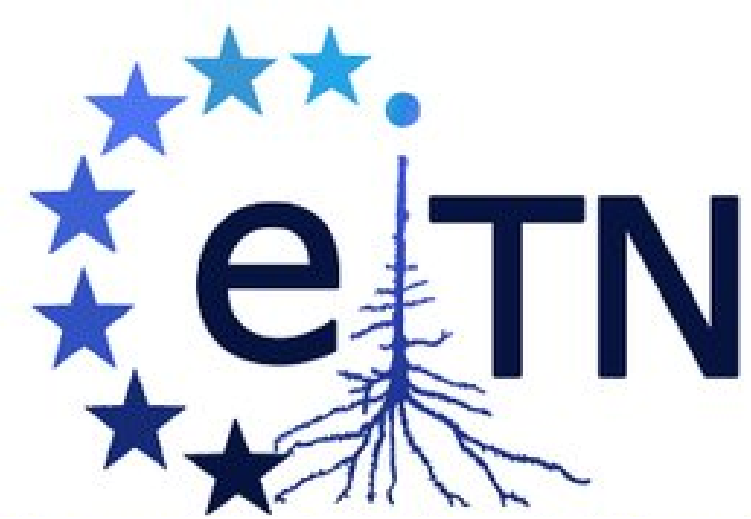


Spring School

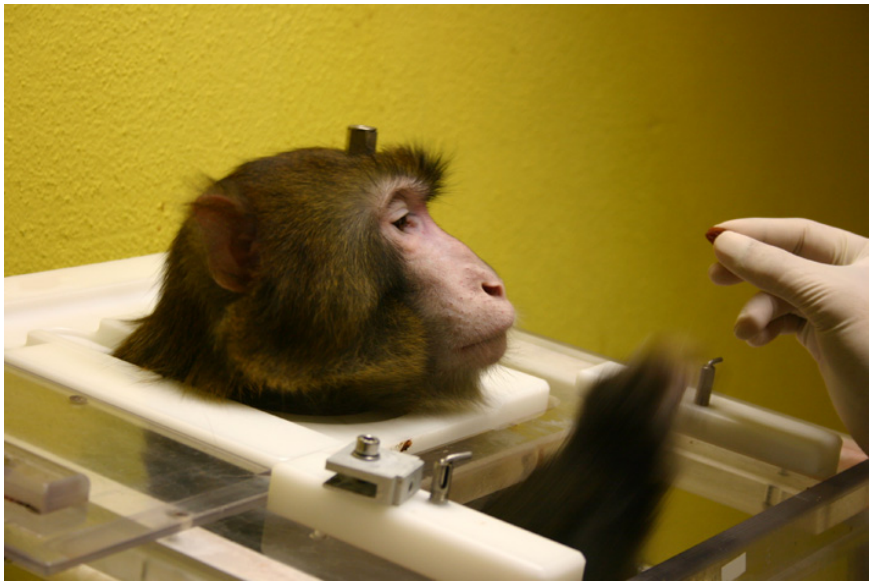
Mikko Lehtimaki
Mate Mohacsi
Alex Stasik
Eduarda Demori Susin

