

Bayesian Clustering of Neural Spiking Activity Using a Mixture of Dynamic Poisson Factor Analyzers

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How to Define Neural Populations?

Brain Regions (Anatomy)

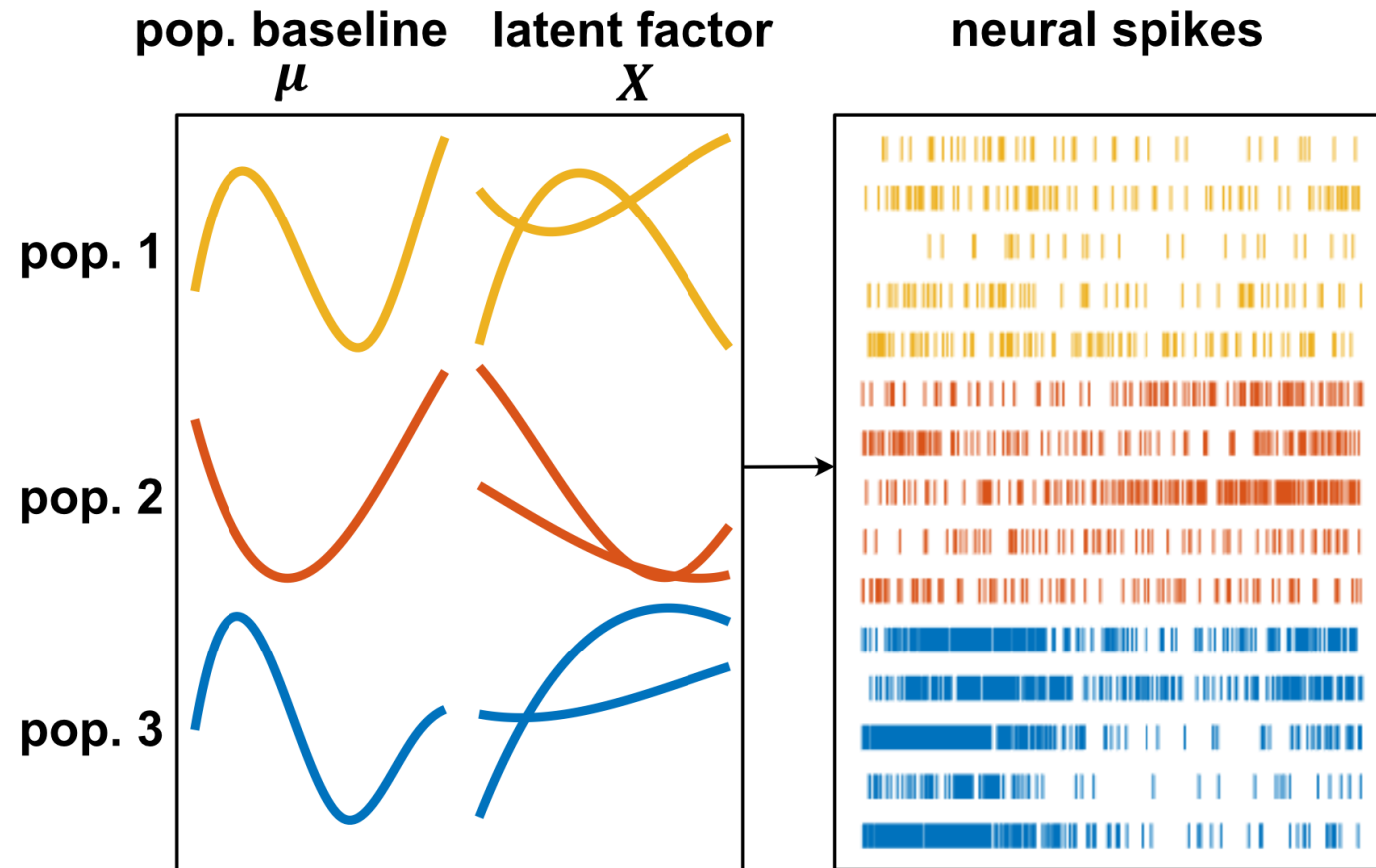


Cell types



- Neurons in different groups may:
 - Interact with each other,
 - Receive common input,
 - Share the same latent structure.
- Using only anatomy or cell type may not accurately describe the data.

