# MRI Object Modeling Workbench - User Manual

About MRI Object Modeling Workbench

The OMW allows to extract objects from large datasets. It has been created for the purpose of 3d-modeling but other usages are possible, for example
object tracing in time series. It has been used for the 3d-reconstruction of a rat's jaw from histological sections, the reconstruction of a palm leave from histological sections and the 3d-modelling of parts of a palm from confocal microscopy.
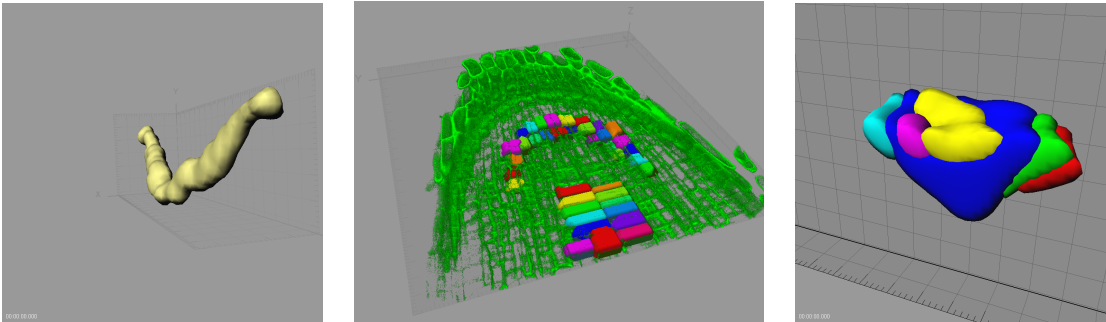
When a series of images is loaded, the slices are listed in a sidepane. When an image is selected it is loaded and shown. Two images can be shown in the same time in the same window. The slices can be aligned automatically, based on the difference between two images for each alignment position, or manually. When a selection on a slice is made it is automatically kept. A special magic wand tool for the selection of compartments is included in the OMW. Objects can be defined by a number of selections. Finally a stack for each object can be saved to disk. This stack can be used as the input data for the 3d modeling.

Features:
- stack registration
- transparent overlay of images
- magic wand for compartment selection
- definition of objects from selections
- transparent display of objects
- subtraction and addition of object areas
- export of objects as image data
- all ImageJ commands can be applied to the images in the worbench display
- can be used as a convenient way to create batch processing jobs on image series

Limitations:
- no 3d modeling and display, but a stack image of the objects can be created in memory and the ImageJ 3d-plugins/commands can be used on it
- 1 object can only have 1 selection per slice and composite selections are not allowed
- only two images can be displayed in the same time
- the image window only works on the primary monitor

