**Overview**

The file ET\_demo.m uses a simulated data set to demonstrate the model-based eye-tracking procedure. The simulation is based on a recording from a 96-electrode Utah-array, and contains 101 units whose stimulus tuning is based on models estimated from the recorded neural population (including 7 single-units and 94 multi-units). Using the default parameter settings, the script requires about 16GB of RAM. You can use a subset of the data by changing the parameter “*useFrac*”, which determines the fraction of the total data to use.

The algorithm is divided into the following stages:

1. First assuming the animal maintains perfect fixation (constant eye position at the 'origin'), we make initial estimates of the stimulus-processing models for all units.
2. Starting from these initial model estimates, we then iterate between estimating a set of 'fixation-corrections' and re-estimating the models, given the current estimates of fixation-corrections.
3. Starting from the best estimate of the fixation-corrections, we iterate between estimating a set of drift corrections, and re-estimating the models.

The stimulus-processing models are based on the “Nonlinear input model” (NIM). The code thus requires that the NIMtoolbox is included in the Matlab path. It can be downloaded from: <http://www.clfs.umd.edu/biology/ntlab/NIM/>.

Note that the folder of ‘helper functions’ must be included in the Matlab path as well.

**Data file**

The simulated data are contained in the file called *simDATA.mat*. This file contains the following variables, where *T* is the number of time samples, *N* is the number of units, and *d* is the number of bar ‘pixels’:

*dt*: scalar containing the time resolution in seconds (0.01)

*sim\_eyepos*: *T*x1 vector containing the true eye position (in degrees relative to the fixation point) at each time.

*Robs\_mat*: *T*x*N* matrix containing the spike counts for each of unit, at each time bin.

*orig\_mods*: 1x*N* struct array containing the stimulus processing models for each unit (at a spatial resolution of 2x the stimulus resolution, or 0.028 degrees).

*stim\_mat*: *T*x*d* matrix containing the pixel values of the 'random-bar' stimulus in each frame. -1 = black, 0 = gray, 1 = white.

*saccade\_start\_inds/saccade\_stop\_inds*: Vectors containing the index values when detected microsaccades start and stop.

*trial\_start\_inds/trial\_stop\_inds*: Vectors containing the index values when trials start/stop (trial duration of ~3.7 sec).

**Model Output**

The key outputs of the model are *fin\_tot\_corr* and *fin\_tot\_std*. The former is the estimated eye position (in degrees) as a function of time, and the latter is the estimated SD (in degrees) of the posterior distribution at each time. The code creates a plot comparing the estimated eye position with the true eye position for each simulated trial.