LIÈGE université
GIGA institute
CONSCIOUSNESS

Image Pre-Processing

CSG PET workshop

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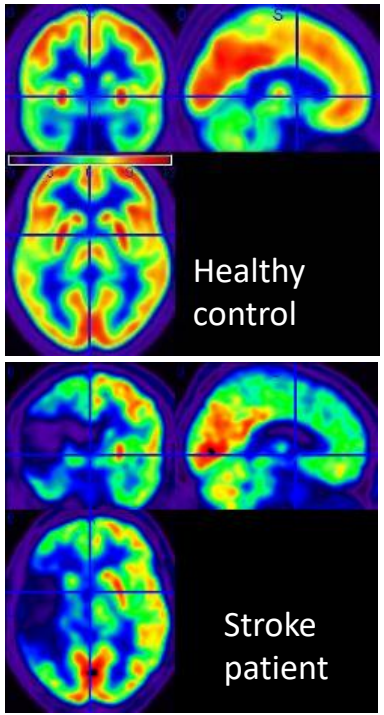
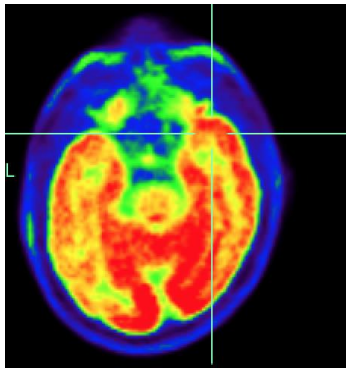
Voxel-level PET image analysis

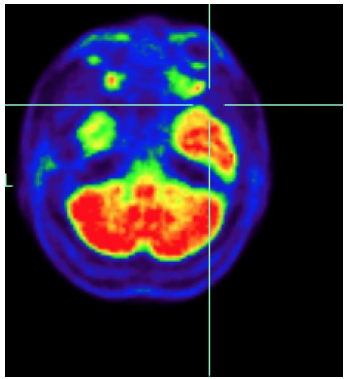


- 1) Spatial Registration, Normalization (or Warping) and Smoothing –> to put all the different images in the same “space”, crucial for statistical comparisons
- 2) Creation of a Parametric Image (SUVRs, DVRs, BP…)
- 3) Statistical Model

Courtesy of Leonardo Iaccarino, PhD, UCSF

From Native to Standard Space





Right now, the crosshairs are “virtually” pointing in the same spot, but it’s clear that it is not working. In the first patient it is pointing at the anterior temporal cortex, in the second is outside of the brain.

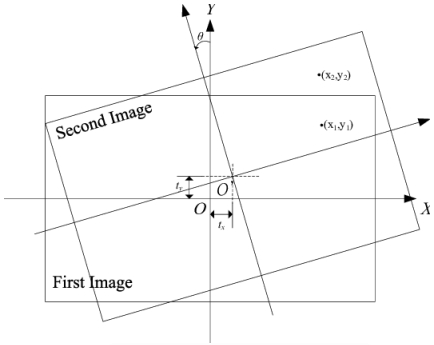
This is because the two images are still in their “native space”, this means that each image shows the actual anatomy of the patient and its orientation during the scan. People can have brains with really different shape and size!

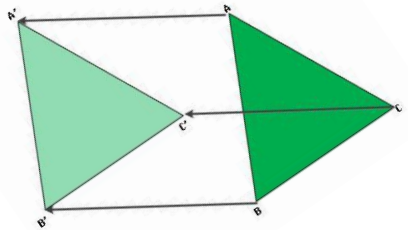
Since we want to compare the values of each voxel across patients and controls (for instance) we need to bring these two images in a standard space in which each voxel corresponds to the same positions