Starting the OMW

Start the object modeling workbench either from Show>object modeling workbench or by clicking the OMW button on the MRI-CIA taskbar.
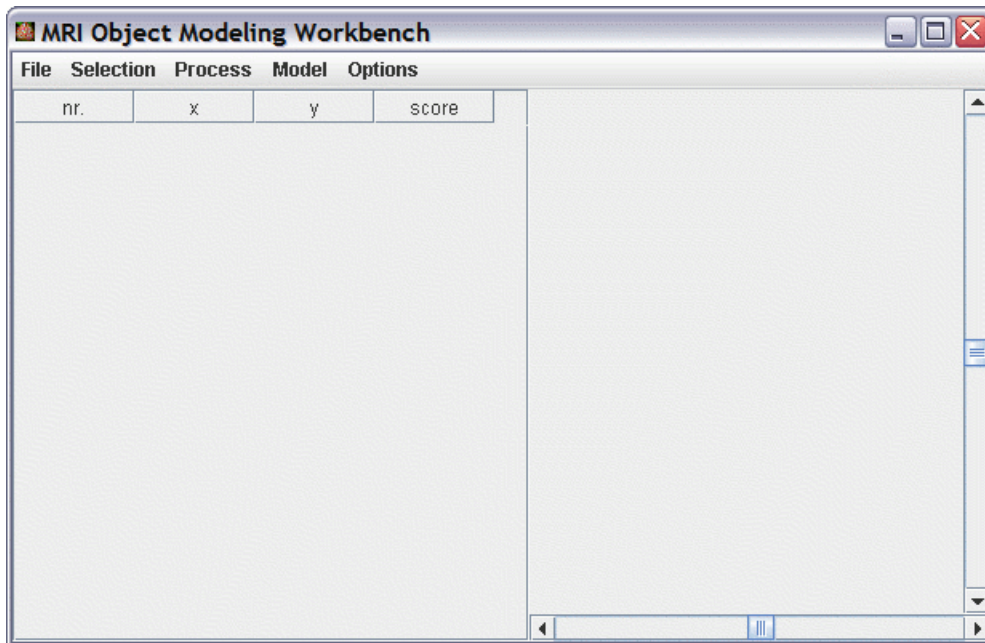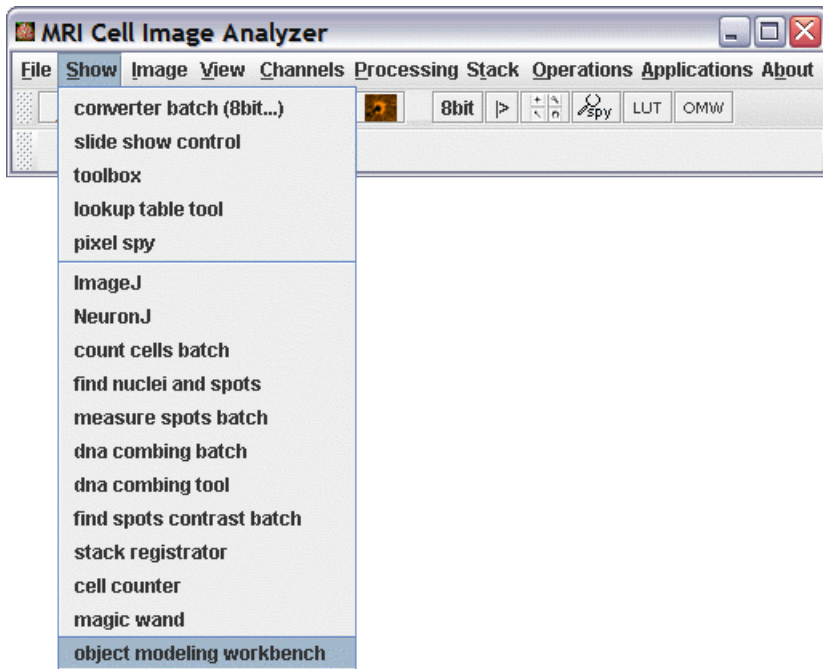
Opening an image series

File>open series... will bring up the list editor. Press add to add a directory or the selected images. If you add a directory all tiff-images in all subdirectories will be added. Before closing the list editor you can remove unwanted images from the list. If your data is in another format than tif-series, you have to convert it before loading it into the OMW.
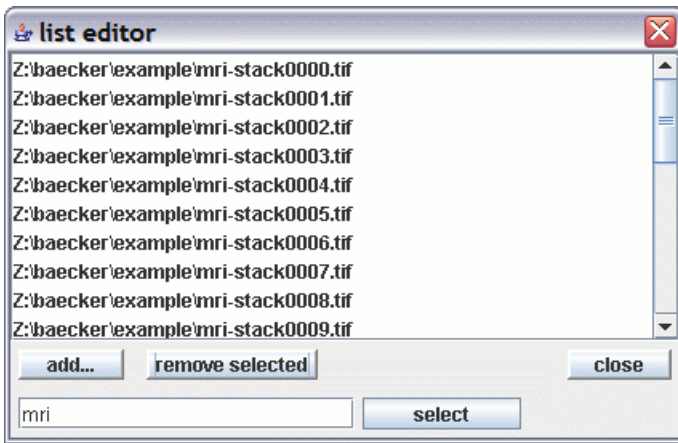
Image display

Select a slice from the list at the left hand. The according image will be loaded and displayed. You can select more than one slice in the same time. When more than one slice is selected, the first and the last selecteded slices are displayed and all commands are send to the last selected slice. With a right click on a slice list entry you can open the slice's display options. You can change the opacity of a slice. An opacity of 100 means fully opaque and an opacy of 0 means fully transparent, thus invisible.
You can apply MRI-CIA operations and ImageJ commands to an image in the OMW. However when you de-select the image all changes are lost, except for:

- the lookup-table
- the opacity
- the selection (roi)

