

Advanced fMRI Practical Nonparametric Inference, Power & Meta-Analysis

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Zurich SPM Course

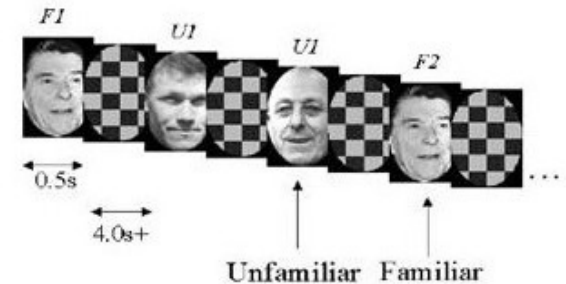
13 & 14 February, 2014

Advanced fMRI Practical

- Nonparametric Inference
- Power
- Meta-Analysis

Henson et al. Faces Data

- Famous-vs-Nonfamous faces
 - Chapter 30 of SPM manual
 - Main effect, Any Faces – Checkerboard
 - 12 subjects
 - ‘cons_can’ Canonical HRF only
 - ‘cons_informed’ Canonical + Temp Deriv + Disp Deriv
- Will compare SnPM to SPM
 - For 1-sample t-test (cons_can)



Using SnPM: Key options

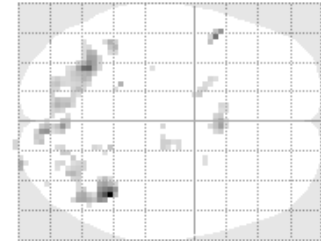
- Choose design
 - One-sample t? Two-sample t? Correlation?
- Cluster inference?
 - Yes: Commit to particular cluster-forming threshold now
 - “Yes, set cluster-forming threshold now (fast)”
 - Yes: Don’t commit, collect *huge* SnPM_ST file
 - “Yes (slow, may create huge SnPM_ST.mat file)”
- Number of permutations
 - Defaults to 5000
 - 10,000 is ‘gold standard’
 - Anyway, this is maximum; possible number might be smaller

Voxel-Wise Results

Canonical HRF t test

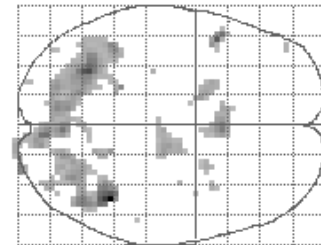
- SPM

- $u_{\text{FWE}} = 9.071$, 371 voxels



- SnPM

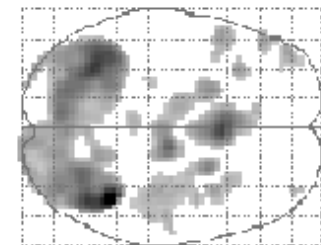
- $u_{\text{FWE}} = 7.925$, 917 voxels



- SnPM w/ Var Smoothing

- (u_{FWE} not comparable) 3575 voxels w/ 6mm

- 3483 voxels w/ 4mm



8mm var. sm.

Advanced fMRI Practical

- Nonparametric Inference
- **Power**
- Meta-Analysis

Estimating Signal Change

- Ideally we'd measure % BOLD signal change
- Units in SPM (or any model) depend on
 1. Data scaling
 - Want (arbitrary unit) fMRI data scaled to mean 100
 - SPM's `spm_global` underestimates global mean

Globals (1)