23/02/2018

6 Data Sets: What is What?

Data from 2 macaques

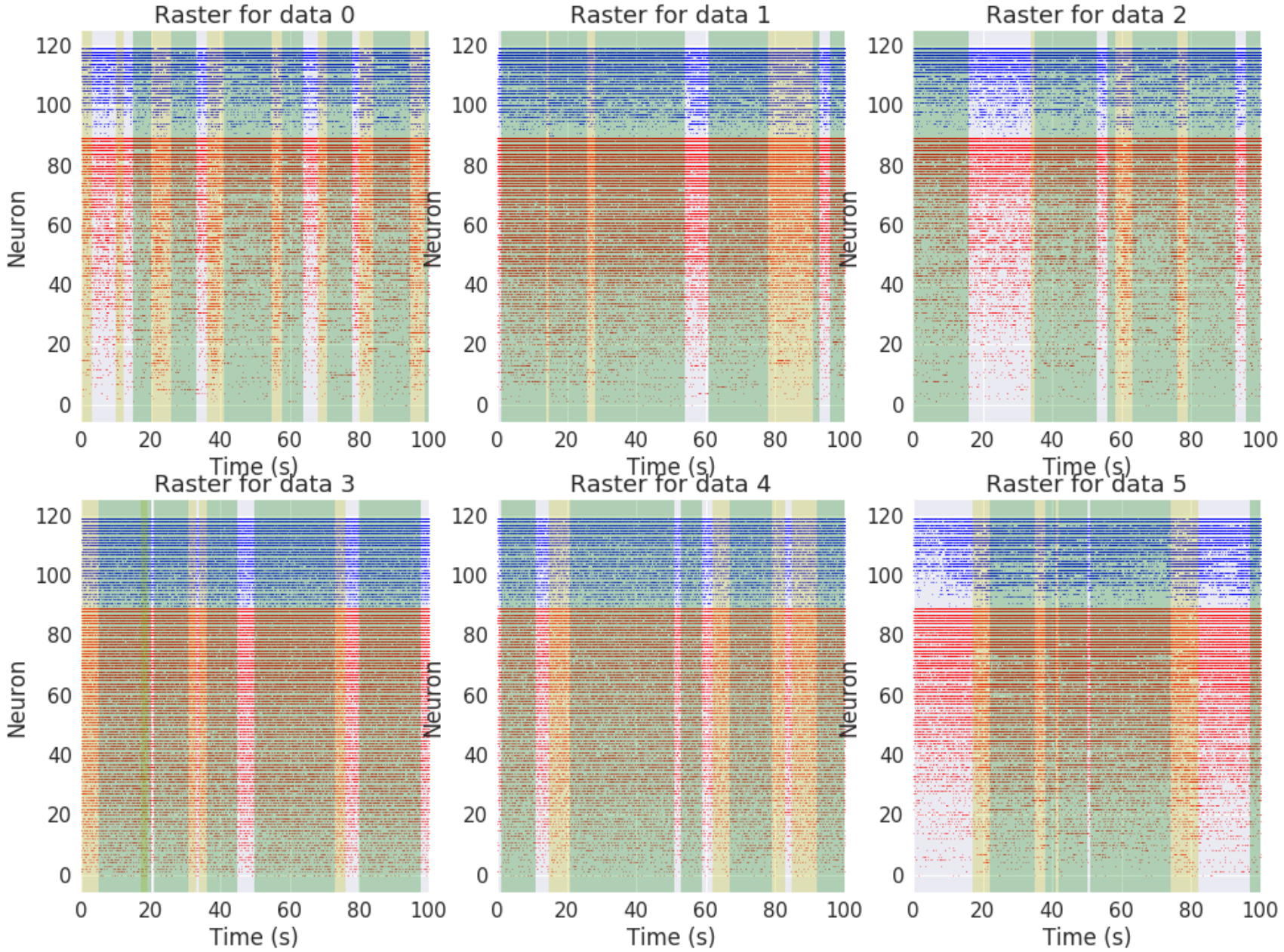
motor cortex



Data generated by a
point-neuron simulation

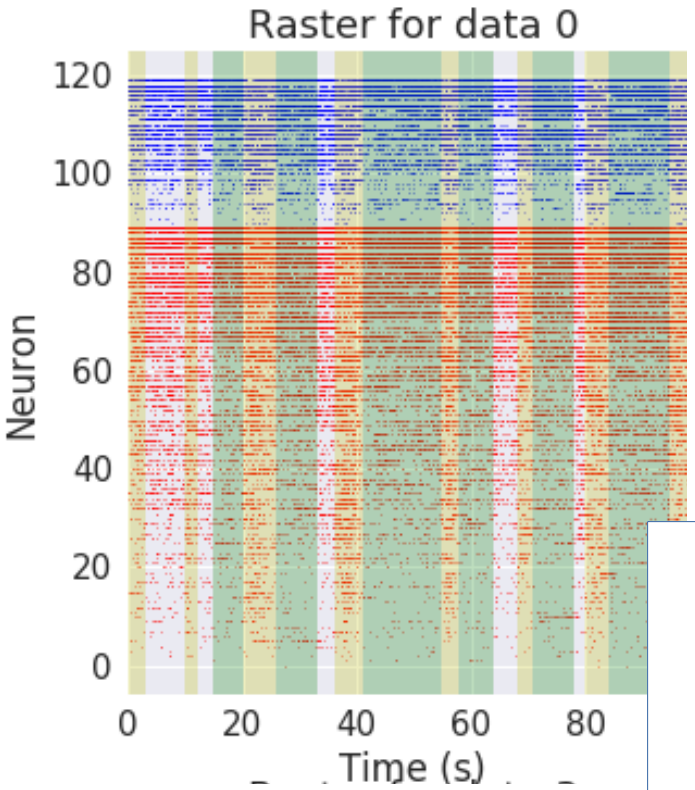
nest ::
simulated()

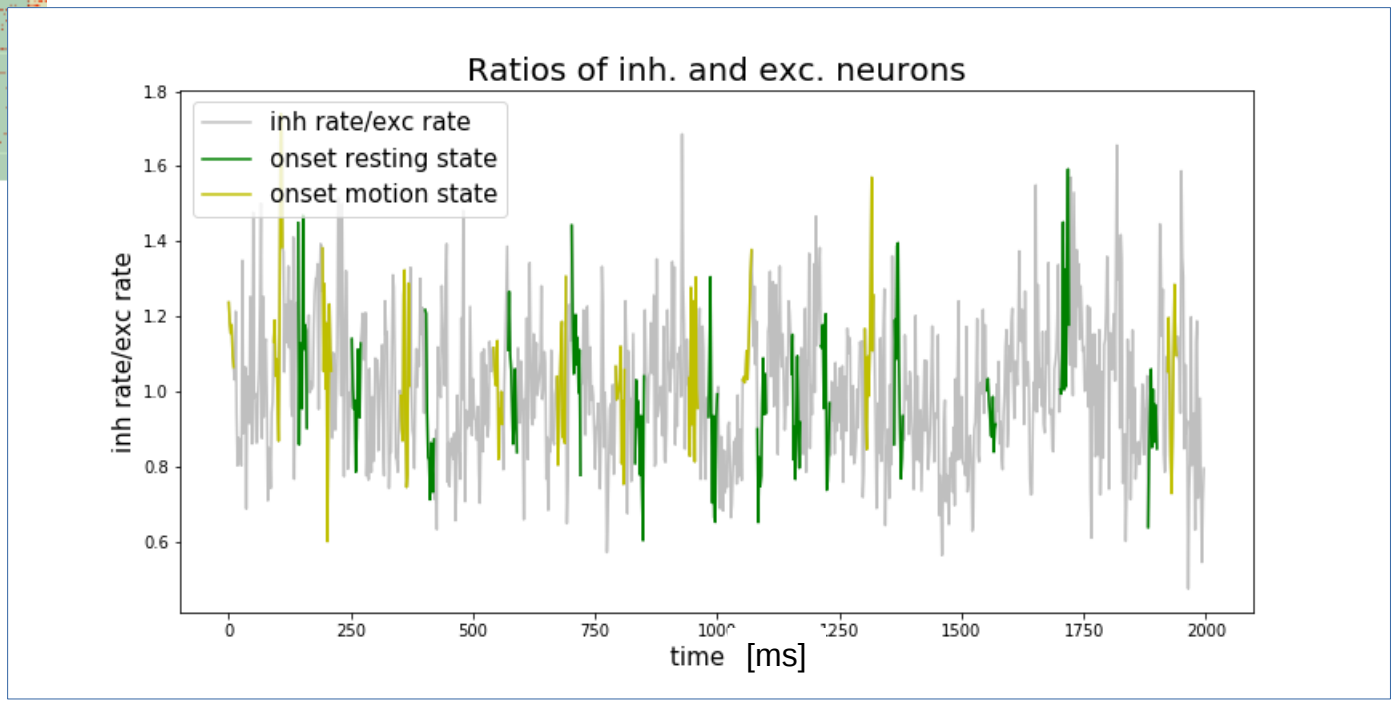
6 Data Sets: What is What?



Green: Rest Periods -Yellow: Moving Periods

6 Data Sets: What is What?





Green: Rest Periods
Yellow: Moving Periods

Methods

Variables Considered:

- Inter-Spike Interval
- Local Coefficient of Variation
- Auto and Cross-Correlations
- Mean Frequency per Neuron
- Attractor Reconstruction

Statistical Tests Used:

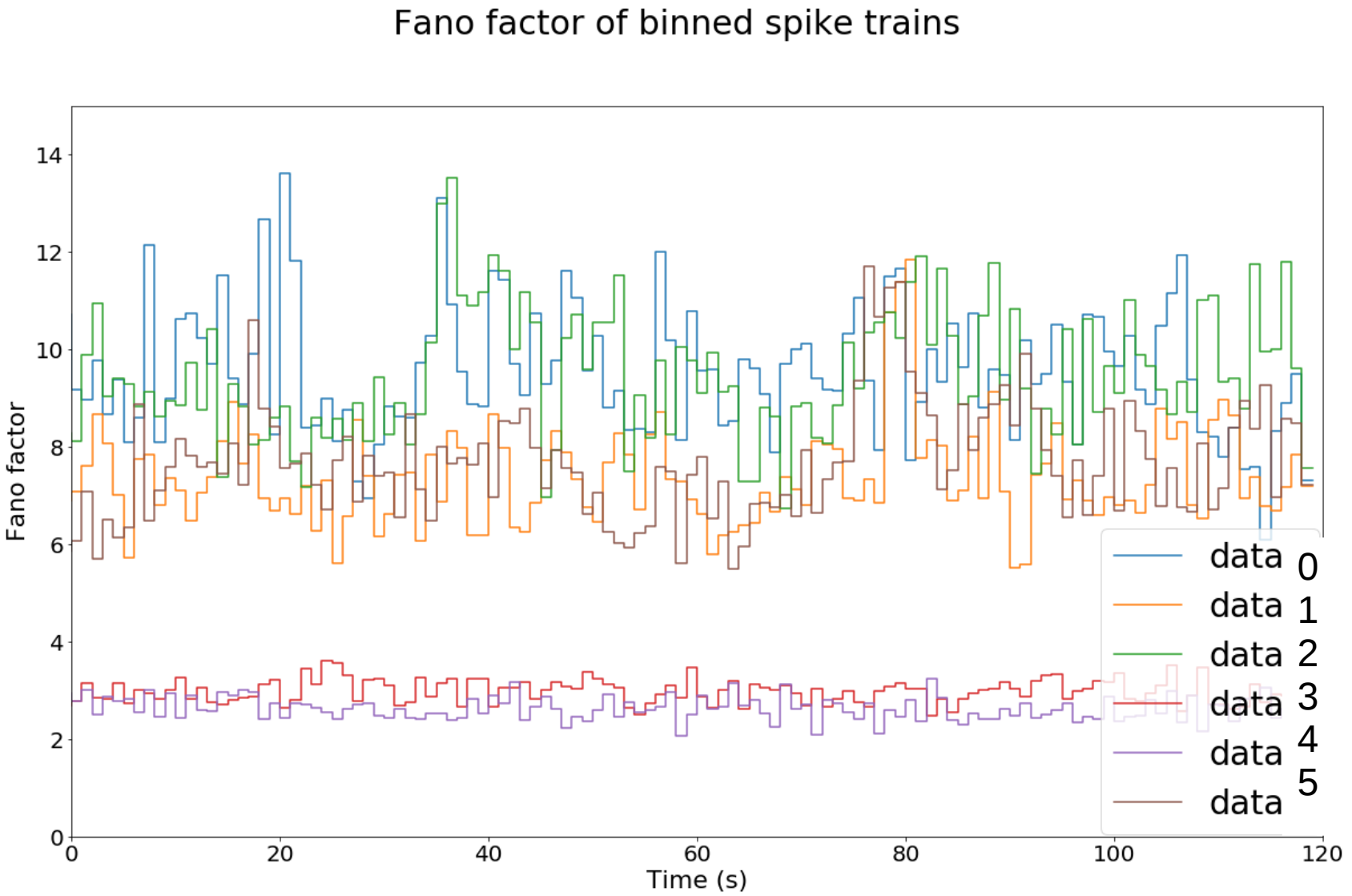
- Kolmogorov-Smirnov test
- Mann Whitney
- Levene
- T-Student Test
- Pearson
- Kruskal

Exploring the Data: Fano-Factors (time binned)

$$F = \frac{\sigma_W^2}{\mu_W}$$

Differentiating Data Sets

- Comparing Fano-Factors

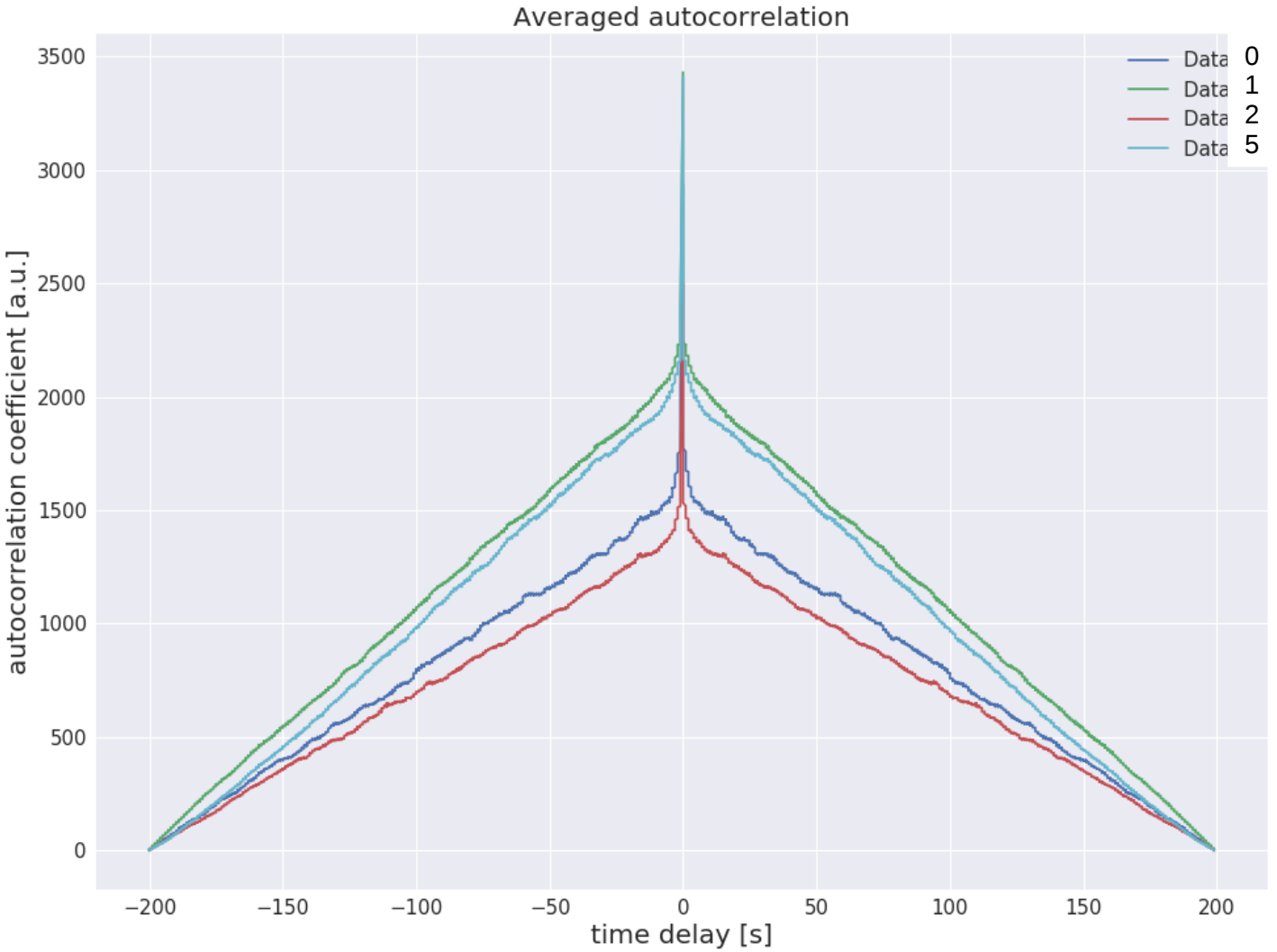


Exploring the Data: Auto-Correlations

$$(f \star g)[n] \stackrel{\text{def}}{=} \sum_{m=-\infty}^{\infty} f^*[m]\, g[m+n]$$