The zoom you choose, by zooming in or out, will be used globally for all images.
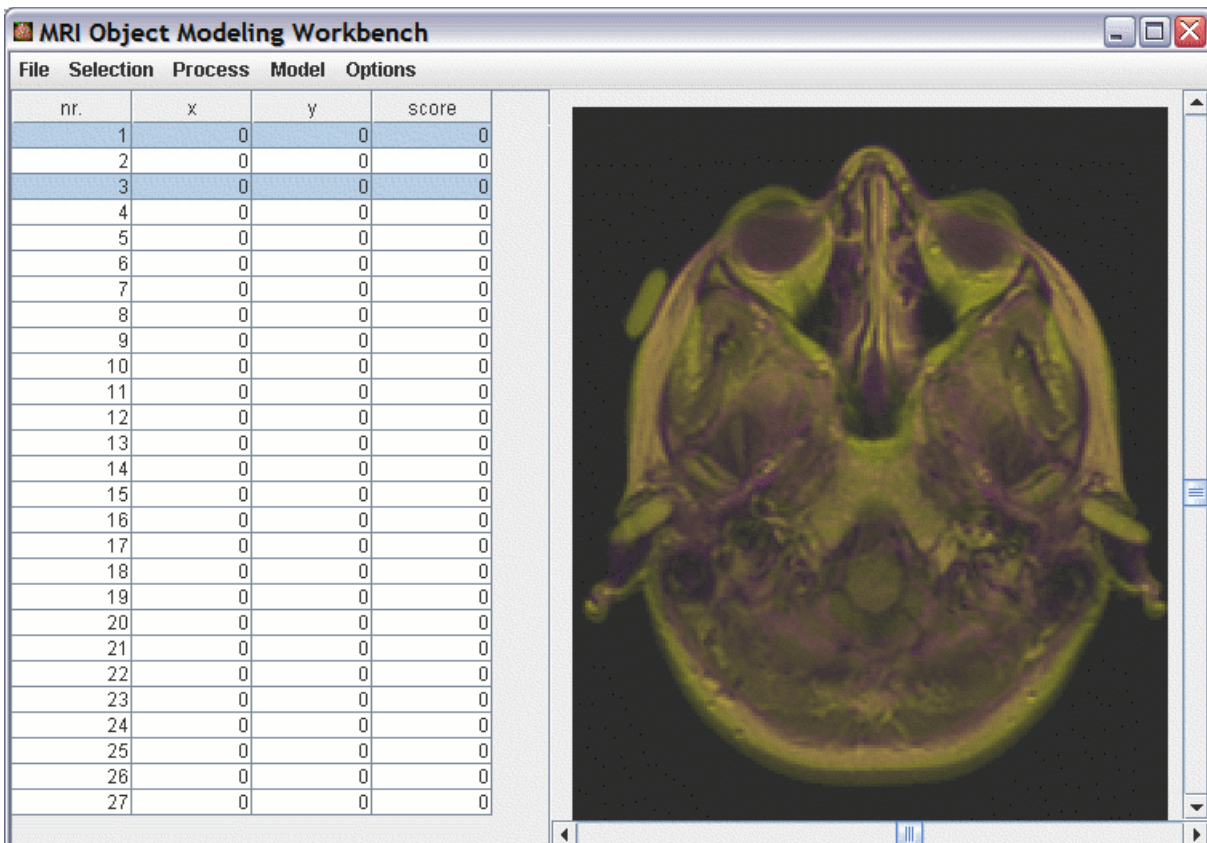
Automatic stack registration

