File: crcns-vim-1-readme. Version 1.2 (4/9/2013)

--- READ ME for Gallant Lab Corel Image Data Set ---

This data set contains BOLD fMRI responses to a set of natural images. The data was originally published in Kay et al, 2008 and Naselaris et al, 2009 (see below for full references).

-- Data --

The data is provided in two formats.

- Format 1: Minimally preprocessed data -

The data for each subject were collected in five scanning sessions on five separate days. In each session, there were seven runs. (One run is one time the scanner was turned on and off) Five of these runs are intended for model estimation or training ("Trn" runs), and two runs are intended for model testing or validation ("Val" runs).

Every brain volume for each subject has been aligned to the first volume of the first run of the first session for that subject. Across-session alignment was performed manually. Additionally, data were temporally interpolated to account for differences in slice time acquisition. (Due to the way fMRI data is collected, some slices within the same brain volume were collected nearly 1 second apart.) See Kay et al 2008 for further preprocessing details.

Each separate run is stored as a separate gzipped NIFTI (.nii.gz) file.

- Format 2: Estimated BOLD responses for each image -

Peak BOLD responses to each of the 1,750 training and 120 validation images were estimated from the preprocessed data. We provide these estimated responses in the "EstimatedResponses.mat" file. The file is stored in matlab version 7.3 .mat file format, which is equivalent to hf5 format, and can be read directly into numpy/python using the PyTables library.

Variables in the file:
dataTrn<S1/S2> : 1,750 x ~25,000 matrix; 1,750 responses (one per training image) in each of ~25,000 voxels
dataVal<S1/S2> : 120 x ~25,000 matrix; 120 responses in each of ~25,000 voxels
voxIdx<S1/S2> : index for mapping the ~25,000 voxels into a 64 x 64 x 18 volume.
roi<S1/S1> : indices for which voxels correspond to each ROI.
roiNames : the names corresponding to each index number.

0 : other
1 : V1
2 : V2
3 : V3
4 : V3A
5 : V3B

6 : V4
7 : LatOcc (Lateral Occiptial area)

The responses for each voxel have been z-scored, so for a given voxel the units of each "response" are standard deviations from that voxel's mean response. Also, of the 73,728 (64*64*18) voxels recorded for each scan, only ~25,000 voxels in or near the cortex were selected for each subject. ROIs for each subject were determined based on separate localizer scans (not included). See Kay et al (2008) for details of BOLD response estimation, voxel selection, and ROI definition.

-- Stimuli --

All stimuli are stored in the "Stimuli.mat" file. The stimulus file is also matlab version 7.3 (hf5 compatible). Variables are:

stimTrn : 1,750 images, 128 x 128 pixels
stimVal : 120 images, 128 x 128 pixels
seqTrn : 672 x 25 matrix of index vectors. Each column is the stimulus index for one training ("Trn") run (1st column = Session 1, TrnRun 1, 2nd column = Session 1, TrnRun 2, ... last column = Session 5, TrnRun 5). Each column specifies which of the 1,750 training images was presented at each of the 672 seconds in that run. 0 indicates that no stimulus was presented at that time point.
seqVal : 696 x 10 matrix of index vectors. Each column is the stimulus index for one validation ("Val") run (1st column = Session 1, ValRun 1, ... last column = Session 5, ValRun 2). Each column specifies which of the 120 validation images was presented at each of the 696 seconds in that run.

The order of the stimuli in the "stimTrn" and "stimVal" variables matches the order of the stimuli in the "dataTrn" and "dataVal" variables for the two subjects' estimated BOLD responses.

* Update 2012-04-07 *
The full-resolution images that were shown to the subjects are now provided as well.

The files Stimuli_Trn_FullRes_<number>.mat contain the full-resolution images show in the training runs in a 3-D matrix. The matrices are 120 x 500 x 500, except for the last one (Stimuli_Trn_FullRes_15.mat), which is 70 x 120 x 120. Note that all together, these matrices provide all 1,750 images (120*14+70 = 1750). The files are separated to be more manageable in computers with limited RAM.

All 120 full-res validation images can be found in Stimuli_Val_FullRes.mat

The images are in the same order as the lower-resolution images in Stimuli.mat (see above) Note also that the image pixel values are not 0-255, as in 8-bit images, but instead are floating-point values that range from approximately -.55 to +.45. These can be viewed using

matlab's imagesc function or pylab's imshow function. It is up to the user to re-scale the luminance values and save the images as separate image files, if that is desired.

* Update 2013-04-09 *
Anatomical scans for both subjects are now provided as well. The anatomical images are provided in g-zipped Nifti format as Sub<1,2>_Anat_msk.nii.gz. Brains have been skull-stripped using FSL's BET (Brain Extraction Tool).

The mask applied to form the full resolution stimuli is included as mask.mat. The full resolution stimuli provided are exactly what was used in the experiment. Having the mask enables inserting some arbitrary image content in the blocked out regions.

-- Getting Started --

For the minimally preprocessed data, software to load .nii files into matlab or python are available at:
http://www.mathworks.com/matlabcentral/fileexchange/8797
http://nipy.sourceforge.net/nibabel/
The nifti files may need to be unzipped before loading into matlab.

For the estimated response data, loading files into matlab is trivial. The following code gives an example of how to load the code into python (you'll need the pyTables library, as well as numpy).

# To get all V1 voxel responses in the training data set:
import tables,numpy
```
f = tables.openFile('EstimatedResponses.mat')
f.ListNodes # Show all variables available
Dat = f.getNode('/dataTrnS1')[:]
ROI = f.getNode('/roiS1')[:].flatten()
V1idx = numpy.nonzero(ROI==1)[0]
V1resp = Dat[:,V1idx]
```

CONDITIONS FOR USAGE OF GALLANT LAB fMRI DATA IN PUBLICATIONS:

If you publish any work using the data, please cite the two papers listed below. Additionally, please notify Kendrick Kay (kendrick@post.harvard.edu).

-- References --

Kay, K. N., Naselaris, T., Prenger, R. J., & Gallant, J. L. (2008). Identifying natural images from human brain activity. Nature, 452(7185), 352-355.

Naselaris, T., Prenger, R. J., Kay, K. N., Oliver, M., & Gallant, J. L. (2009). Bayesian reconstruction of natural images from human brain activity. Neuron, 63(6), 902-915.