Nonlinear Warping in AFNI

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Scientific and Statistical Computing Core
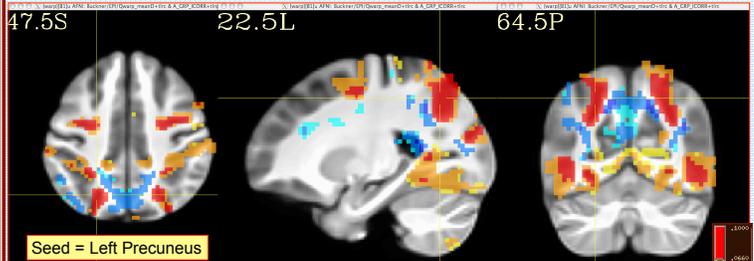NIMH & NINDS / NIH / DHHS / Bethesda MD USA
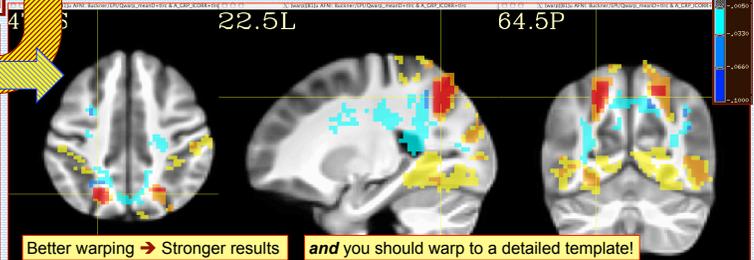Contact: robertcox@mail.nih.gov   http://afni.nimh.nih.gov

Boring Text Introduction

◆ **3dQwarp** = nonlinear alignment of 2 volumes
  ❖ C^1 polynomial patches ➜ incremental $W_i(x)$
  ❖ Optimize $W_1(x)$, then $W_2(W_1(x))$, then
    $W_3(W_2(W_1(x)))$, … , over shrinking patches
◆ Script to template-ize a collection of datasets
◆ Optional "*meet-in-the-middle*" warp = bring 2
  datasets to alignment "half-way" in between
  ❖ Application: unwarping blip-up/blip-down EPI
◆ **Soon** to be built into standard **AFNI**
  processing stream for FMRI datasets
  ❖ With parallel anatomical atlases & templates

◆ **3dQwarp** ➜ align 188 Cambridge datasets
  from FCON-1000
◆ Underlay = template-ized T_1 anats
◆ Overlay = difference in mean seed-based
  correlation maps when using **3dQwarp**
  alignment to detailed template **versus**
  ❖ [**upper**] affine alignment to MNI-152
  ❖ [**lower**] **3dQwarp** alignment to MNI-152

RS-FMRI: Qwarp vs Affine registration (188 datasets)

Seed = Left Precuneus

RS-FMRI: Qwarp-to-detailed-template vs Qwarp-to-MNI-152

Better warping ➜ Stronger results   *and* you should warp to a detailed template!

Align MindBoggle 101 T_1 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*
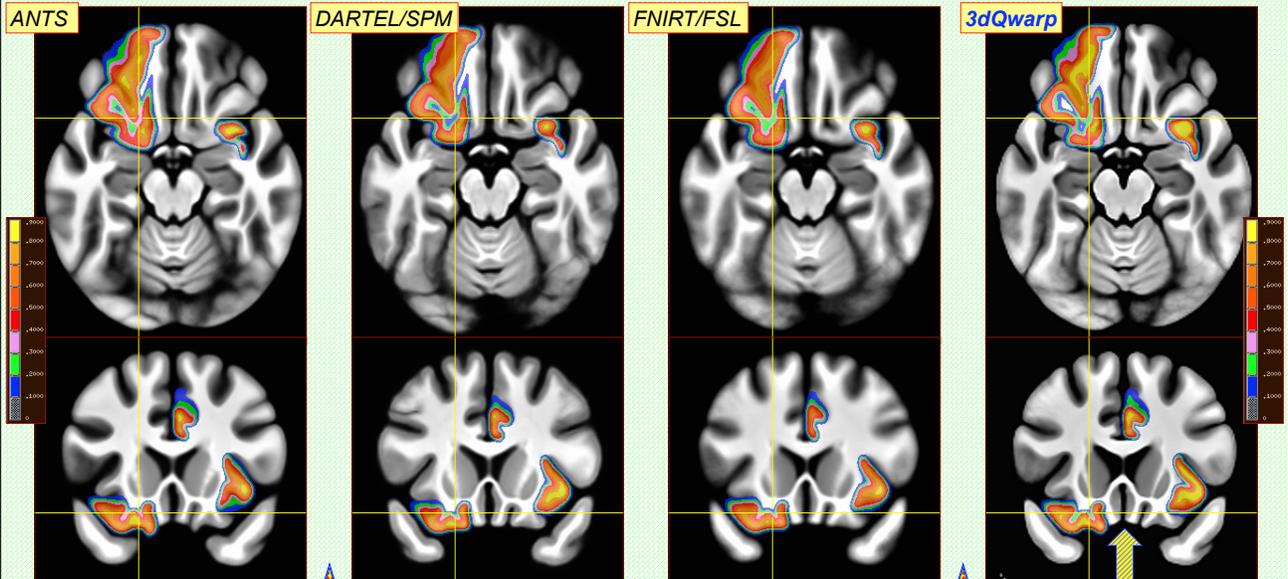
ANTS & DARTEL & FNIRT run with default settings

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

Unedited and unsolicited quote from a happy early adopter:
"*Just got through testing the new non-linear warping scheme and I love it long time! It's every bit as good as manual warping with sub-cortex and cingulate. And wicked convenient. Let my testimony ring loud and clear throughout this glorious kingdom*."