The images from histological sections have to be aligned before one can start to extract objects. This is called stack registration. You can do it either manually or automatically. To start the automatic registration use Process>>calculate translations. You will be asked where to save the result file. The translations file is a text file where each row contains three entries, seperated by tabs. The first entry is the x-offset, the second the y-offset and the third the score. The score indicates the quality of the alignment. The lower the score the better the alignment. It is the average difference between the two images in the overlapping region for a given translation.
The computation is finished when the ImageJ progress bar is not moving anymore.
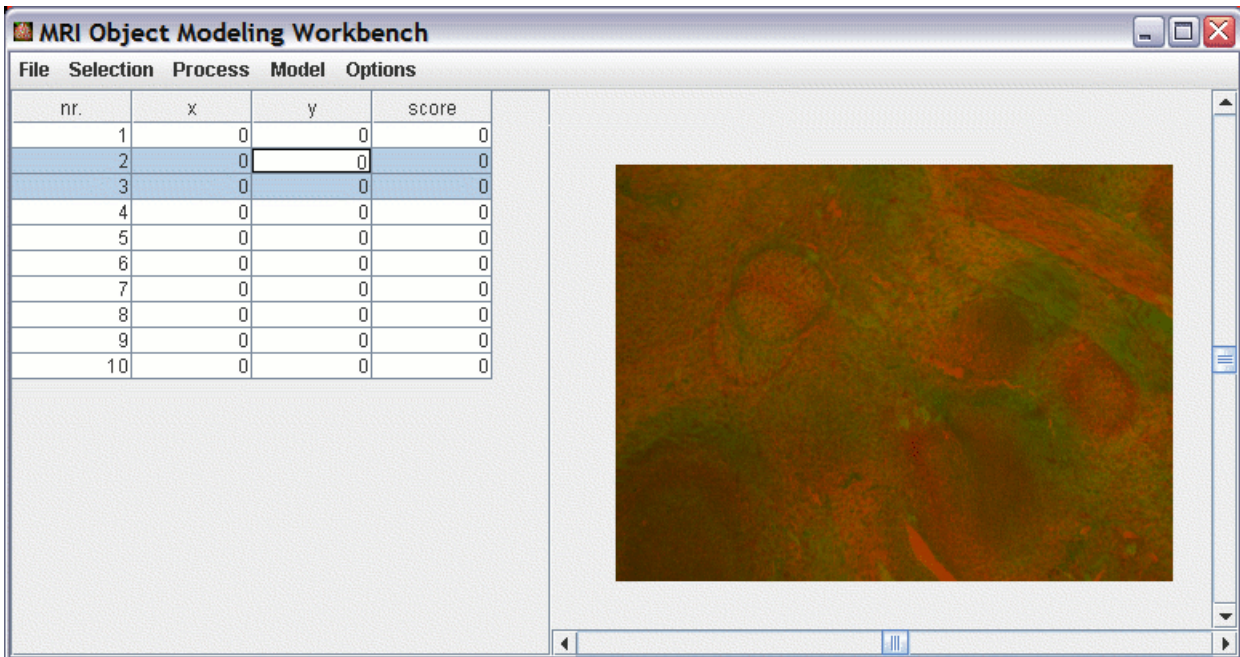
Once the translations are written you can apply them to the opened image series by using File>open translations... The offset and the score will then be displayed in the object modeling workbench and the images will be displayed in the according positions.
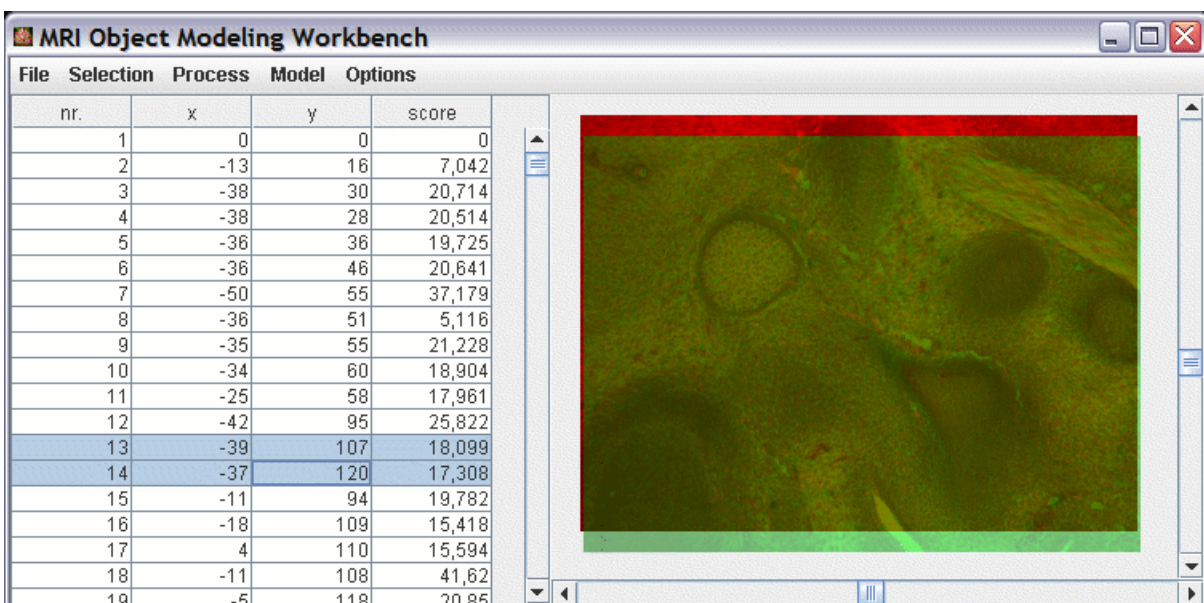
The calculation of the translations can take a long time. You might eventually want to scale down the images before starting the translation calculation.

