# Notations (common)

Each row is the recording for neuron , , Denote the cluster index for neuron as . The number of neurons in cluster is , and .

# Model

Denote the latent vector in cluster as . For simplicity, assume all . Each observation follows a Poisson distribution as follows:

Where and .

In this version, the loading and are also cluster dependent. That is,

Denote all latent states as and they evolve linearly with Gaussian noise:

To simplify, assume is known (e.g. ).

If we assume block diagonal (as in Joshua et al., 2020) for process noise covariance, we can write things as:

Notice forms the full transition matrix as:

If the row block of is . Then, .

If we further let be diagonal: denote the row of , , as , , . The corresponding process noise variance as . Then:

The parameters need to estimate:

1. Latent vectors:
2. Initials:
3. Linear mapping for latent vectors: and
4. Mean and covariance for linear mapping in each cluster: and
5. Linear dynamics for latent vectors: and
6. Process noise:

Since the progress noise is independent in the model, , where is the Poisson density and is the parameters in cluster .

# Conditional Priors

Others are the same as v3, but modify loading related ones, i.e. mean and covariance for linear mapping in each cluster and :

Where and

Where and

# MCMC iteration

Others are the same as v3, but modify loading related ones.

1. Update and :

Denote and .

Where is Poisson log-likelihood.

Use Newton-Raphson to find and

1. Update and :

Again, denote .

Mean : by conjugacy,

Covariance: by conjugacy,