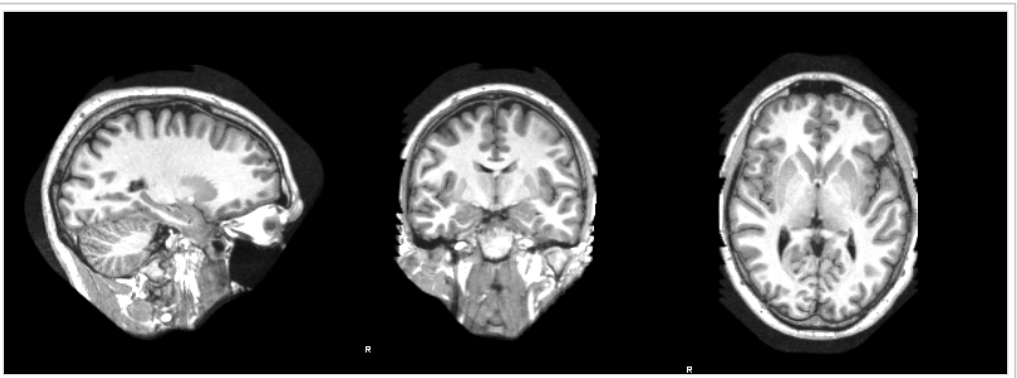
NiftyReg Segmentation Propagation Tutorial

From TIG

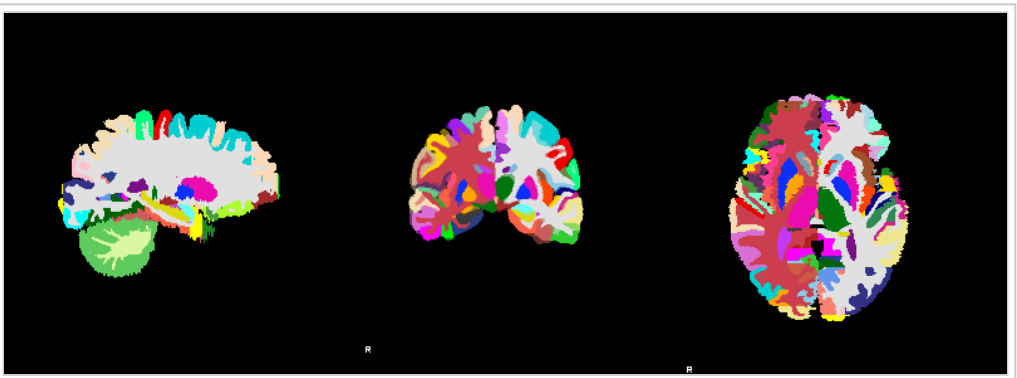
Segmentation propagation uses image registration to transfer segmentations (or labels) from the space of one image to the space of another.

Assuming a template image (template.nii) and its associated segmentation (labels.nii), on can transfer the label information into the space of another image (new_image.nii).

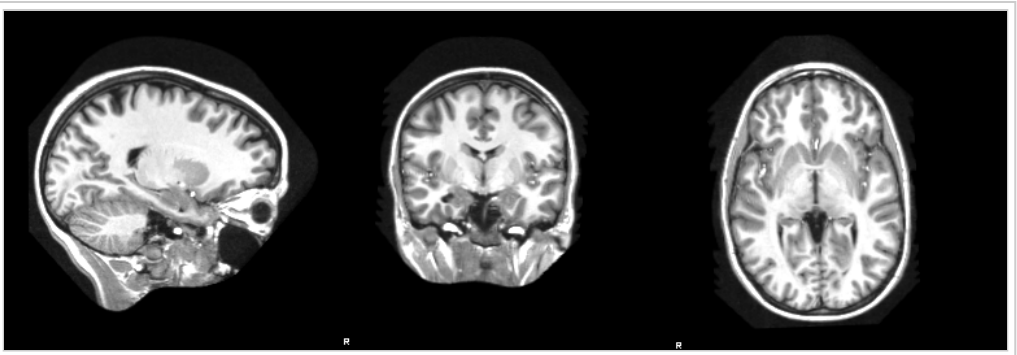
For this example, we used the file 1000_3.nii from neuromorphometrics (http://www.neuromorphometrics.com) and its associated segmentation as template and subject 1001_3.nii from the same database as new image. Below are shown the ortho-views (mid-plane along each axis) of the three input images:



template.nii



labels.nii



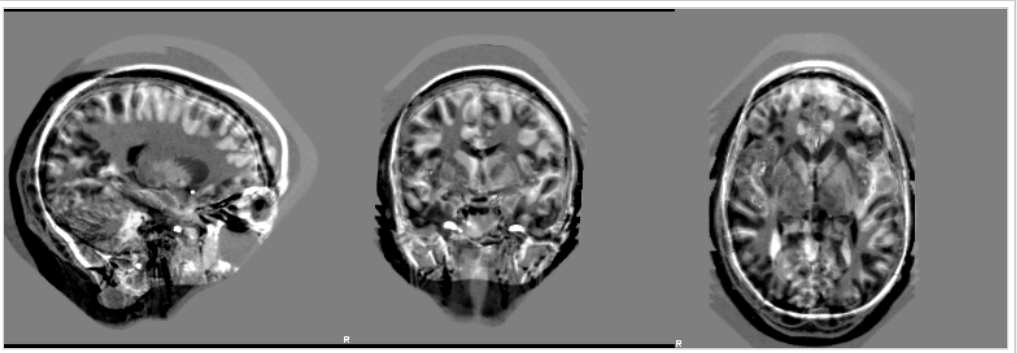
new_image.nii

The first step is to globally (affine) register the image, the template.nii image is used as a floating image and the new_image.nii image is used as a reference:

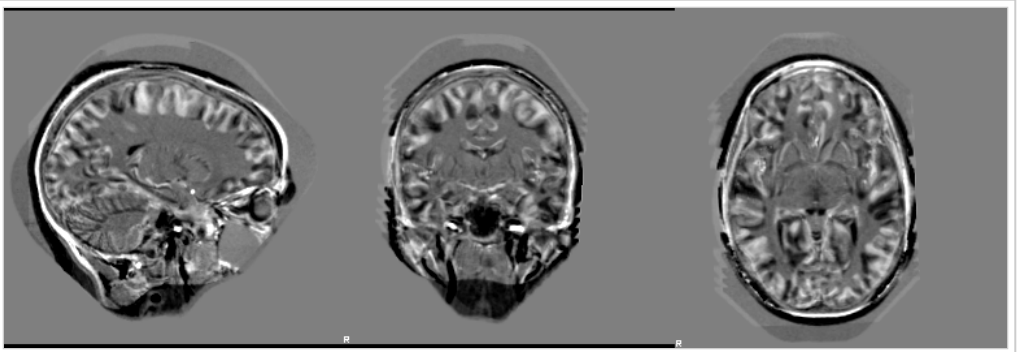
- `reg_aladin -ref new_image.nii -flo template.nii -res ref_template_flo_new_image_affine_result.nii \`

  `-aff ref_template_flo_new_image_affine_matrix.txt`

The following images show the difference images before and after the affine registration.



Difference image prior to registration



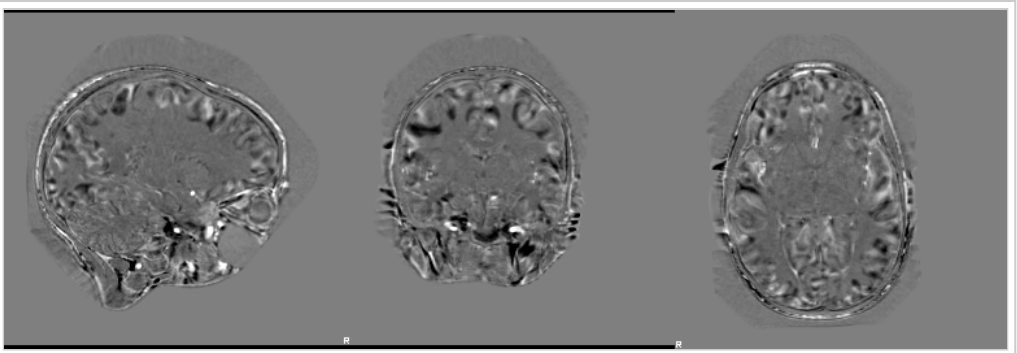
Difference image after affine registration

The affine matrix obtained with reg_aladin, ref_template_flo_new_image_affine_matrix.txt, can now be used to initialise the non-linear registration step:

- `reg_f3d -ref new_image.nii -flo template.nii -res ref_template_flo_new_image_nrr_result.nii \`

  `-aff ref_template_flo_new_image_affine_matrix.txt -cpp ref_template_flo_new_image_nrr_cpp.nii`

The following image shows the difference after the non-linear registration.



Difference image after non-linear registration

By using the two commands above, we used the default parameters for both reg_aladin and reg_f3d. To see all available options, see `reg_aladin -help` and `reg_f3d -help`.