Differentiating Between Monkeys

- Comparing the Auto-Correlations
  → Kolmogorov-Smirnov test not robust enough

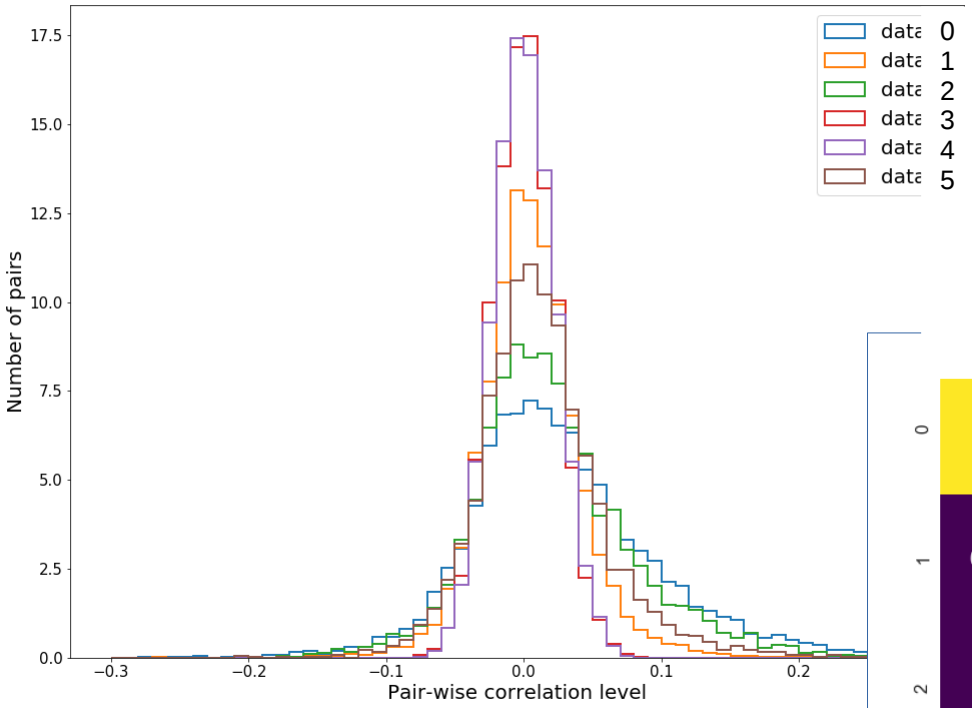


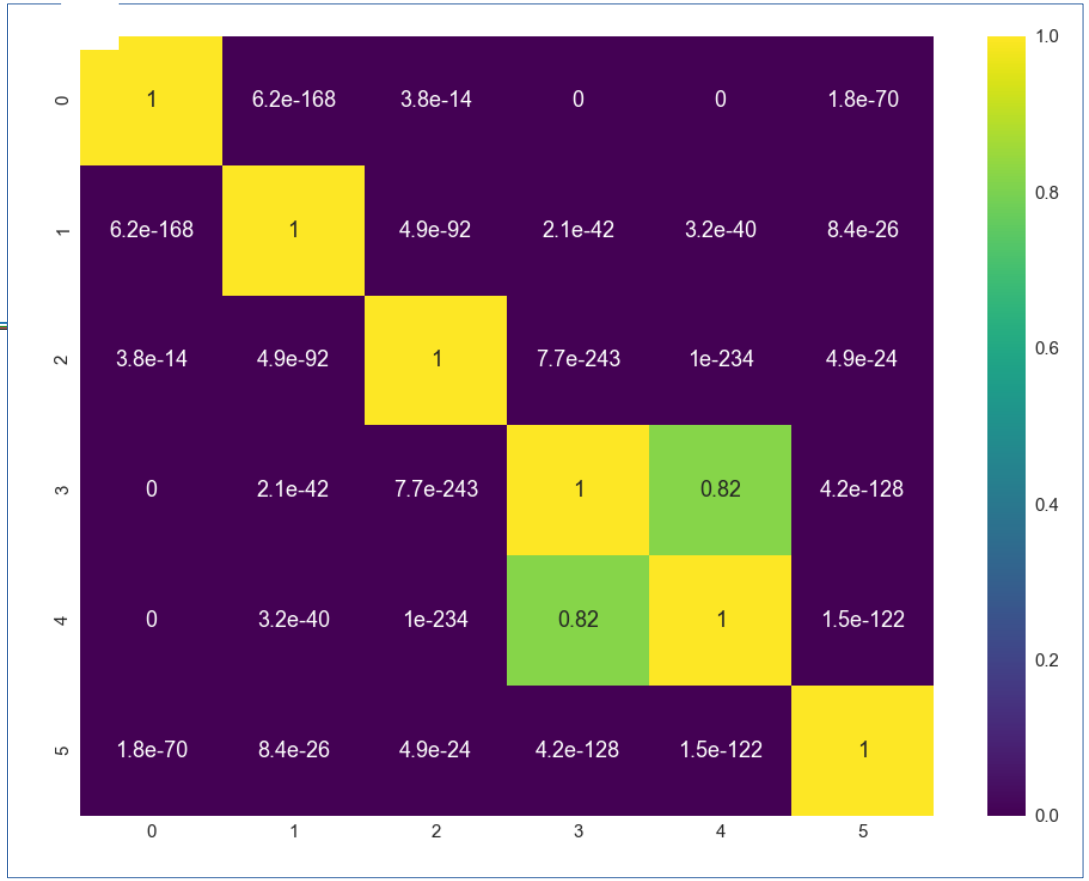
Statistical tests:
Cross-Correlations Comparisons

$$(f \star g)[n] \stackrel{\text{def}}{=} \sum_{m=-\infty}^{\infty} f^*[m]\, g[m+n]$$