Courtesy of Leonardo Iaccarino, PhD, UCSF

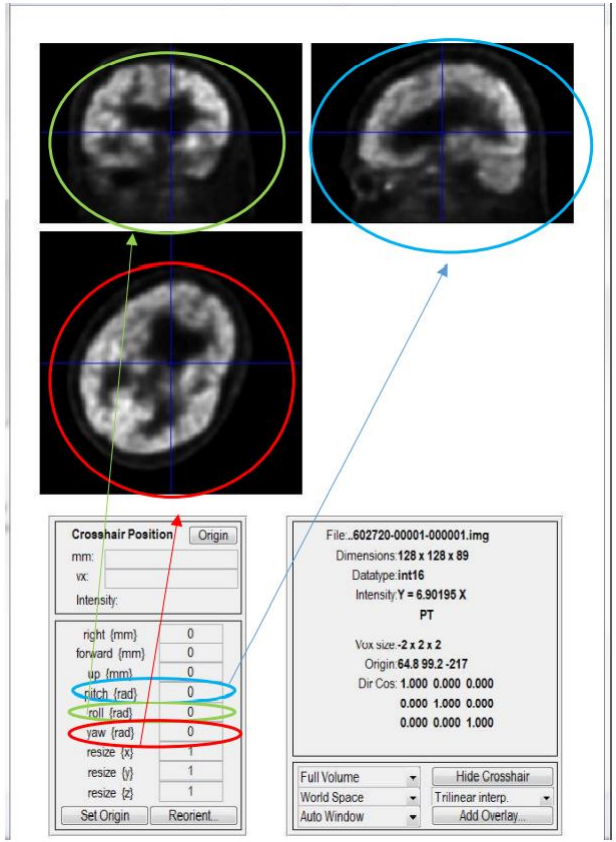
Registration

Rigid transformations
- Rotations
- Translations

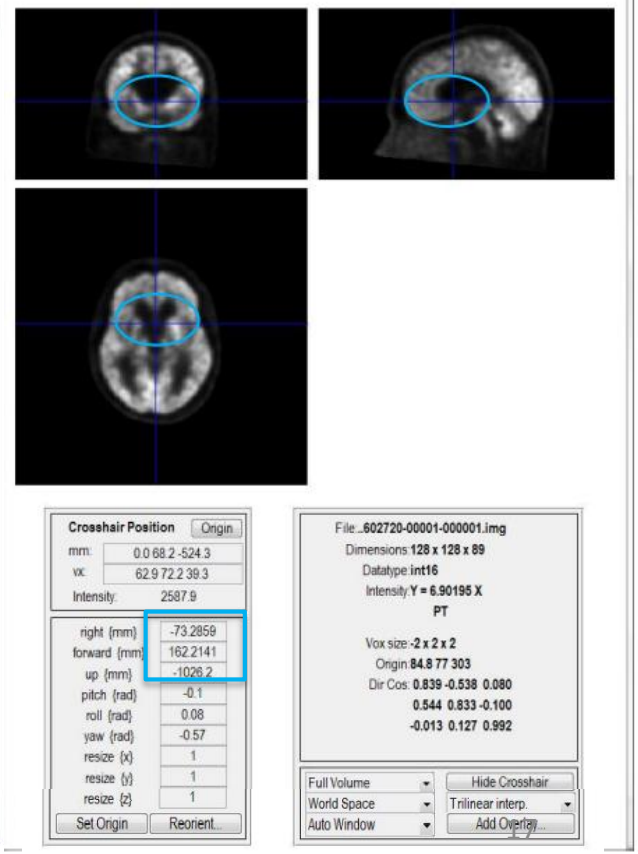




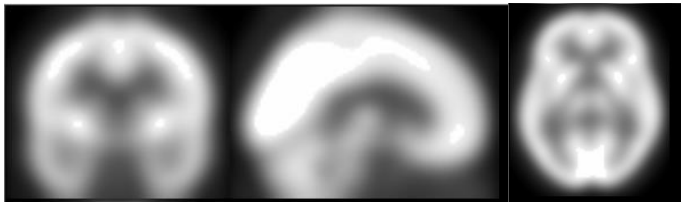
Rotations



Translations



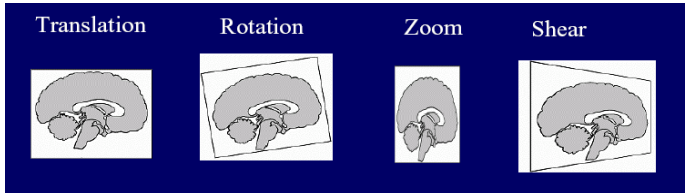
Normalization: two ingredients



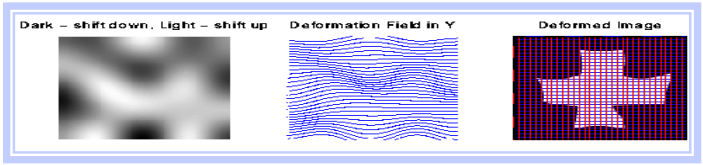
Custom FDG Template (DOC)

TEMPLATE-> basically mean images created from large sets of patients and controls in a standard space, the MNI (Montreal Neurological Institute). The MNI is a standard space, this means that when you report coordinates of a cluster in