Can we define neural populations by activity?

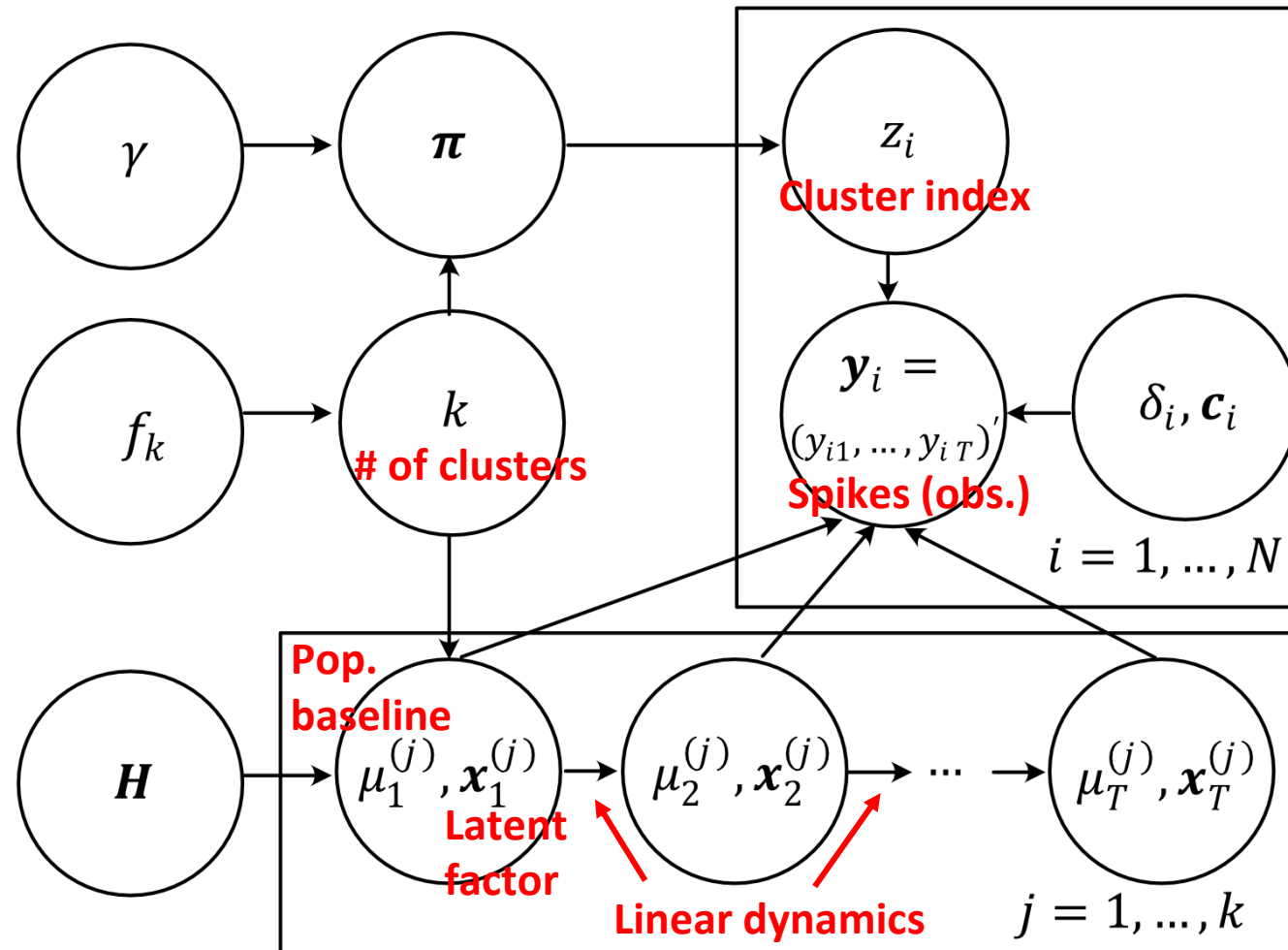


Goal: Cluster neurons according to activity

- High Level Idea:
 - Mixture of latent structure models
 - Mixture of dynamic Poisson factor analyzers (mixDPFA)
- Advantages:
 - Simultaneously extract latent structure underlying the activity of populations,
 - Defined populations are related to function directly,
 - Flexibly describe neural activity when the input is non-homogeneous.

