Voxel-wise Induced Power in Source Space:
Single Time Window

Single Time Window Analysis

- Generate single brain image for frequency band and time window of experimental interest

- These images can be contrasted with those from control condition or other experimental condition

- Should have similar amount of data in active and control conditions

- Group statistics conducted in AFNI

  - T tests / ANOVAs

  - Correlations with performance or other data

sam_3d and sam_3dc

- Similar to the other programs, sam_3d and sam_3dc differ in the order of operations

- sam_3dc will project the continuous data into source space, compute the metric, then parse data into trials and calculate mean and variance

- sam_3d will apply beamformer weights to MEG data for each trial, compute the metric, and produce mean and variance

- As always, sam_3dc is slower but necessary for methods like entropy that are more stable with longer data segments
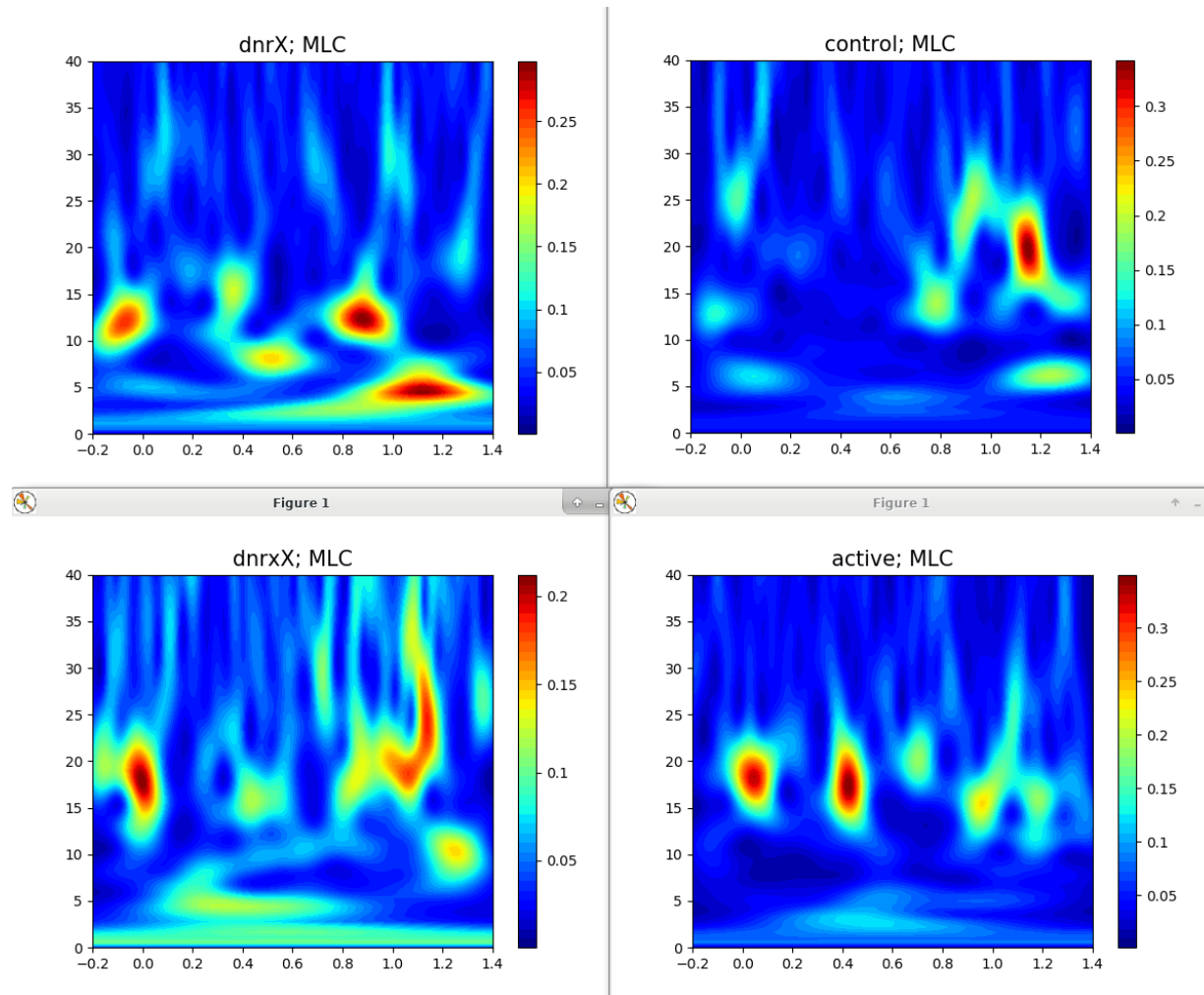
Continuous Performance Task (CPT)

