Overview

- Poisson Generator
- Receptive Fields
- Delta-function
Poisson Generator

Poisson distribution describes uncorrelated random events

Generate this behavior:
- Divide time into discrete bins
- Check in every time bin, if condition is met
- Probability of spike in bin:

\[ p = r \Delta t \]
Receptive Fields

• From scholarpedia:
  “The receptive field is a portion of sensory space that can elicit neuronal responses when stimulated.”

• A receptive field looks like the optimal stimulus driving a neuron.
Receptive Fields

- Spike triggered average:

\[ C(x, y, \tau) = \frac{1}{\langle n \rangle} \left\langle \sum_{i=1}^{N} s(x, y, t_i - \tau) \right\rangle \]

- Correlation between Stimulus and Rate:

\[ Q_{rs}(x, y, \tau) = \frac{1}{T} \int_{0}^{T} r(t)s(x, y, t + \tau)dt \]

Are related:

\[ \langle r \rangle C(x, y, \tau) = Q_{rs}(x, y, -\tau) \]
Receptive Fields

Example receptive fields in cat visual cortex

DeAngelis et al., 1995
Receptive Fields

● Receptive field from exercise 6.

● Discretized on a 128x128 grid with gridsize 1/20.

\[
W(x, y) = \frac{1}{2\pi \sigma_x \sigma_y} \exp \left( -\frac{x^2}{2\sigma_x^2} - \frac{y^2}{2\sigma_y^2} \right) \cos(2\pi k_x x)
\]
Receptive Fields

How to “measure” receptive fields:

- WN stimulus
- Calculate rate
- Generate spike trains
- Compute spike triggered average
Delta Function

- **Definition:**
  \[ \delta(x) = \frac{1}{2\pi} \int_{-\infty}^{\infty} e^{ipx} \, dp \]

- **Properties:**
  \[ \int_{a-\epsilon}^{a+\epsilon} f(x) \delta(x - a) \, dx = f(a) \]
  \[ \delta(x - a) = 0 \quad x \neq a \]