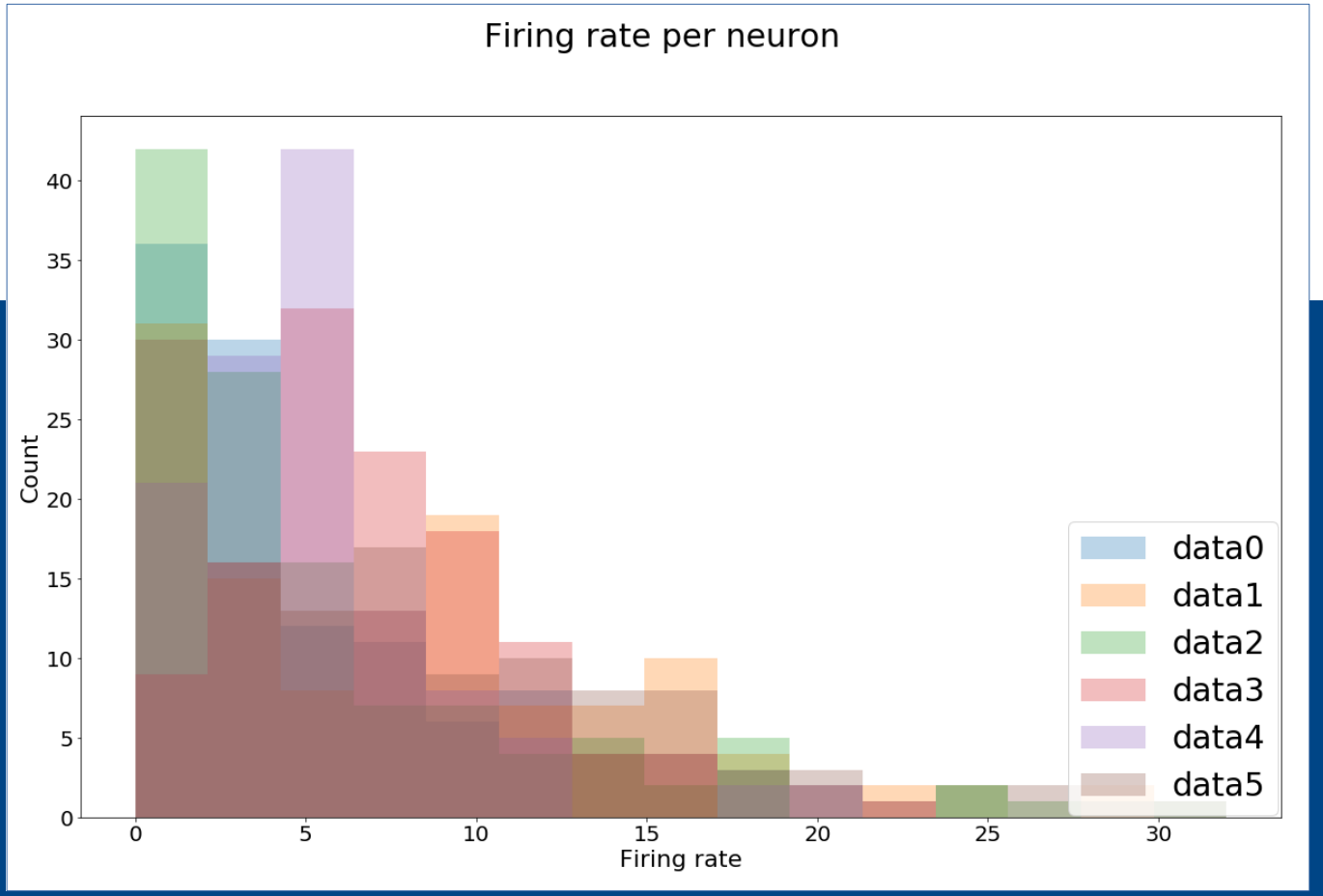
Differentiating between Simulated and Non-Simulated Data

