Supplement II

Analyzing receptive field maps with spherical distributions

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Import data

```matlab
SetDirectory("/Users/work/manuscripts/2010-method/supplement_2/product/");

<< fileIO.m
<< preprocess.m
<< visualization.m
Quiet[<< fisherbingham.m]

datafile = "13G_0H2[sph3Checker8].data";
```

xpos: the longitude of the center of the 8 x 8 grid. In degree.
ypos: the latitude of the center of the 8x8 grid. In degree.
cellsize: the size of the flashing square. In degree.
duration: the ON interval of the flashing. In 0.1msec.
pause: the OFF interval following the ON interval. In 0.1msec
conditionSpkTimes: spike arrival times. In 0.1msec.

```matlab
{xpos, ypos, cellsize, duration, pause, conditionSpkTimes} = readCheckerboard[datafile];
```
Preprocessing

- Use Quiroga’s *Event Synchronization* to find an initial estimate of the receptive field.

```
spikePatternPlot[conditionSpkTimes, duration + pause, threshold = 0.2]
```

```math
\{(\text{baselineRemovedSoft, baselineRemovedHard, sel, nonSel, nPerCondition, baseline}) = \text{baselineProcessing}[conditionSpkTimes, duration + pause, threshold]\}
```
Mean firing rate contour plots

- A simple raster plot of the receptive field map

  ```math
  m2 = Partition[baselineRemovedSoft, 8];
basicCheckerboardPlot[m2]
  ```

- Contour plot on a 3D hemisphere (Interactive)

  ```math
  sphericalContourPlot3D[xpos, ypos, cellsize, m2, ImageSize -> 300]
  ```
- Lambert-projected contour plot

\[
lambertContourPlot[xpos, ypos, cellsize, m2]
\]

\[
lambertContourPlot[xpos, ypos, cellsize, m2, 
  x0 \rightarrow 30 \text{ Degree}, x1 \rightarrow 90 \text{ Degree}, y0 \rightarrow -30 \text{ Degree}, y1 \rightarrow 20 \text{ Degree}]
\]
Fitting the 5-parameter-Fisher-Bingham distribution

- Rotation to the standard reference frame
  \[ (m, t) = \text{fbGeometry}[\text{baselineRemovedHard}, \text{xpos}, \text{ypos}, \text{cellsize}]; \]

- Fit FB5 in the standard reference frame
  \[ \{c, \kappa, \beta, r^2\} = \text{fbFit}[m, t, \text{baselineRemovedSoft}, \text{xpos}, \text{ypos}, \text{cellsize}]; \]
  \[ \text{fbFit}[m, c, \kappa, \beta, r^2] \]
  
  RF center: \( (73.6^\circ, -15.3^\circ) \)
  eccentricity: 74.2°
  polar angle: -15.9°
  width: 7.8°
  length: 11.0°
  quality: 0.93

Visualize fitted function

- As color-coded map in 3D (interactive)
  \[ \text{plotFB3D}[[m, t, c, \kappa, \beta]] \]

- Lambert-projected contour plot
  \[ \text{fbm} = \text{sampleFB}[[m, t, c, \kappa, \beta], \text{xpos}, \text{ypos}, \text{cellsize}] // Reverse; \]
lambertContourPlot[xpos, ypos, cellsize, fbm]

Visualize the envelope (using Lambert projection)

This format is most useful for plotting many receptive fields in the same figure.

patch = plotFBPatchLambert[{m, t, c, kappa, beta}, PatchStyle -> Pink];
Show[
lambertUnitSphere[],
  patch
]

Show[
lambertUnitSphere[x0 \rightarrow 30 \text{ Degree}, x1 \rightarrow 90 \text{ Degree}, y0 \rightarrow -30 \text{ Degree}, y1 \rightarrow 20 \text{ Degree}],
  patch
]