**IMPORTANT - Read and understand this document first before commencing any analysis.**

**About the experiment**

1. Virus expressing GCaMP6f was injected into the V1 of mice. Approximately 3 weeks post infection, mice were imaged under a 2-photon microscope while sinusoidal drifting gratings were presented on a computer screen placed 3 inches from the mouse (1 degree of visual space ~ 21.3 pixels on the screen).
2. Aims: (1) to map orientation tuning responses of excitatory pyramidal neurons in V1. (2) to determine response reliability at preferred orientation. (3) to determine signal and noise correlations between neuron as a function of orientation tuning.

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**Notes about stimulus**

1. Sinusoidal drifting gratings at **16 different directions** (0:22.5:337.5). Spatial frequency was fixed at 0.03 cycles per degree.
2. Each direction was repeated **10 times** (i. e. 10 trials per direction). Directions are presented in a **randomized order**.
3. Each direction was presented for **2s** and was always preceded by a **4s** gray screen. Therefore the total duration of the stimulus is **6s**
4. Calcium signals (GCaMP6f in awake mice) were acquired from awake mice at 20 frames per seconds. Thus, sampling rate is **20Hz**.

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**Notes about Data.mat**

Data.mat contains 4 entries:

1. Data.rawF = raw fluorescence values. **Matrix size = number of cells x number of frames.**
2. Data.dFF = fluorescence normalized to baseline (dFF = (F-F0)/F0, where F0 is the baseline fluorescence computed using a sliding window of 400 frames). Same size as above.
3. Data.Spks = inferred spike rate using the Vogelstein deconvolution algorithm. Same size as above.
4. Data.StimSeq = contains sequence of directions presented during that experiment. **Vector size = 160 x 1**.

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**Notes about Ori.mat**

Ori.mat contains 20 entries. The most pertinent entries are:

1. Ori.OSI = orientation selectivity indices of the neurons
2. Ori.OrFit = double-wrapped Gaussian fits
3. Ori.OrFitQuality = goodness of Gaussian fits. (Higher the percentage value, the better the fit)
4. Ori.Width = tuning width in degrees
5. Ori.PrefOri = preferred orientation
6. Ori.SpkResponse = Contains neural responses for each cells sorted according to the different directions. Size: 1xNumber of cell Cell array. Each cell entry contains a 1x Number of Direction Cell array, which contains a Number of Frames x Trials matrix.

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**Task**

1. Work only with the data contained in Data.mat.
2. For each cell, use the information contained in StimSeq. To sort the dFF into various directions. Verify this result using Ori.CaResponse. Do the same with Spks.
3. For each cell, use the sorted information to plot orientation-tuning curves, that is, average response (could be dFF or spks, average over stimulus epoch and time) vs. direction. Sharply tuned cells should have responses that peak at 1 orientation, while broadly tuned cells have responses to almost all orientations.
4. Read paper A , code the equations in these papers corresponding to OSI and preferred orientation. For each cell, compute OSI and preferred orientation. OSI is a measure of how strongly a cell responds to an orientation, so sharply tuned cells should have an OSI close to 1. Verify these results using Ori.OSI
5. Perform whatever further analysis on the data you desire. (Suggestions: compute correlation between cells and plot as function of OSI or preferred oriention, compute reliability between trials….)