- Using Pairs-wise Correlations and the Kolmogorov-Smirnov test



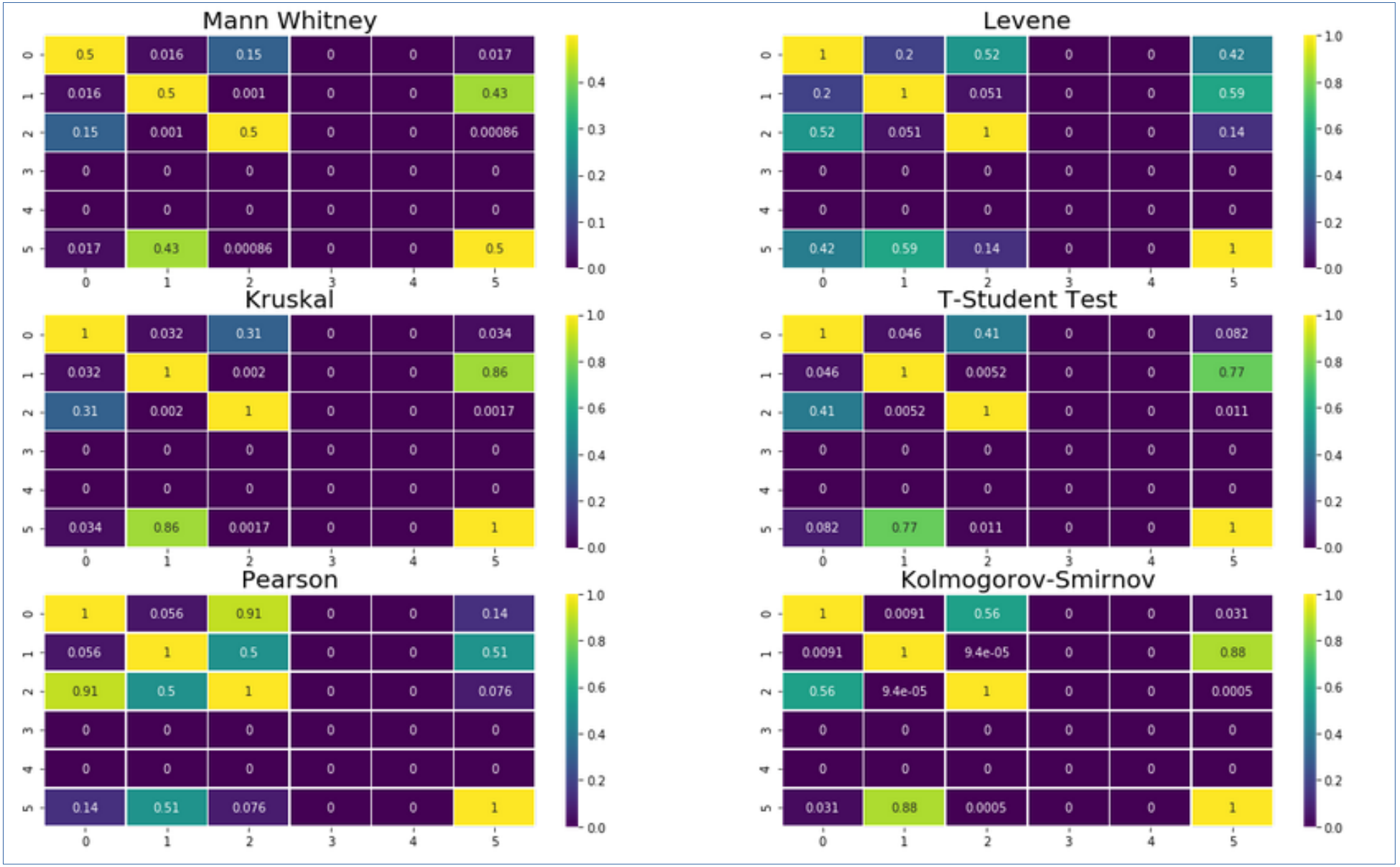


Statistical tests:
Comparing Firing Rate per Neuron



Differentiating Data between the 2 Monkeys

- Using Frequency per Neuron Distribution and the different statistical tests

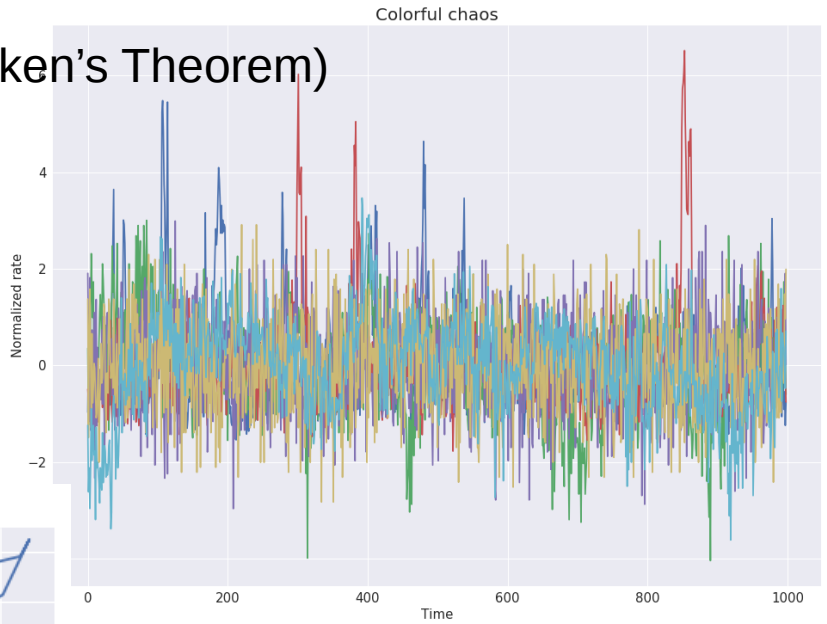


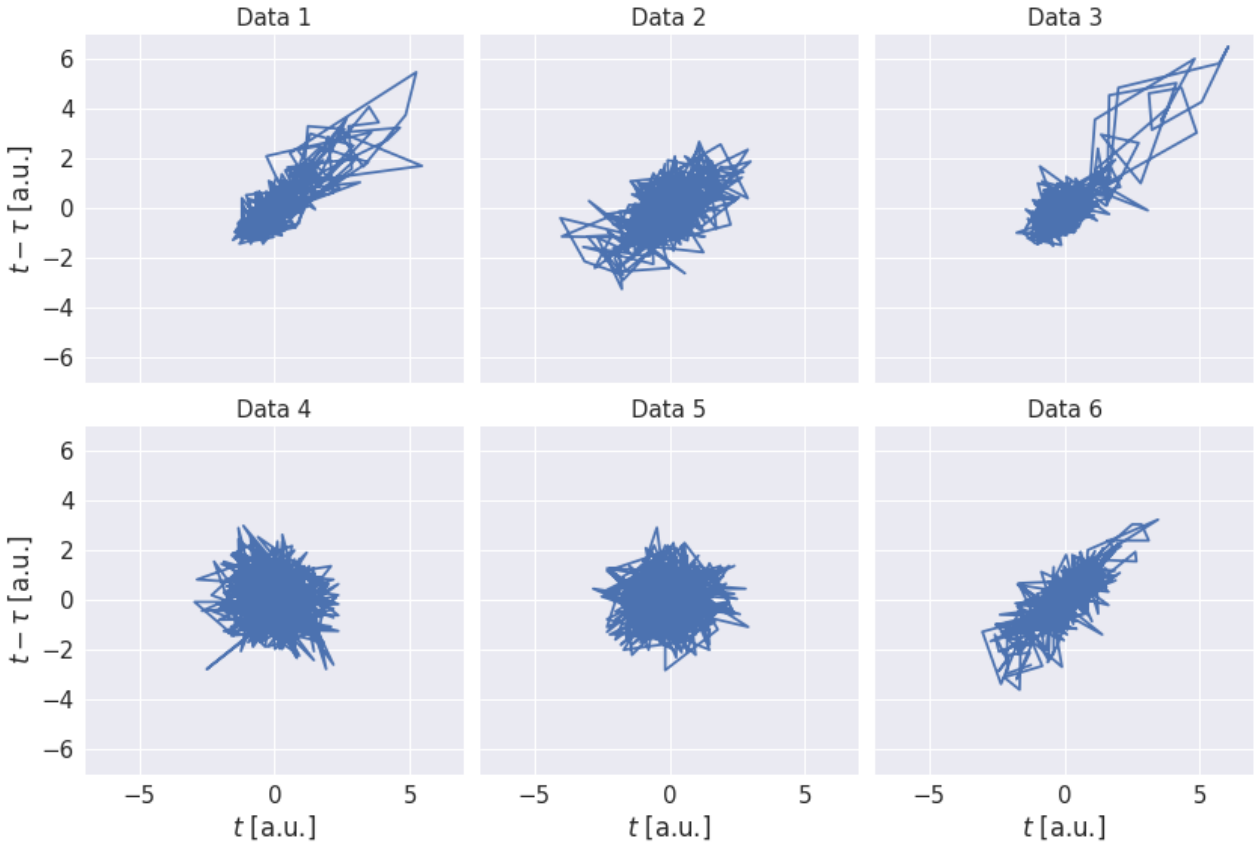
Statistical tests: Attractor Reconstruction

$$\vec{r}(t) = (x(t), x(t-\tau), x(t-2\tau), \ldots, x(t-m\tau))^T$$
$$\approx (x_i, x_{i-1}, x_{i-2}, \ldots, x_{i-m})^T$$

Differentiating between Simulated and Non-Simulated Data

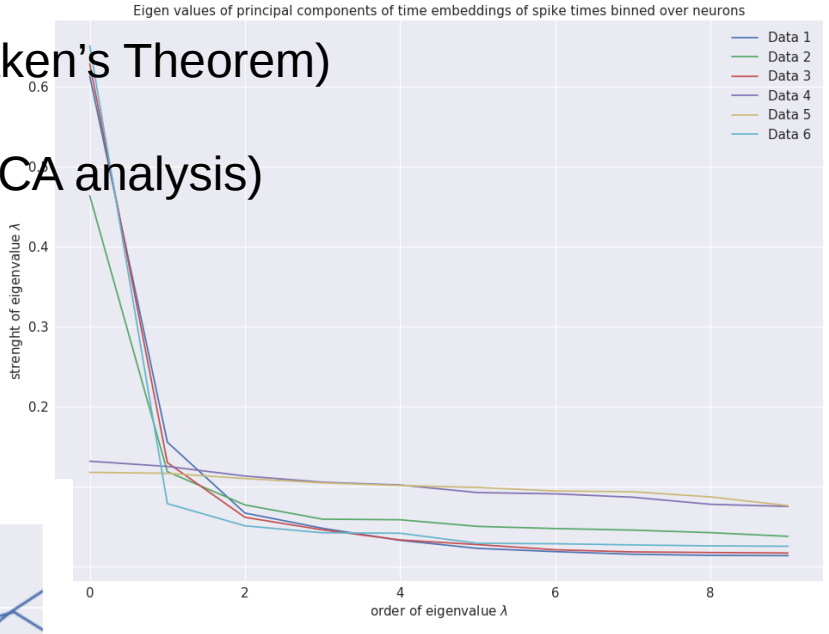
- Using Time embedding for attractor reconstruction (Taken's Theorem)
  - Parameter used: Intantaneous Firing Frequency