- Go / no-go task

- Letter from A-Z presented to left and right of a fixation dot.

- Subjects respond with a button press when see any letter but X

- Response blocks alternate with identical ones requiring no response

CPT markers

- stim   when a letter appears

- resp   when a response appears

- dnr / dnrx   class marks, one at the start of each trial

- left / right   which side of the fixation the letter appears

- A-Z   letter marks, synced to the stim mark

- dnrA-H   A-H (first 8) no response trials

- dnrX   X, no response trials

- dnrxA-H   A-H, response trials

- dnrxX   A-H, no-go trials

- active   A-H, dnrx trials (response)

- control   A-H, dnr trials (no response)

You might use time-frequency analysis to guide SAM

SAM parameter file

```
XBounds -10 10          # standard ROI
YBounds -9 9
ZBounds -2 14
ImageStep .8            # voxel size

NumMarkers 2            # which marker set
Marker1 dnrxX .0 .5 true
Marker2 dnrX .0 .5 true

OrientBand 15 30        # frequencies
CovBand 15 30
ImageBand 15 30

Model MultiSphere       # forward model
Mu 2                    # regularization
CovType SUM
ImageMetric Power
ImageFormat ORIG

MRIDirectory ../mri
ImageDirectory CPTimage # output directory name follows marker name
```

SAM subject list

dslistCPT

EYZQADGL_cpt_20180608_01-f.ds
OENJHTBX_cpt_20180615_01-f.ds
OMXYBYSM_cpt_20180717_01-f.ds

SAM script

```sh
#! /bin/sh

dosam() {
    ds="$1"
    m="$2"
    sam_cov -r $ds -m $m
    sam_wts -r $ds -m $m
    sam_3d -r $ds -m $m
}

doall() {
    ds="$1"
    dosam $ds CPTbeta,multi
    dosam $ds CPTgamma,multi
}

for dsname in `cat dslistCPT`; do
    ds="../data/$dsname"
    doall $ds
done
```

Talairach / Process SAM results

```sh
#! /bin/sh

band1=CPTbeta,multi
band2=CPTgamma,multi
mark1=dnrxX
mark2=dnrX

dotlrc() { … }

rm $band1,${mark1},${mark2},list
rm $band2,${mark1},${mark2},list
pushd CPTimage
for dsname in `grep -v '^#' ../dslistCPT`; do
   ds="../../data/$dsname"
   hashcode=`basename $dsname | cut -d_ -f1`
   for band in $band1 $band2; do
           echo $band
      dotlrc $hashcode $band $mark1 $mark2
   done
done
popd
```

Talairach continued...

```
dotlrc() {
    hashcode="$1"
    b="$2"
    m1="$3"
    m2="$4"
    active=${hashcode},${b},${m1},3D_PWR,Mean
    control=${hashcode},${b},${m2},3D_PWR,Mean
    logratio=${hashcode},${b},${m1},${m2},logratio

    rm -f ${active}_at.nii
    rm -f ${control}_at.nii
    rm -f ${logratio}+tlrc*

    @auto_tlrc -apar ../../mri/${hashcode}/brain+tlrc -input ${active}.nii -dxyz 8
    @auto_tlrc -apar ../../mri/${hashcode}/brain+tlrc -input ${control}.nii -dxyz 8

    3dcalc -a ${active}_at.nii -b ${control}_at.nii -expr 'log(a/b)' -prefix $logratio
    3dcalc -prefix ${logratio},mask -a ${logratio}+tlrc -b Mask8mm.nii -expr 'a*b'

    echo ${logratio},mask+tlrc >> ${b},${m1},${m2},list
}
```

