Visual Area V4 is one of the visual areas in the extrastriate visual cortex. V4 is tuned for orientation, spatial frequency, and color.
The cortical homunculus represents the importance of various parts of your body as seen by your brain. Somatosensory processed in area SII, combined with the V4 area, is the cortical pathway used to process object information.
Statistics

• The default or the most probable outcome is the null hypothesis, p-value is less than a significant level, usually 0.05 or 0.01, it is significant.

• If the results are to be $p < 0.05$, or $p$ is less than 5%, the null hypothesis, also defined as the most likely observation, is rejected.

• $r^2$, variance or the square of the correlation coefficient, tests for a goodness of fit of the data.
Agenda

Background
Paper
Discussion
Experiment

- They studied the intermediate stages in area V4 and SII to see how the cortical pathways process object information.

- Using contour stimuli, the experimenters recorded the response of individual V4 and SII neurons.

- For testing area V4, contour stimuli were adjusted several degrees of visual angle.

- For testing area SII, different finger pads were used for specific stimuli.
Tuning for curvature direction

- In Fig. 1A, contour fragment stimuli were flashed into the cell's receptive field while the monkey performed a fixation task.
- In Fig. 1B, tactile stimuli were indented into the distal finger pad of a monkey performing a distraction task.
Tuning for curvature direction

The curves on the right are von Mises distribution, also known as circular normal distribution. The spike of the distribution shows which sections of the stimuli has the most activity.
• Fig. 1C and 1D shows the distribution of curvature tuning for the V2 and SII area, respectively.
• Filled circles are "significant", or show a smooth von Mises distribution, whereas the empty circles are not significant and do not have a good distribution.
• Larger values of "k" value signifies a sharper peak on the von Mises distribution.
These are examples of curvature direction tuning functions from 20 V4 and SII neurons. These curves are normalized and show von Mises distributions of the neurons.
Principal Components Analysis (PCA)

A  Simulated random PC1
B  Simulated orientation PC1

- PCA is used to visualize salient response patterns in the data.
- For Fig. 2A, a simulated population of neurons there is no distinct pattern because the neurons are not tuned for orientation and are completely random.
- For Fig. 2B, the simulated population of neurons are tuned for orientation and a pattern emerges (four distinct response peaks).
Principal Components Analysis (PCA)

- Fig. 2B shows the preferred "orientation," which is only a segment of the stimuli. In this case, the orientation is a line going northwest.

Hence, the stimuli that makes the neurons fire the most are the shapes that have the specific segment.

Note: This is only a simulated response of a neuron. If an actual V4/SII neuron was tuned for orientation, the results would show the same patch-like responses.
For Fig. 2C, simulated population of neurons are tuned for curvature direction.
The curvature direction is the direction of where the shape is pointing.
Fig. 2D shows the observed response of actual V4/SII neurons. It seems that V4/SII neurons are attentive to curvature direction, rather than shape or angle.
Neurons Tuned For Curvature Direction

These figures show the responses of random individual V4 and SII neurons, which shows they are tuned for curvature direction.
• Fig. 3 shows the response variance of combined V4/SII, individual V4, and individual SII PCA respectively.
• It is apparent that PC1 accounts for most of the variance (about 35%), which would mean that these neurons are tuning for curvature direction and not anything else.
• The first 10 PCs accounted for 61% of total variance. The other 38 PCs, that would accumulate to 100%, are not shown.