your sample, everybody in the world can replicate and/or check the same position in their data.

AFFINE/LINEAR AND NON-LINEAR TRANSFORMATIONS



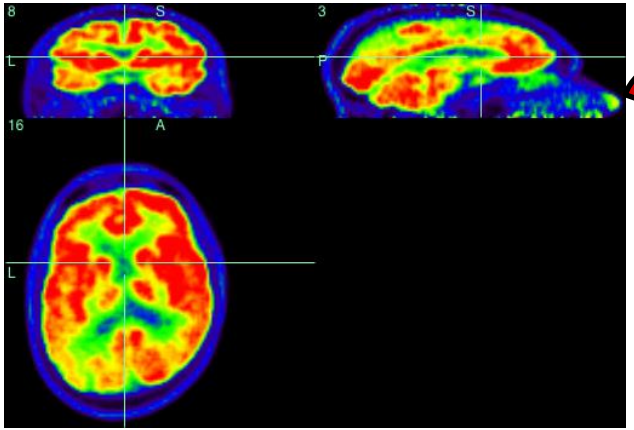
-> Affine/linear transformations determines the optimum 12-parameter affine transformation to match the size and position of the image based on translations, rotations, sheers and zoom



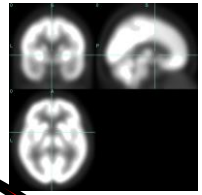
-> Non-linear transformations: deformations consist of a linear combination of smooth basis images; regularization based on Bayesian contraints is perfomed to avoid introducing unnecessary warping into the normalized images