Alternatively you can use Process>>calculate translations quickly. You will be asked for a step width. The images will be compared using a raster with cells of size step width. The final position will be searched around the best fit on the raster. Although this is much faster, it might, depending on your images, create more false alignments.

When the translations are computed you should look for translations with a high score. These are likely to be false and you should correct them manually.

Scaling images

To scale up or down all images in a series use Process>>scale series... You'll be asked for the x- and y-scale factor and if interpolation should be used. The you have to indicate a destination folder for the scaled series. The translations will be scaled accordingly and the scaled series is loaded after the processing finished.

Manual stack registration

Click into the image canvas to activate it. You can now use the arrow keys to move the second selected images in all directions. The movement will accelerate as long as you you keep a key pressed. The current offset and the current score are displayed in the MRI-CIA status bar. Once you found the right translation you can apply it to the moved slice only by pressing ENTER and to the moved slice and all following slices by pressing CTRL+ENTER.

Manual object extraction

Open the 3D object manager from Model>open 3D object manager. Click the add object... button and enter a name for the new object. Select the show checkbox, so that objects will be displayed on the image. Make a selection on one of the slices using the usual selection tools, for example a freehand-selection. Check that the object is selected and press the add selections button. The selection is added to the object. You can use SPACEBAR to create a new object and add the current selection to the object in one step and CTRL+SPACEBAR to add the current selection to the current object. Do the same thing for all slices on which the object is visible.

You can transfer a selection from one slice to another by selecting the selection in the 3d object manager and pressing the set to active image button. In this way you can compare the position of the object on to different slices.