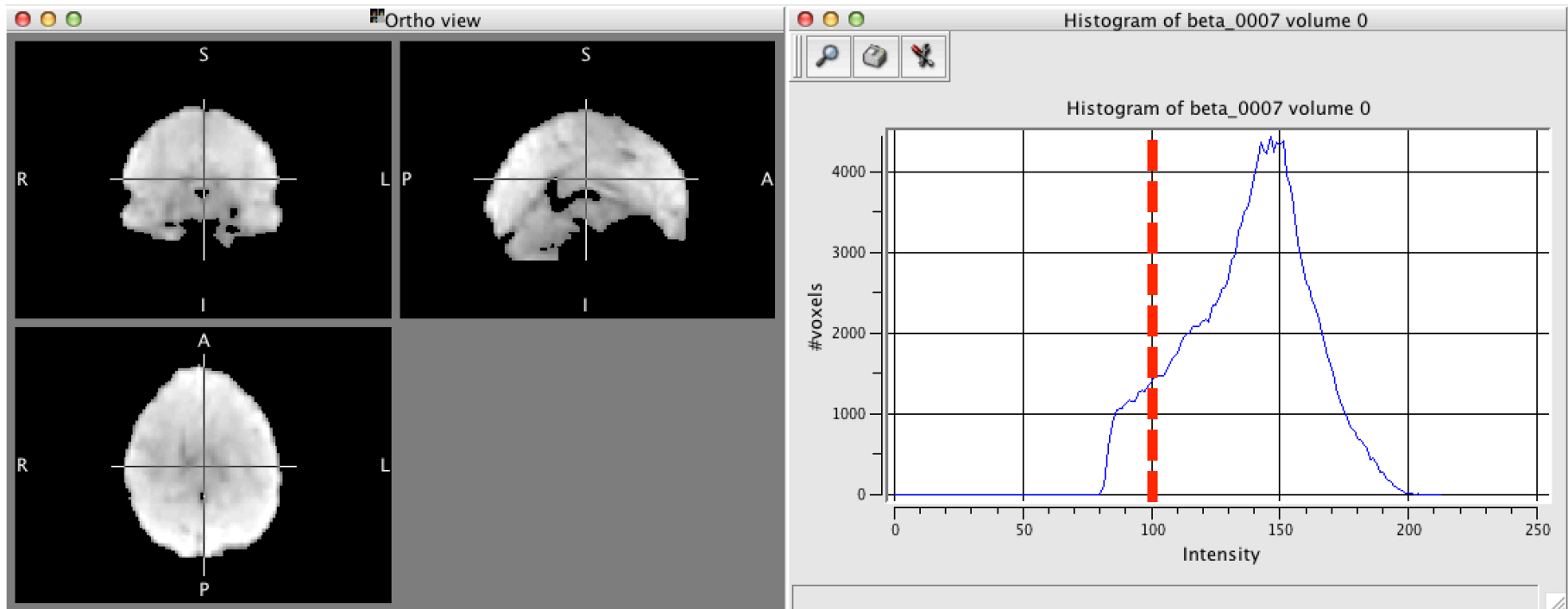
- Standard practice in fMRI
 - Scale brain mean to 100
 - Then 1 unit change approximately % change
- SPM, uses `spm_global` to find brain mean
 - Good estimate for tightly cropped PET data
 - Less good for fMRI

```
function GX = spm_global(V)
% Compute the global mean for a volume image - a compiled routine
% FORMAT GX = spm_global(V)
% V - image handle structure
% GX - global mean
%-----
% spm_global returns the mean counts integrated over all the slices from
% the volume.
%
% The mean is estimated after discounting voxels outside the object using
% a criteria of greater than > (global mean)/8.
%-----
% Copyright (C) 1996-2012 Wellcome Trust Centre for Neuroimaging
% Anonymous
% $Id: spm_global.m 4021 2012-09-13 11:16:31Z williams
```

```
% Anonymous
% $Id: spm_glob
```

Globals (2)

- Quick check in SPM
 - View last beta_XXX - usually the constant/intercept – check it!



- Modal brain intensity 150 \gg 100 !
- Use (e.g.) MarsBar to get % BOLD change

Estimating Signal Change

- Ideally we'd measure % BOLD signal change
- Units in SPM (or any model) depend on
 1. Data scaling
 - Want (arbitrary unit) fMRI data scaled to mean 100
 - SPM's `spm_global` underestimates global mean
 2. Design matrix scaling
 - Predictor should have [0,1] range?
 - **SPM** Long blocks: **yes**; Short blocks: **no**; Events: **no**.
 3. Contrast scaling
 - Sum of positive contrast values equal 1.0?
 - Sum of negative contrast values equal -1.0?

[1 1 -1 -1] vs. [0.5 0.5 -0.5 -0.5]

Estimating Signal Change

- Solution 1:
 - Admit that we are using arbitrary units
 - Only compute (unitless) effect sizes δ
- Solution 2:
 - Use MarsBar or another tool to get the % change

Resources

[What are the units of a plot in SPM?](#) blog post by me (T. Nichols)

[How is the percent signal change calculated?](#) from the MarsBar FAQ.

