More Complex Mapping

• Coming soon to an **AFNI** program near you: **Nonlinear Warping**

  \[ I_{\text{new}}(x) = I_{\text{old}}( W(x) ) \]

  o where \( W(x) \) depends on a **lot** of parameters (1000-50000+)
  o Method: Incremental transformation with Hermite cubic polynomials over finer and finer 3D patches

  ★ Better alignment of anatomical volumes to template space
  o Then carry the functional results to template space for better group analyses?
  o As an aid to brain segmentation and atlas-ing accuracy?

  ★ Pre- and post-surgical alignment?

• Status of software:
  o **Done**: **3dQwarp** program brings 2 volumes into alignment
  o **TBD**: Integrate it into scripts to make it actually useful
Example: Brain Averages

Averages of 21 3 Tesla brain volumes with varied levels of refinement in the nonlinear warping (smaller patch=more refinement)

MNI 152 template

Linear = Affine

Nonlinear: Patch=101

Nonlinear: Patch=49

Nonlinear: Patch=23

12 parameters

+1002

+9048

+70008
Example: Neurosurgery

Pre-surgical volume
Example: Neurosurgery

Post-surgical volume
Example: Neurosurgery

Pre-surgical volume

3dQwarp-aligned to Post-surgical volume
Example: Atlas Creation

Align MindBoggle 101 T₁ Datasets to Separate Template:
Overlap Probability Maps for 3 of the Labeled Regions

LH: lateral orbital frontal
RH: caudal anterior cingulate
RH: insula

ANTS
DARTEL/SPM
FNIRT/FSL
3dQwarp

ANTS & DARTEL & FNIRT
run with default settings

3dQwarp distribution of overlap probabilities is 2nd order
stochastically dominant in a majority of 62 labeled regions

More yellow in the overlay means
more 90+% overlap in labels