Extension 1: include more information such as dispersion

Currently, the spike counts are modeled by Poisson distribution. We can further include the dispersion information by assuming negative-binomial distributed or even Conway-Maxwell-Poisson distributed neural spikes. These further information can be used for more detailed clustering, by expanding the state space to model dynamics in dispersion parameters.

Extension 2: include interactions between populations

Denote the contribution of cluster to cluster in state vector transition as . Therefore, we can rewrite as . If we stack all latent vector at together as , and denote corresponding bias as , transition matrix as and process noise covariance as . By allowing have non-zero elements for and keeping the diagonal block diagonal, we can model the interactions between different clusters while ensuring the model identifiability.

Since the transition matrix is just a part of the prior for latent vector , relaxing the structure in won’t influence the likelihood too much but allowing extracting more latent structures at the same time. We can further make time-varying by including one more latent variable to govern the switching of linear dynamics, as illustrated in Joshua et al. These extensions can be easily integrated in current clustering framework.