# Linear Dynamical System (LDS)

Each row is the recording for neuron i, , Denote the cluster index for neuron as . The number of neurons in cluster is , and . The mean firing rate of neuron at t is and . The mean firing rate of cluster j at t is . Denote the state space in cluster j as .

## The “full” model

Where , and are all unknown. Only is known. The latent state evolves linearly with Gaussian noise

## Reduced model in Poisson-LDS (PLDS)

This defines lots of shares in dynamics & noise.

Where , , and . The latent state evolves linearly with Gaussian noise

## Gibbs Sampler Iteration (in PLDS)

Denote the observed spike counts in cluster j as and latent trajectory as .

Priors:

,,, ,

and

Add some constraints: e.g.

Notice:

In each iteration:

The updates for clustering-related part keeps the same. Only show update for PLDS:

1. Latent or :

In PLDS paper, they use Laplace approximate for overall posterior:

where and . By making use of log-concavity and Markov structure, they can compute a Newton update in .

But this still can be easily handled by local Laplace approximation (approximate at each step) and do adaptive smoothing. Since this is just some initial trials, I use the adaptive smoothing to save time.

Update by adaptive smoothing.

1. Update ,and

Make use of log-concavity of Poisson\*Normal: adaptive rejection sampling.

Or use Laplace approximation again?…

Or use PAL (as in Poisson-GPFA, https://arxiv.org/pdf/1906.03318.pdf)?

1. Update

Use conjugacy

# Poisson-GPFA

Switch to <https://arxiv.org/pdf/1906.03318.pdf>, instead of LDS model…