**Dynamic filtering of spike count data with non-Poisson variability**

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# Abstract

# Introduction

Drift…

(Rokni et al. 2007)

(Chestek et al. 2007)

(Stevenson et al. 2011)

(Tomko and Crapper 1974)

Stability…

(Dickey et al. 2009)

(Steinmetz et al. 2021) [shows that correcting for electrode drift reduces some instability]

[some amount of drift is functional] adaptation/plasticity…

(Lesica et al. 2007)

Variability…

(Ghanbari et al. 2019)

(Stevenson 2016)

(Fenton and Muller 1998)

(Barbieri et al. 2001)

(Maimon and Assad 2009)

(Churchland et al. 2010)

(Churchland et al. 2011)

(Eden et al. 2004)

(Brown et al. 2001)

(DeWeese and Zador 1998)

# Methods

## General Form for CMP Adaptive Filtering

Assume there are neurons at time bin . Denote the number of spikes at in neuron be and all observations at as , with . Further denote all observations up to as .

Assume follows a Conway-Maxwell Poisson (CMP) distribution with parameters and , i.e. . (May add some property about CMP, e.g. dispersion performance for different ). Assume parameters are governed by latent state vector and history of the spiking process as and . If each observation within step is independent, the likelihood () and log-likelihood () at step is:

, where .

Assume the state vector evolves linearly with gaussian error (state equation) as , where is a system evolution matrix and represents gaussian noise with covariance . By Bayes’ theorem, the posterior at

# Results

## Simulations

## Applications

# Discussion

Omitted variables can increase the apparent variability of observations via the law of total variance. For example, in the hippocampus, place cell firing is highly variable on different passes through the field (cite Fenton). This may be partially due to joint selectivity to position, speed, and head direction, as well as the influence of theta phase. Here, rather than model these distinct covariates assuming Poisson observations, we allow the variability to be non-Poisson.

# Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant No. 1931249.

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