http://www.mrc-cbu.cam.ac.uk/Imaging/Common/Orsay/jb_spatial.pdf

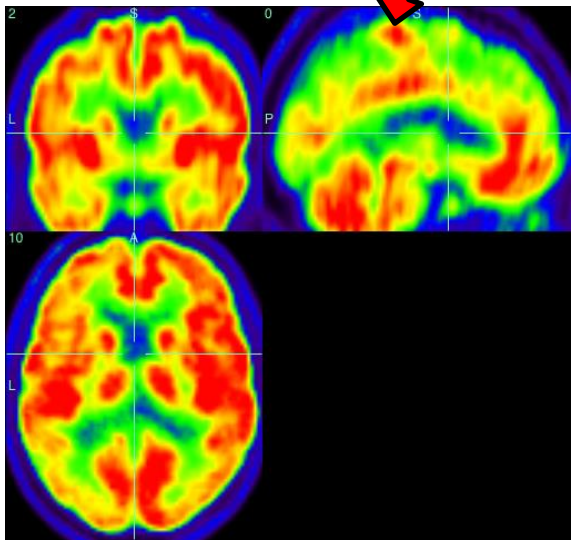
Normalization: an example



Native space



Template



Standard space

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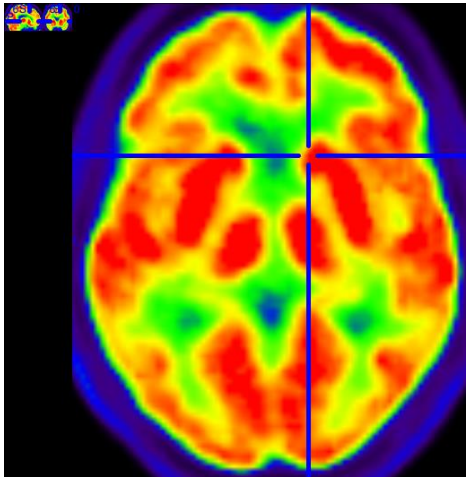
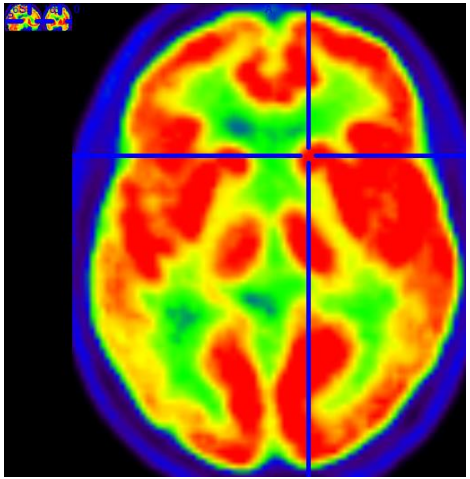




• Now the crosshairs look at the same anatomical position, still with differences but way more comparable.

• These images are then smoothed

Smoothing

Smoothing is basically applying a blurring to your images

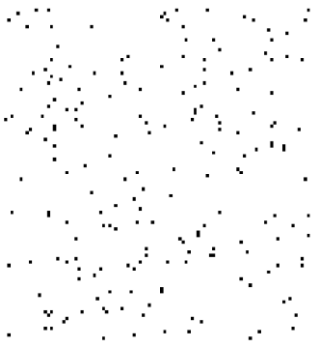
- The aims are:

(i) To improve signal-to-noise ratio

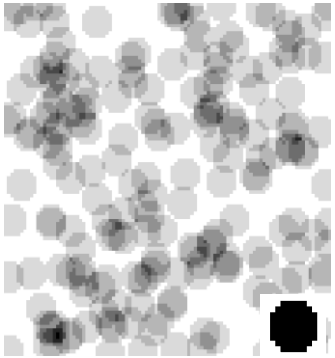
(ii) Further minimize differences between normalized images prior group comparisons

(iii) Increase validity of statistics (errors more likely to be normally distributed)

