Spring School

Mikko Lehtimaki
Mate Mohacsi
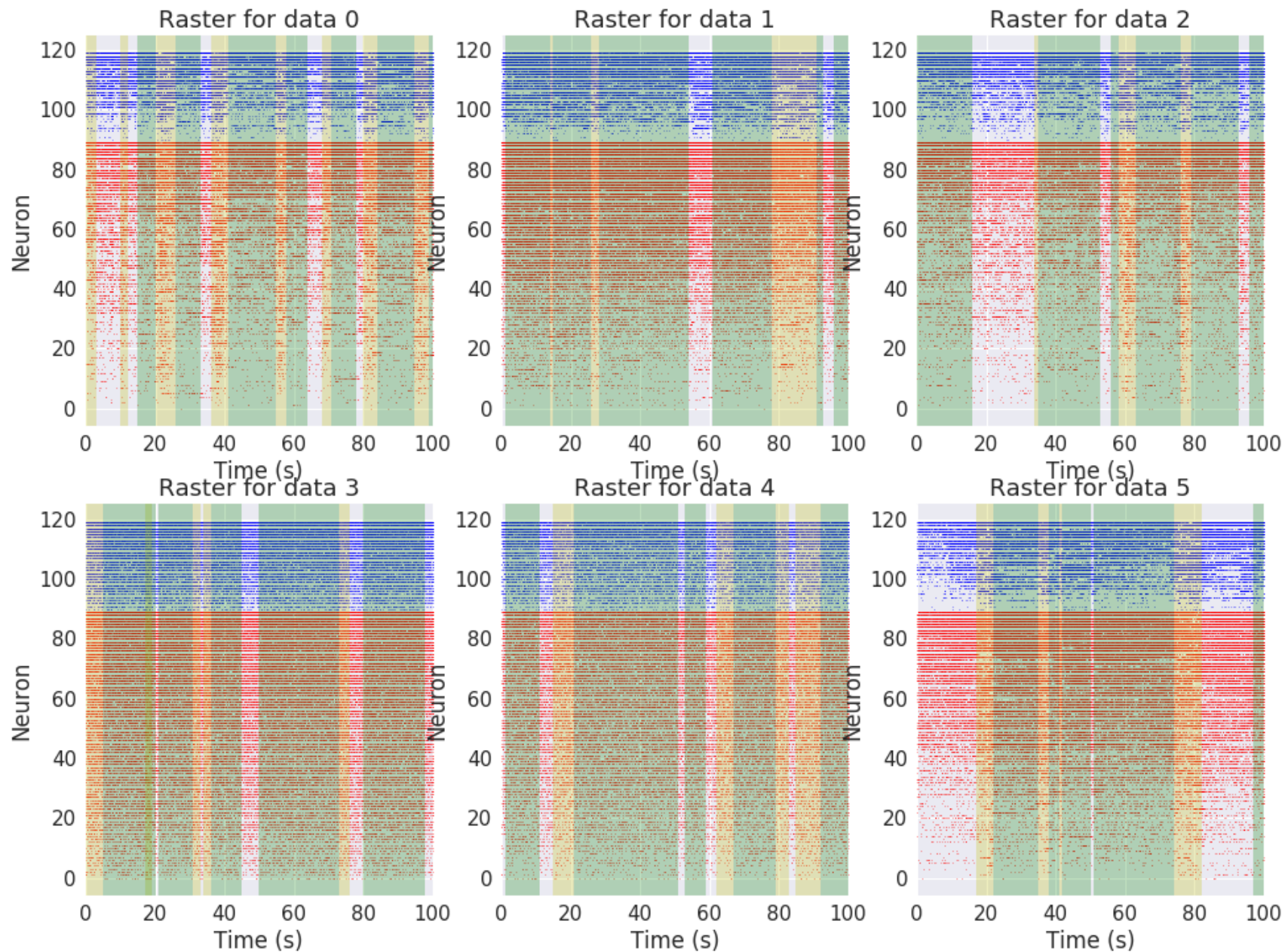**Alex Stasik**
Eduarda Demori Susin

23/02/2018

Data from 2 macaques

motor cortex
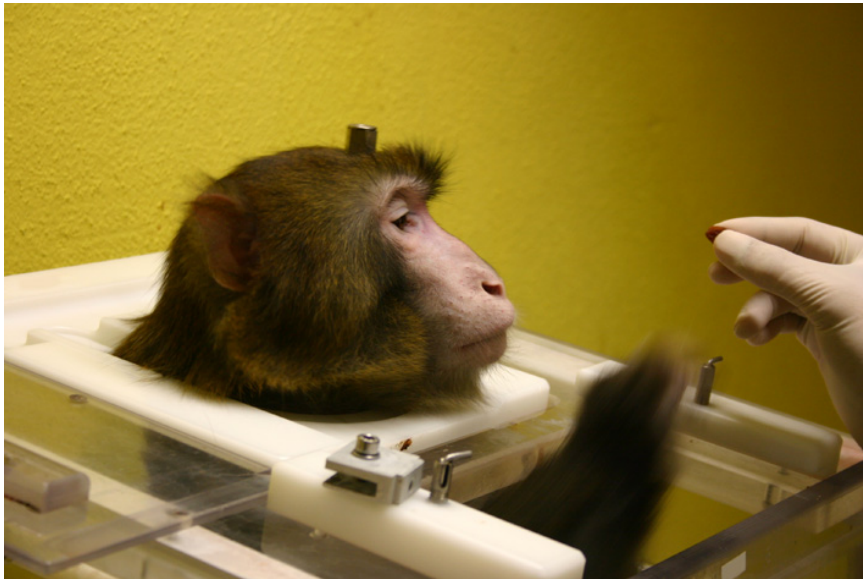
Data generated by a
point-neuron simulation