Stats in AFNI

doStatsCPT.sh

```
#! /bin/sh

list1=CPTbeta,multi,dnrxX,dnrX
list2=CPTgamma,multi,dnrxX,dnrX

pushd CPTimage

for list in $list1 $list2; do
    3dttest++ -prefix ${list},Ttest -setA `cat ${list},list`
done

popd
```

View Results in AFNI

CPTimage directory

Underlay:
TT_N27+tlrc.BRIK.gz
TT_N27+tlrc.HEAD

Overlays:
CPTbeta,multi,dnrxX,dnrX,Ttest+tlrc.BRIK
CPTbeta,multi,dnrxX,dnrX,Ttest+tlrc.HEAD

CPTgamma,multi,dnrxX,dnrX,Ttest+tlrc.BRIK
CPTgamma,multi,dnrxX,dnrX,Ttest+tlrc.HEAD

[A]u AFNI: scripts/CPTimage/TT_N27+tlrc & CPTbeta,multi,dnrxX,dnrX,Ttest+tlrc

[order: RAI=DICOM]
x = -20.000 mm [R]
y = -5.000 mm [A]
z = 56.000 mm [S]

Xhairs Multi X+
Color green
Gap 5 Wrap
Index 0

Axial Image Graph
Sagittal Image Graph
Coronal Image Graph

New Etc->
BHelp done
AFNI Tips

Original View
AC-PC Aligned
Talairach View

Define OverLay ->
See OverLay

Define Datamode ->

DataDir Switch Read
UnderLay EditEnv
OverLay NIML+PO
Control Surface

T-t   OLay
1.000
Edit OLay
InstaCorr
Clusterize Setup ICorr
*Clear Rpt   *NOT Ready*

ULay #0 colin27T1_seg
OLay #0 SetA_mean
Thr #1 SetA_Tstat

ULay   0:   222
OLay -0.292787: 0.174504
Thr -52.41667: 12.14369

autoRange: 0.292787
10000 Rota F

9.94

See TT Atlas Regions

p=.0100   # **
q=.4601
** 2   Pos?

ULay = 141
OLay = -0.25013
Thr = -34.01981

-1.000

[A]u AFNI: scripts/ ... **[A]u AFNI: scripts/CPTimage** ... **[A]u AFNI: scripts/CPTi...**