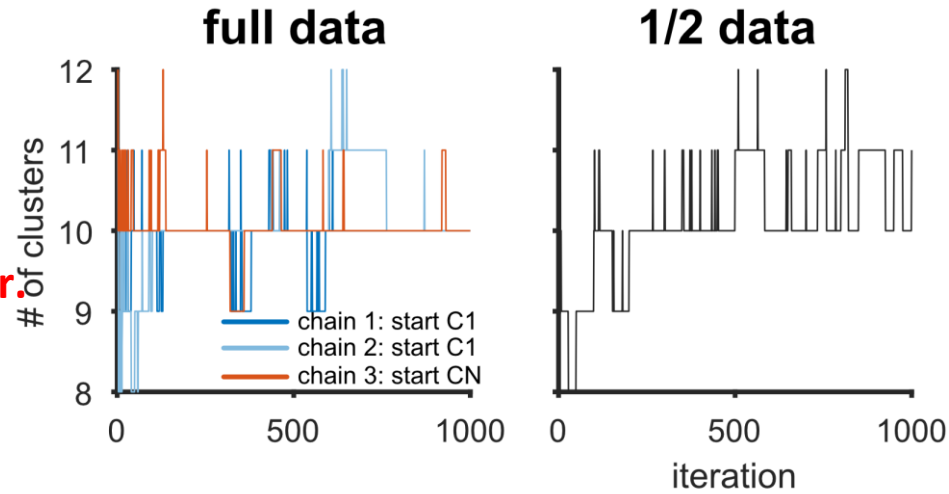
mixDPFA

Bayesian inference via a MCMC algorithm

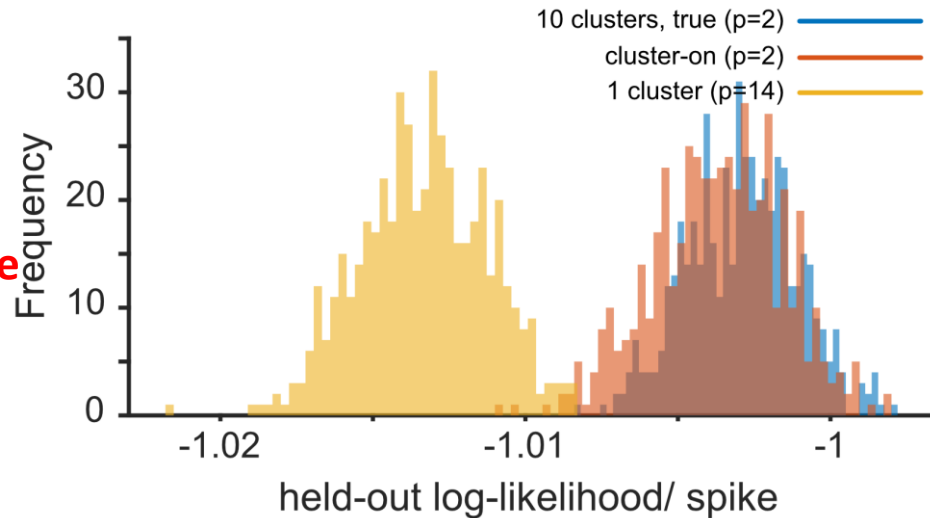


Simulation Results

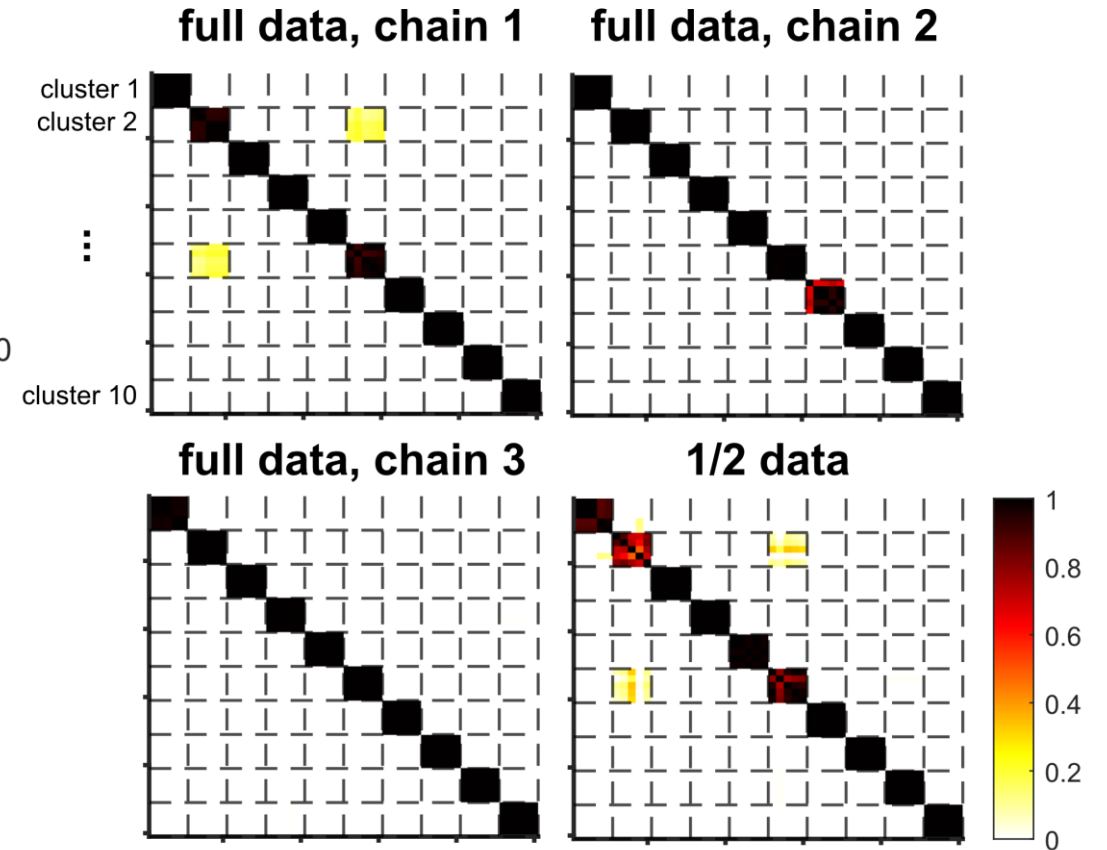
(i) Recover true number of cluster.



(iii) Perform better than single cluster model.



(ii) Recover true cluster assignment.



Other Details in Paper

- Constraints on the model...
 - Make the model **identifiable**,
 - **Cluster by latent trajectories**, instead of baseline amplitude etc.
- Sample posteriors for latent factors...
 - **Exactly** by Pólya-Gamma (PG) augmentation with a Metropolis-Hasting step,
 - Compare to samples from widely used **Laplace approximation**.
- Fitting to large-scale Neuropixels data...
 - Bayesian clustering results are **reliable**, differ from **anatomical regions**, and depend on **stimuli**.

Summary

- Cluster neurons according to activity
 - Mixture of dynamic Poisson factor analyzers (mixDPFA)
- Advantages:
 - Simultaneously extract latent structure underlying the activity of populations,
 - Flexibly describe neural activity when the input is non-homogeneous.

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