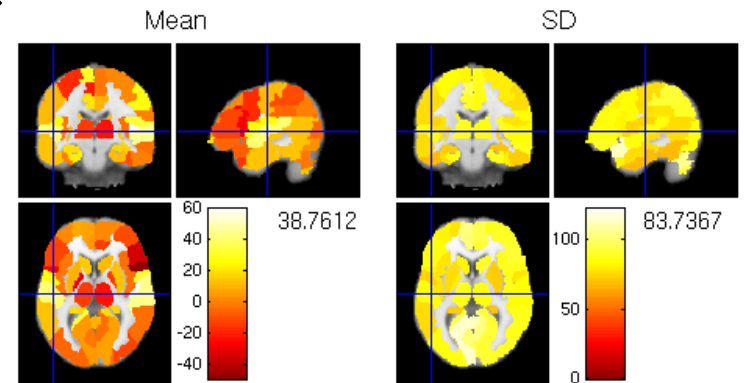
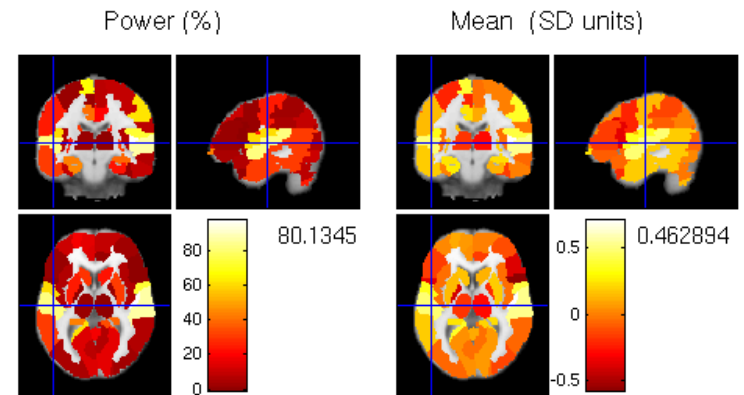
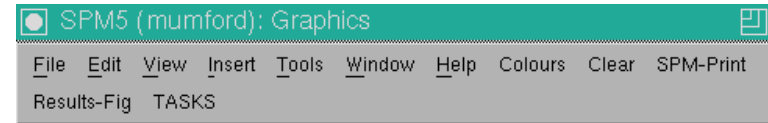
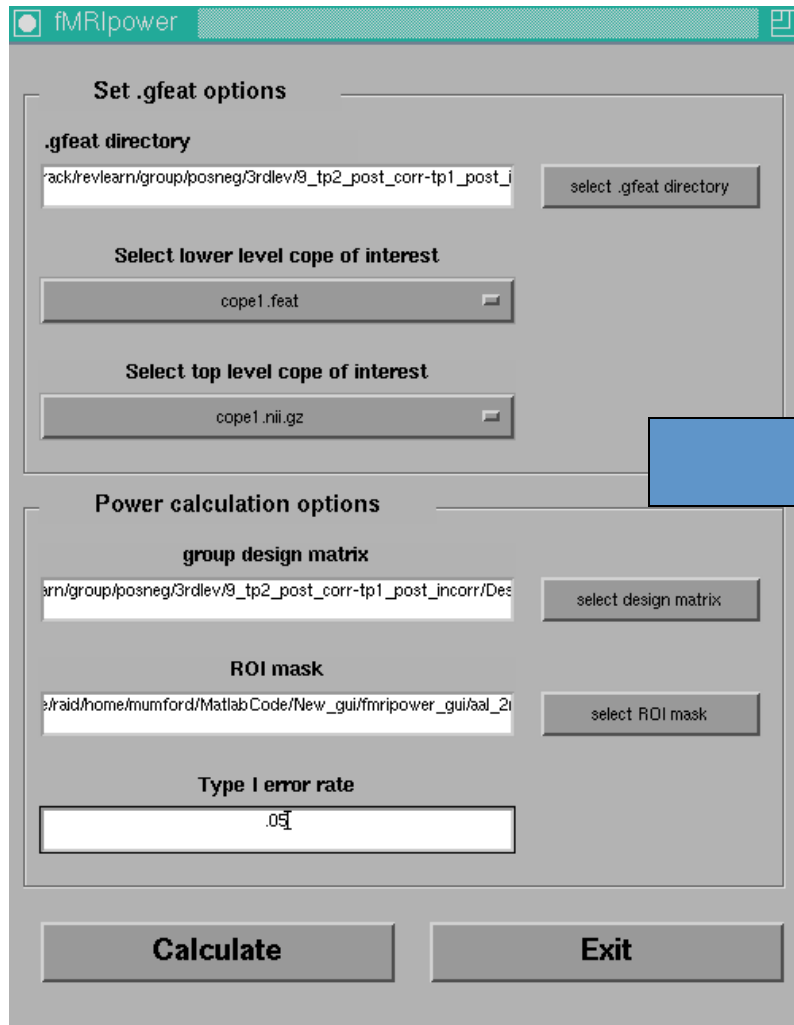
[Percent Signal Change for fMRI calculations](#) by Paul Mazaika.