You can use ctrl+left click on an object in a slice to select it in the 3d object manager.
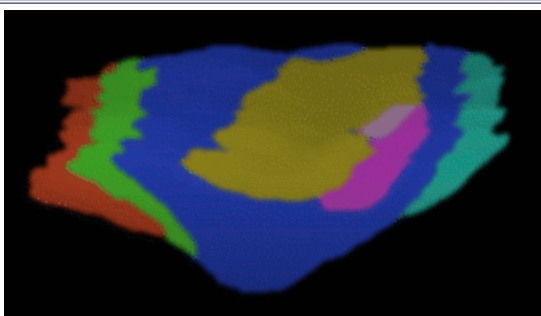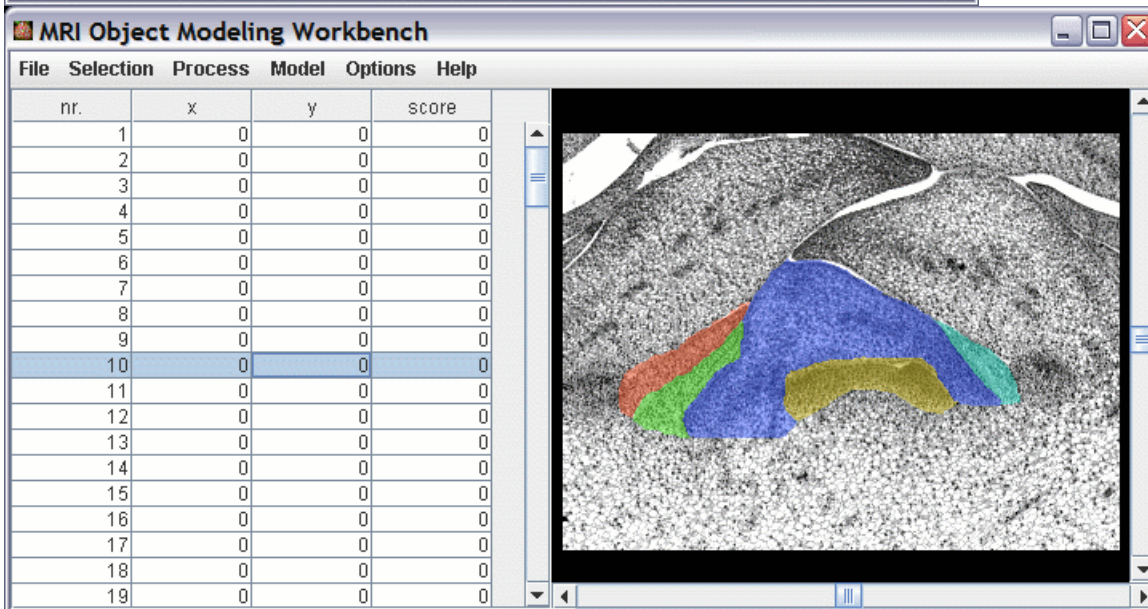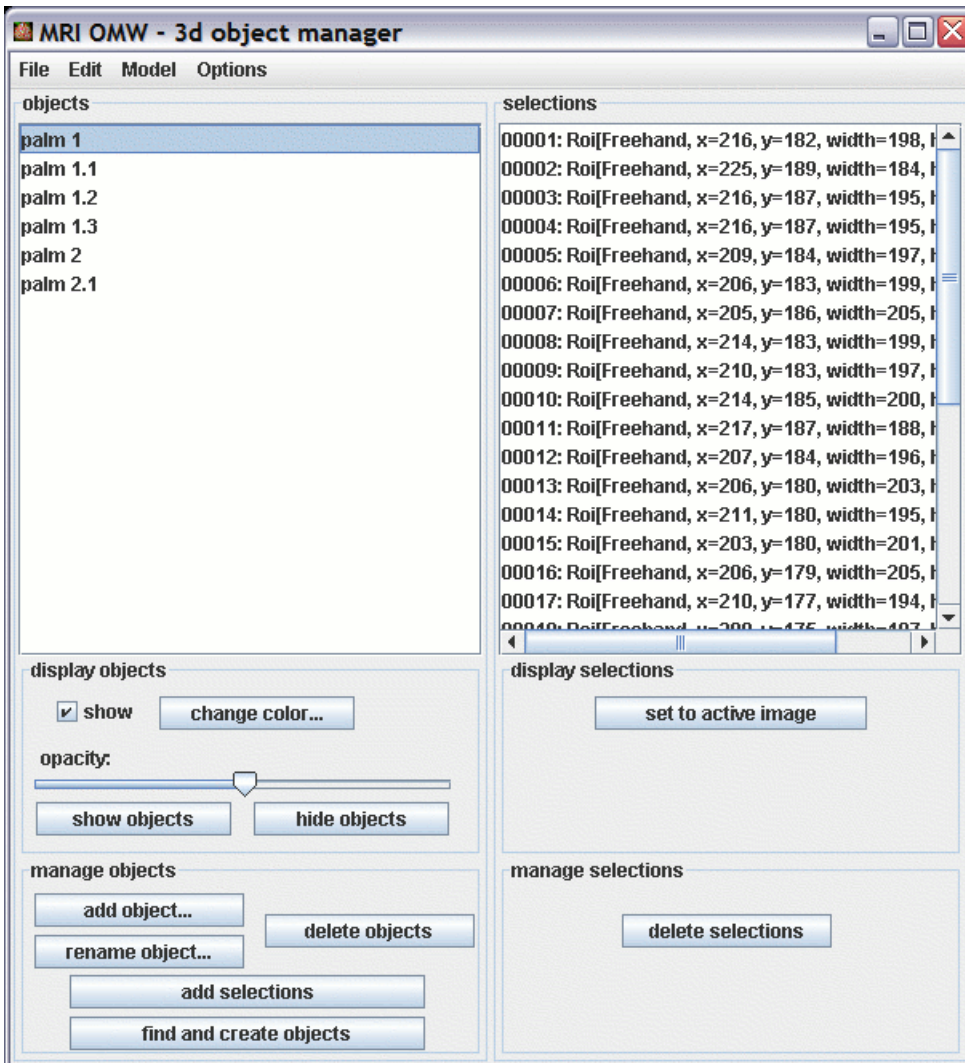
(Semi-)automatic object extraction

Keyboard shortcuts

ENTER	apply alignment to current clice only
CTRL + ENTER	apply alignment to the current and all following slices
CTRL + left mouse button	click on an object in the OMW to select it in the object manager
CTRL + SPACEBAR	add the current selection in the OMW to the current object
SPACEBAR	create a new object from the current selection

UP, DOWN, LEFT, RIGHT	move the current image into the indicated direction