**Overview**

The file ET\_demo.m uses a set of simulated data 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. Using the default parameter settings, the script requires about 8GB of RAM.

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). It thus requires that the NIMtoolbox be installed. It can be downloaded from: http://www.clfs.umd.edu/biology/ntlab/NIM/.

**Data file**

The simulated data are contained in a .mat file called simDATA. 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 deg 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 deg).

*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 degree) 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.