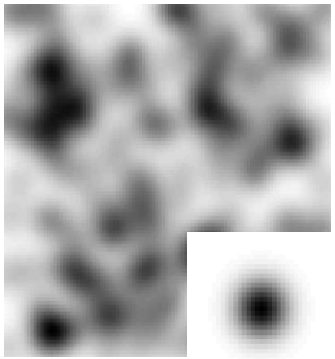
Before convolution

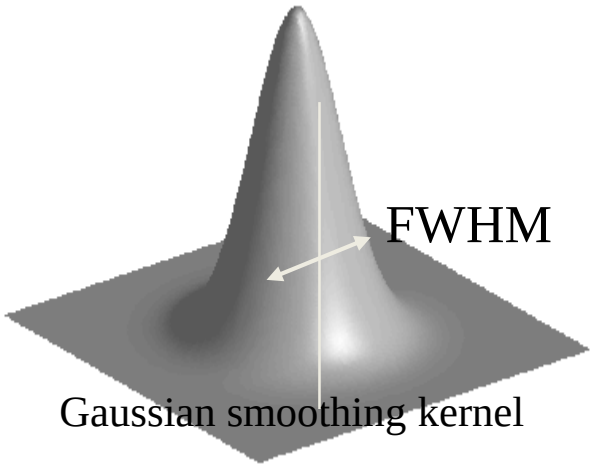


Convolved with a circle



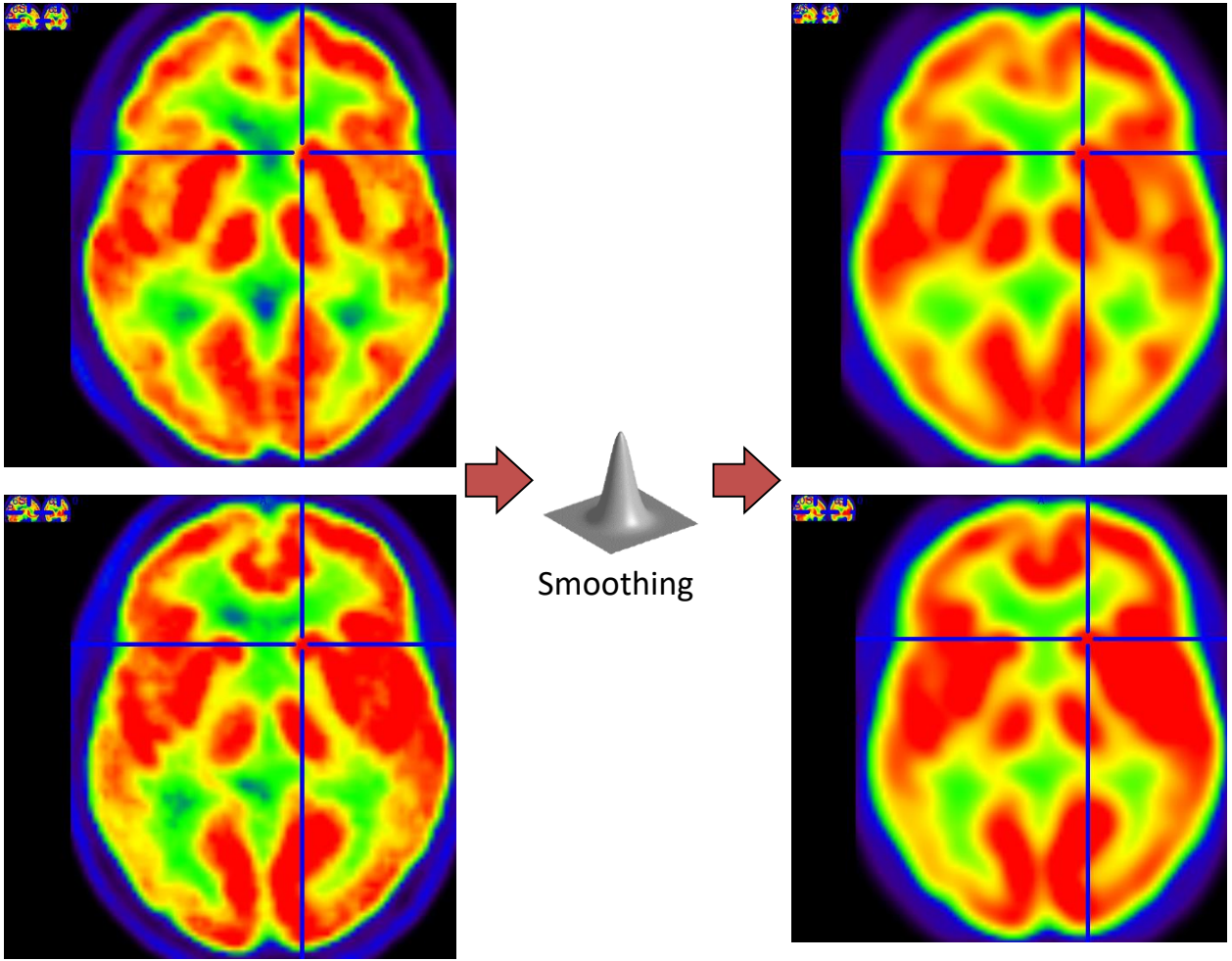
Convolved with a Gaussian





https://www.fil.ion.ucl.ac.uk/mfd_archive/2009/VBM.ppt

http://www.mrc-cbu.cam.ac.uk/Imaging/Common/Orsay/jb_spatial.pdf



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