection, straight line, or angle) and press **[Add]** on the ROI manager window to add it into the measurement list.

✓ Select the ROIs and press **[Measure]** on the ROI manager window to view the measurements in ROI(s). The unit of measurements is mm or mm^2.



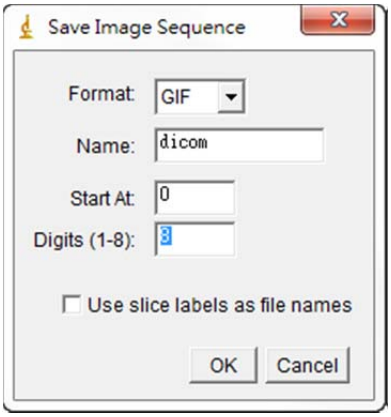
✓ The target volume (such as the tumor volume) can be calculated as the area (in mm^2) of ROI multiplied by the slice thickness (in mm). The value of slice thickness can be found in the **SequenceName\pdata\method** file (open with Word or WordPad).

```
##$PVM_SliceThick=0.8
```

< Section 4: Export processed images >

✓ To save the image sequence as the specified format,

➢ Press **[File]** → **[Save As]** → **[Image Sequences…]**, select the image format (BMP, GIF, JPEG, PNG,…), and press **[OK]** to create the consecutive slice images.



✓ Instead, you can select **[File] → [Save As] → [Animated GIF]** to export image sequence as an animated GIF file.

< Section 5: 3D Viewer for MR angiography >

✓ For the image sequence of MR angiography (MRA), **3D Viewer** Plugin has to be installed for once (download from http://3dviewer.neurofly.de/, and copy the downloaded file into the **ImageJ\plugins\3D** folder).

✓ Import MRA image sequence and press **[Plugins] → [3D] → [3D Viewer]** to open the **ImageJ 3D Viewer** window.

✓ Select **[Edit] → [adjust threshold]** to adjust threshold for displaying vessel structures.