121   100   75

Disp Sav1.ppm Mont Done Rec
nrxX,dnrX,logratio,mask+tlrc.BR
i

Colr Swap Norm
Colr Swap Norm
Colr Swap Norm

Disp Sav1.ppm Mont Done Rec
Disp Sav1.ppm Mont Done Rec

```
ANOVA_P300_NVvPB_10_5+tlrc.BRIK   ANOVA_P300_NVvPB_10_5+tlrc.HEAD   TT_N27+tlrc.BRIK.gz   TT_N27+tlrc.HEAD

CPT.sh       doTlrc2.sh      dslistCPT        image              ROIcpt.param      sefmarks.param
.log         doTlrcCPT.sh    makemask.sh      ROI.param          vefimage
.sh          doTlrc.sh       gamma,ers.param  runscript.py       vefmarks.param
tsCPT.sh     dslist          gamma,multi.param  marks.param      runscript.pyc     Xmarks.param
esh.sh       dslist~         gamma,nolte.param  Notes.txt        sefimage
                             gamma.param        processing.cfg

dnrxX,dnrX,logratio,mask+tlrc.HEAD   OENJHTBX,CPTgamma,multi,dnrxX,dnrX,logratio+tlrc.HEAD
dnrxX,dnrX,logratio+tlrc.BRIK        OMXYBYSM,CPTbeta,multi,dnrX,3D_PWR,Mean_at.nii
dnrxX,dnrX,logratio+tlrc.HEAD        OMXYBYSM,CPTbeta,multi,dnrX,3D_PWR,Mean.nii
                                     OMXYBYSM,CPTbeta,multi,dnrX,3D_PWR,Variance.nii
nrX,3D_PWR,Mean_at.nii               OMXYBYSM,CPTbeta,multi,dnrxX,3D_PWR,Mean_at.nii
nrX,3D_PWR,Mean.nii                  OMXYBYSM,CPTbeta,multi,dnrxX,3D_PWR,Mean.nii
nrX,3D_PWR,Variance.nii              OMXYBYSM,CPTbeta,multi,dnrxX,3D_PWR,Variance.nii
nrxX,3D_PWR,Mean_at.nii              OMXYBYSM,CPTbeta,multi,dnrxX,dnrX,logratio,mask+tlrc.BRIK
nrxX,3D_PWR,Mean.nii                 OMXYBYSM,CPTbeta,multi,dnrxX,dnrX,logratio,mask+tlrc.HEAD
nrxX,3D_PWR,Variance.nii             OMXYBYSM,CPTbeta,multi,dnrxX,dnrX,logratio+tlrc.BRIK
nrxX,dnrX,logratio,mask+tlrc.BRIK    OMXYBYSM,CPTbeta,multi,dnrxX,dnrX,logratio+tlrc.HEAD
nrxX,dnrX,logratio,mask+tlrc.HEAD    OMXYBYSM,CPTgamma,multi,dnrX,3D_PWR,Mean_at.nii
nrxX,dnrX,logratio+tlrc.BRIK         OMXYBYSM,CPTgamma,multi,dnrX,3D_PWR,Mean.nii
nrxX,dnrX,logratio+tlrc.HEAD         OMXYBYSM,CPTgamma,multi,dnrX,3D_PWR,Variance.nii
dnrX,3D_PWR,Mean_at.nii              OMXYBYSM,CPTgamma,multi,dnrxX,3D_PWR,Mean_at.nii
dnrX,3D_PWR,Mean.nii                 OMXYBYSM,CPTgamma,multi,dnrxX,3D_PWR,Mean.nii
dnrX,3D_PWR,Variance.nii             OMXYBYSM,CPTgamma,multi,dnrxX,3D_PWR,Variance.nii
dnrxX,3D_PWR,Mean_at.nii             OMXYBYSM,CPTgamma,multi,dnrxX,dnrX,logratio,mask+tlrc.BRIK
dnrxX,3D_PWR,Mean.nii                OMXYBYSM,CPTgamma,multi,dnrxX,dnrX,logratio,mask+tlrc.HEAD
dnrxX,3D_PWR,Variance.nii            OMXYBYSM,CPTgamma,multi,dnrxX,dnrX,logratio+tlrc.BRIK
dnrxX,dnrX,logratio,mask+tlrc.BRIK   OMXYBYSM,CPTgamma,multi,dnrxX,dnrX,logratio+tlrc.HEAD
dnrxX,dnrX,logratio,mask+tlrc.HEAD   TT_N27+tlrc.BRIK.gz
dnrxX,dnrX,logratio+tlrc.BRIK        TT_N27+tlrc.HEAD

fedora_21_64: May  4 2016 (Version AFNI_16.1.11)

Thanks go to DA Jacobson for inspiration

Initializing: X11.. Widgets...... Input files:++ AFNI is detached from terminal.
[fred@pico CPTimage]$
 session #  1  = /net/tako/eon1/normal/scripts/CPTimage/ ==> 52 datasets
 dataset count = 52
 Time series   = 0 files read
 NLfit & NLerr= Optimizer (AFNI_NLFIM_METHOD) is SIMPLEX
 NLfit & NLerr= Found 28 models
 Plugins       = 52 libraries read

++ NOTE: This version of AFNI was built May  4 2016 ++
++ NOTE: 'Define Markers' is hidden: right-click 'DataDir' to see it
++ NOTE: you may want to consider creating a '.afnirc' file in your home
        directory, to control AFNI's setup.  For more details, see
        https://afni.nimh.nih.gov/pub/dist/doc/program_help/README.environment.html
*+ WARNING: Forced switch from 'Original View' to 'Talairach View' [#1]
```

SUMA (part of AFNI)

Used to visualize results on cortical surface
You can make movies!