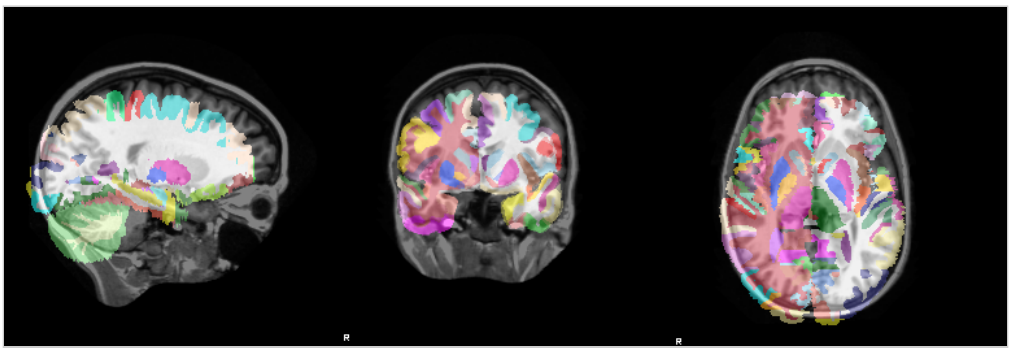
The non-linear transformation parametrisation, ref_template_flo_new_image_nrr_cpp.nii, can now be used to propagate the labels.nii image into the space of template.nii. Since the labels are binary, we specify to use a nearest-neighbor interpolation scheme:

- `reg_resample -ref new_image.nii -flo labels.nii -res propagated_labels.nii \`

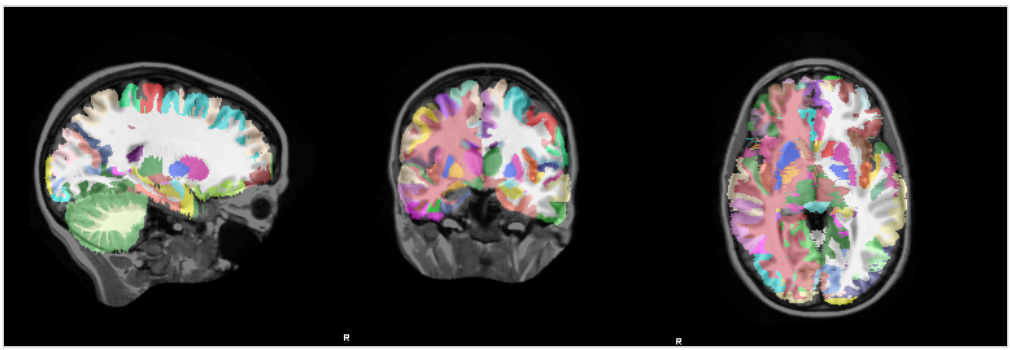
  `-trans ref_template_flo_new_image_nrr_cpp.nii -inter 0`

Note that while resampling, only the non-linear parametrisation is specified, not the affine. The non-linear parametrisation contains the affine since it was used to initialise the non-linear registration.

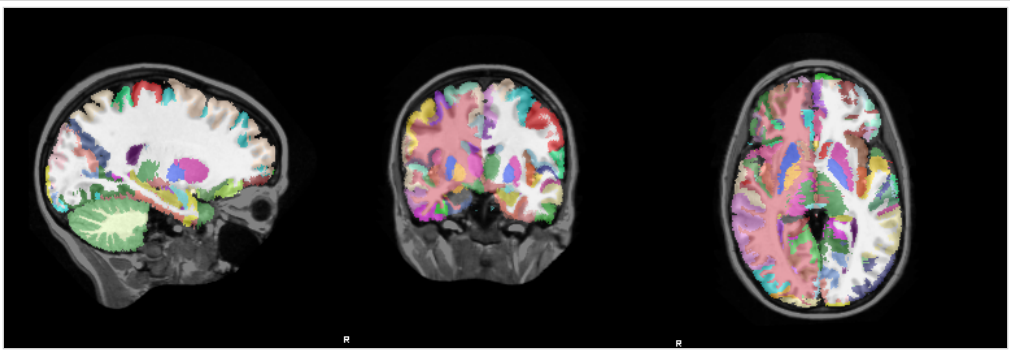
Images below show the propagated labels into the space of new_image.nii, with no registration, with affine only and with non-linear registration.



Propagated labels without registration



Propagated labels with affine registration



Propagated labels with non-linear registration

The label images without registration and with affine only have been generated using the following commands respectively:

- `reg_resample -ref new_image.nii -flo labels.nii -res propagated_labels.nii -inter 0`
- `reg_resample -ref new_image.nii -flo labels.nii -res propagated_labels.nii \`

  `-trans ref_template_flo_new_image_affine_matrix.txt -inter 0`