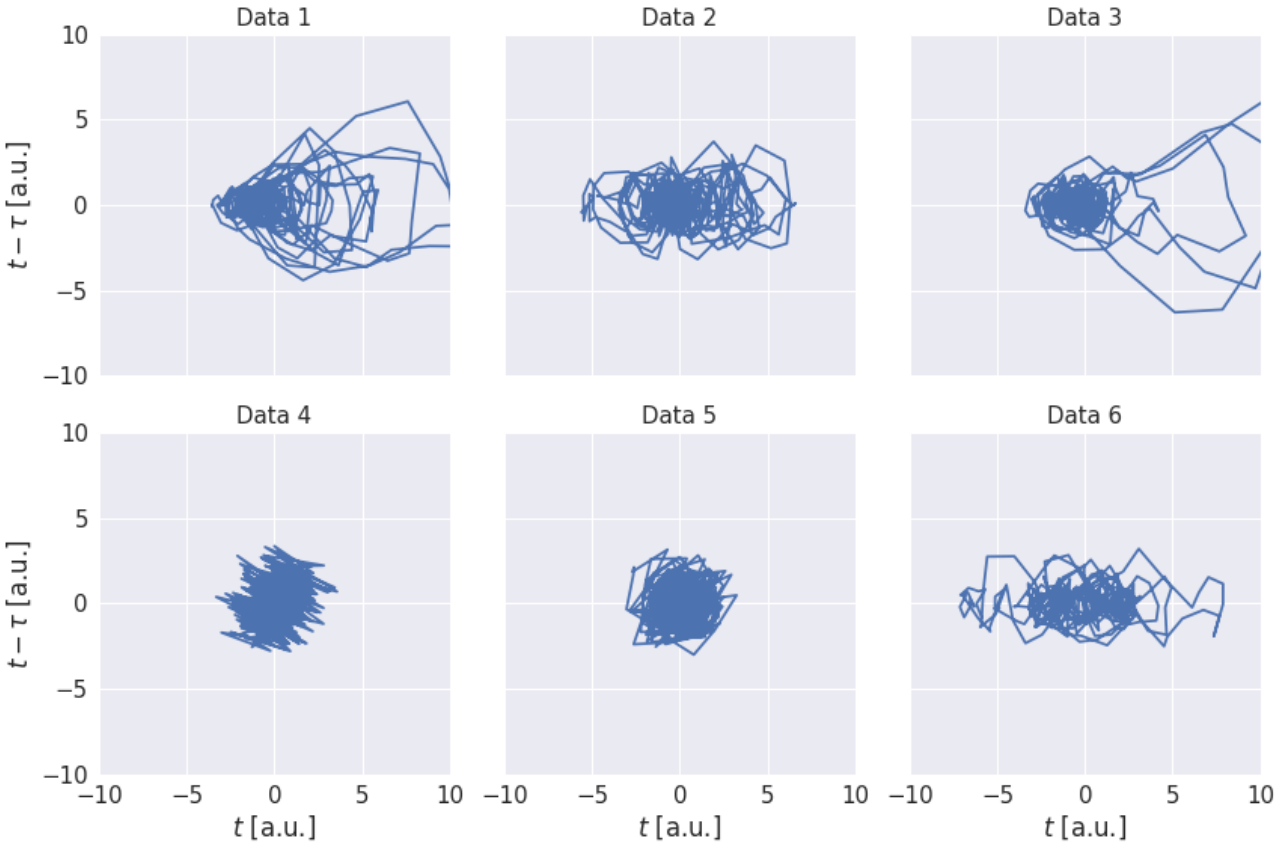




Differentiating between Simulated and Non-Simulated Data

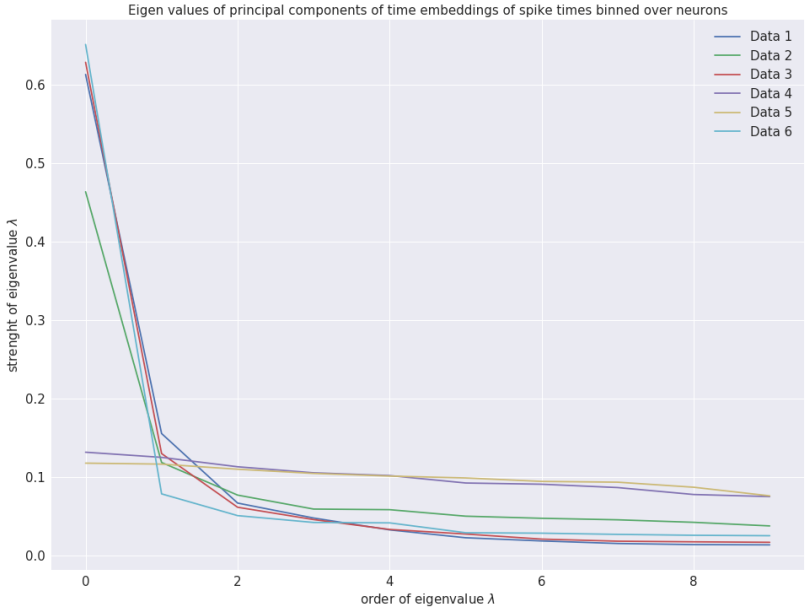
- Using Time embedding for attractor reconstruction (Taken's Theorem)
  - Parameter used: Eigenvalues (calculated through PCA analysis)

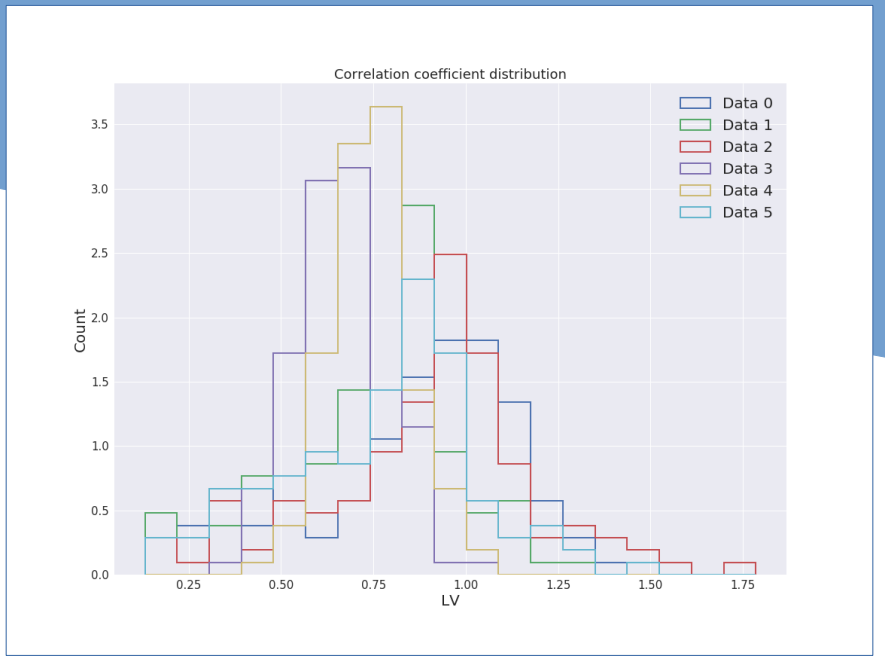




Differentiating between Simulated and Non-Simulated Data

- Using Eigenvalues and the Kolmogorov-Smirnov test





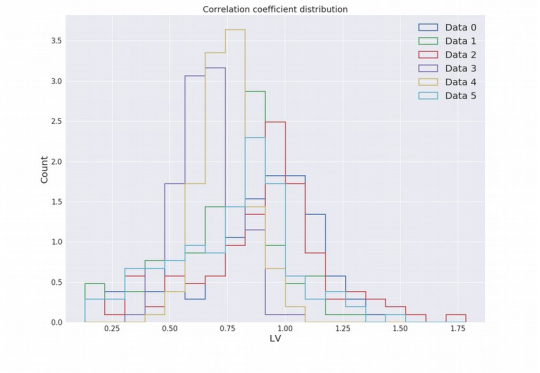
Statistical tests:

Local Coefficient Of Variations

$$LV := \frac{3}{N} \sum_{i=1}^{N-1} \frac{(isi_i - isi_{i+1})^2}{(isi_i + isi_{i+1})^2}$$

Differentiating Between Monkeys

- Comparing the Local Coefficient of Variation Distribution



Conclusions

Data: Monkey 1

Data Set 0

Data Set 2

Data: Monkey 2

Data Set 1

Data Set 5

Data: Simulations

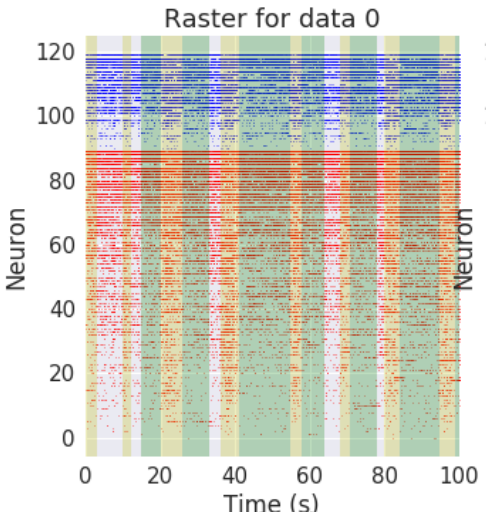
nest::
simulated()

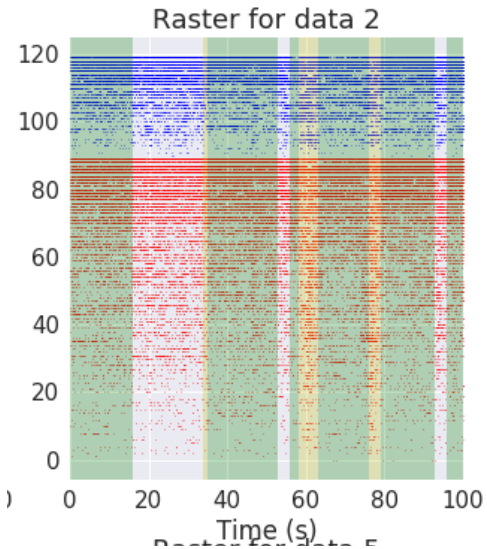
Data Set 3

Data Set 4

Conclusions

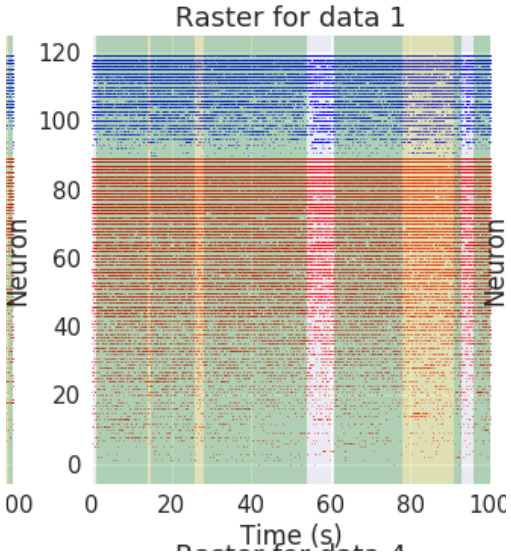
Data: Monkey 1

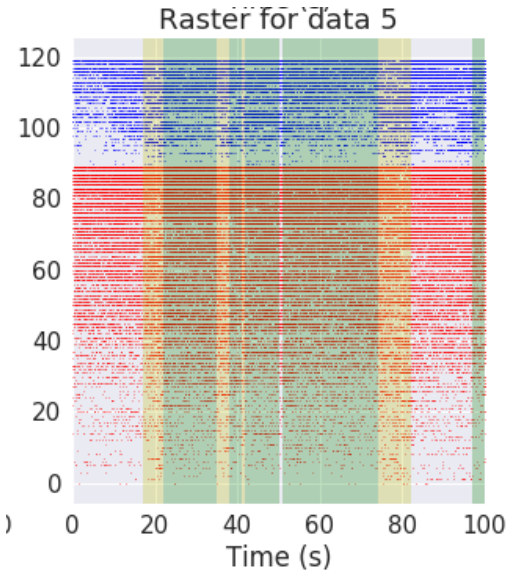




Data Set 0
Data Set 2

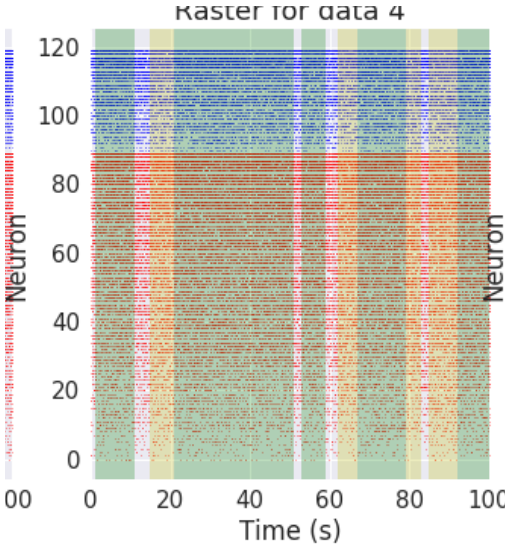
Data: Monkey 2

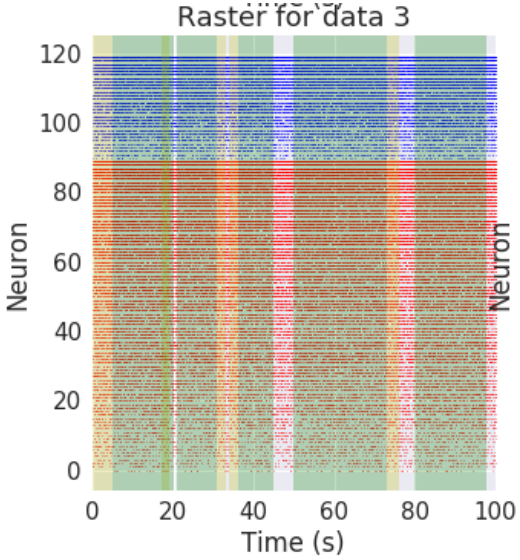




Data Set 1
Data Set 5

Data: Simulations





Data Set 3
Data Set 4

Thank you!