[Percent Signal Change FAQ](#) from the MIT Mindhive on brain research.

fMRIpower tool

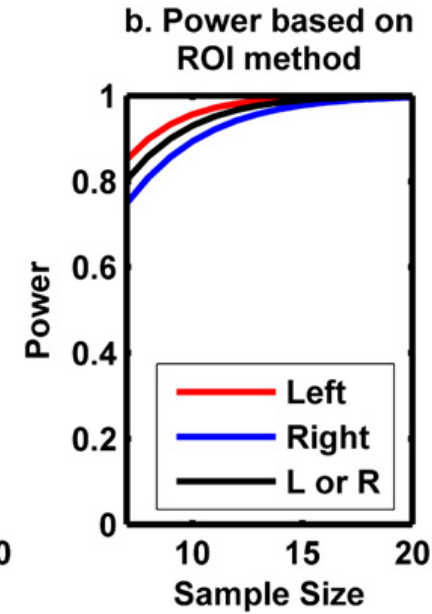
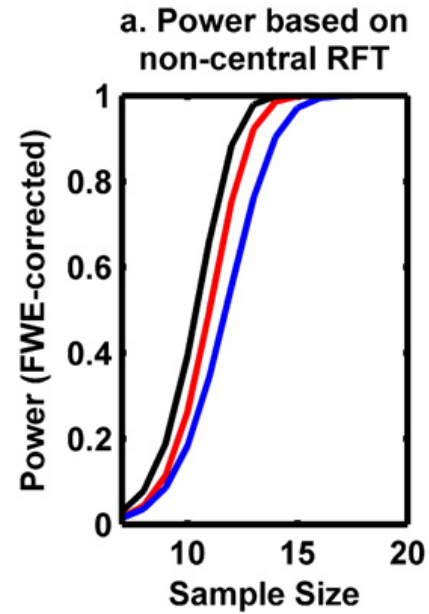
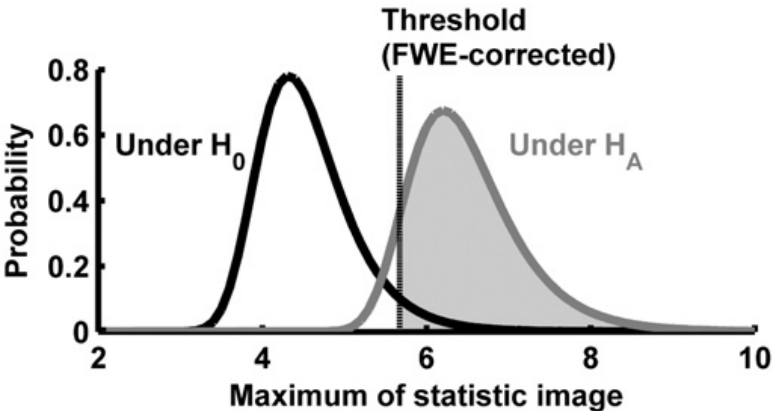
<http://fmripower.org>

for both SPM & FSL



Crosshair Position	
mm:	-48.5 -18.0 4.1
vx:	70.3 55.0 39.1
Region #	81
Region:	Temporal_Sup_L

Voxel-wise Power Analyses (with RFT)



PowerMap
tool

<http://sourceforge.net/projects/powermap>