6 Data Sets: What is What?
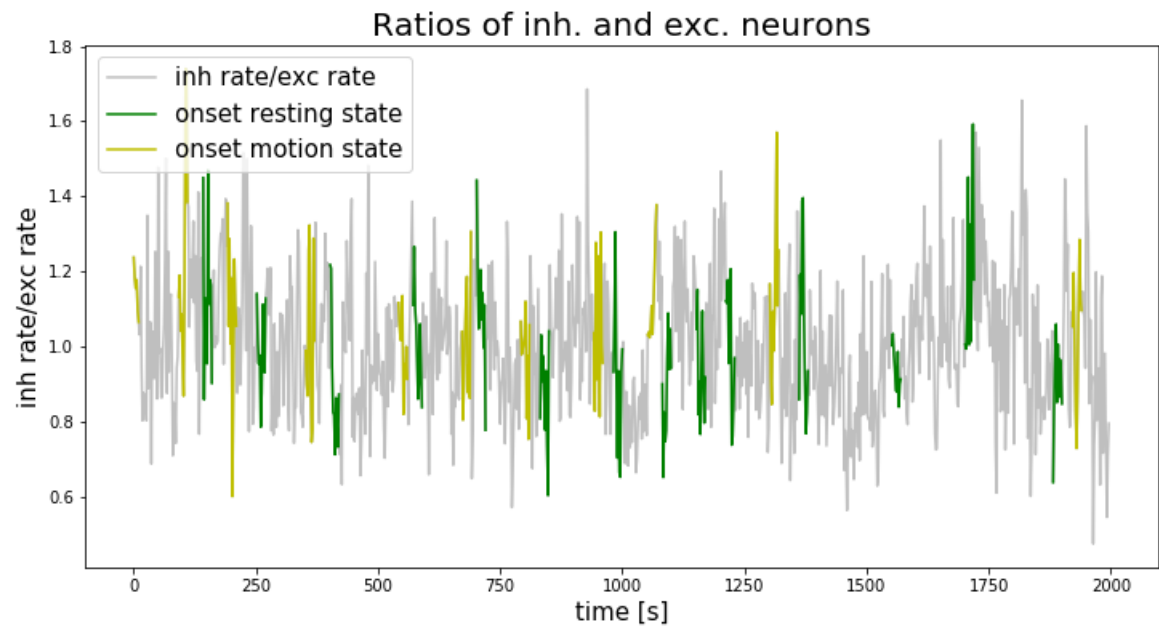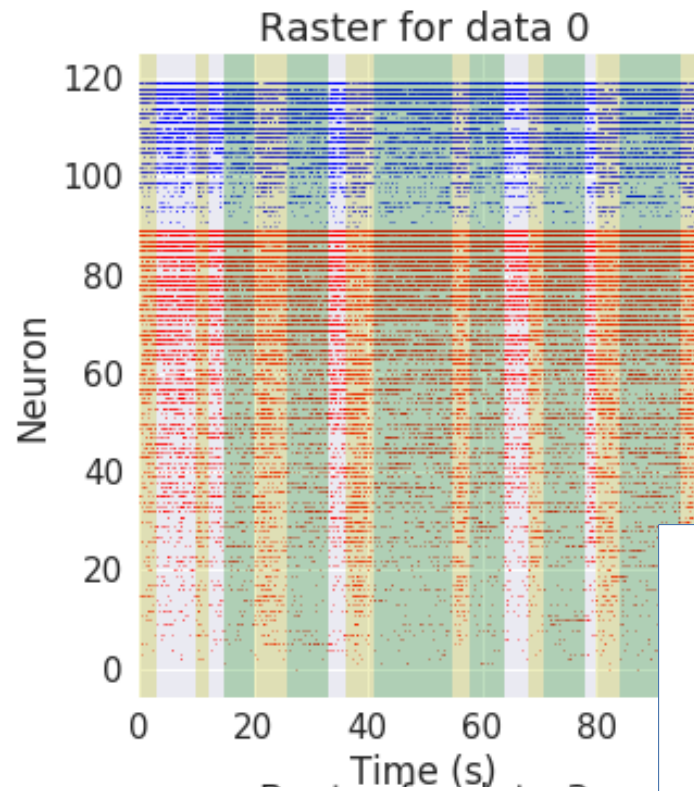

Green: Rest Periods   -Yellow: Moving Periods

6 Data Sets: What is What?

Raster for data 0

Ratios of inh. and exc. neurons

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
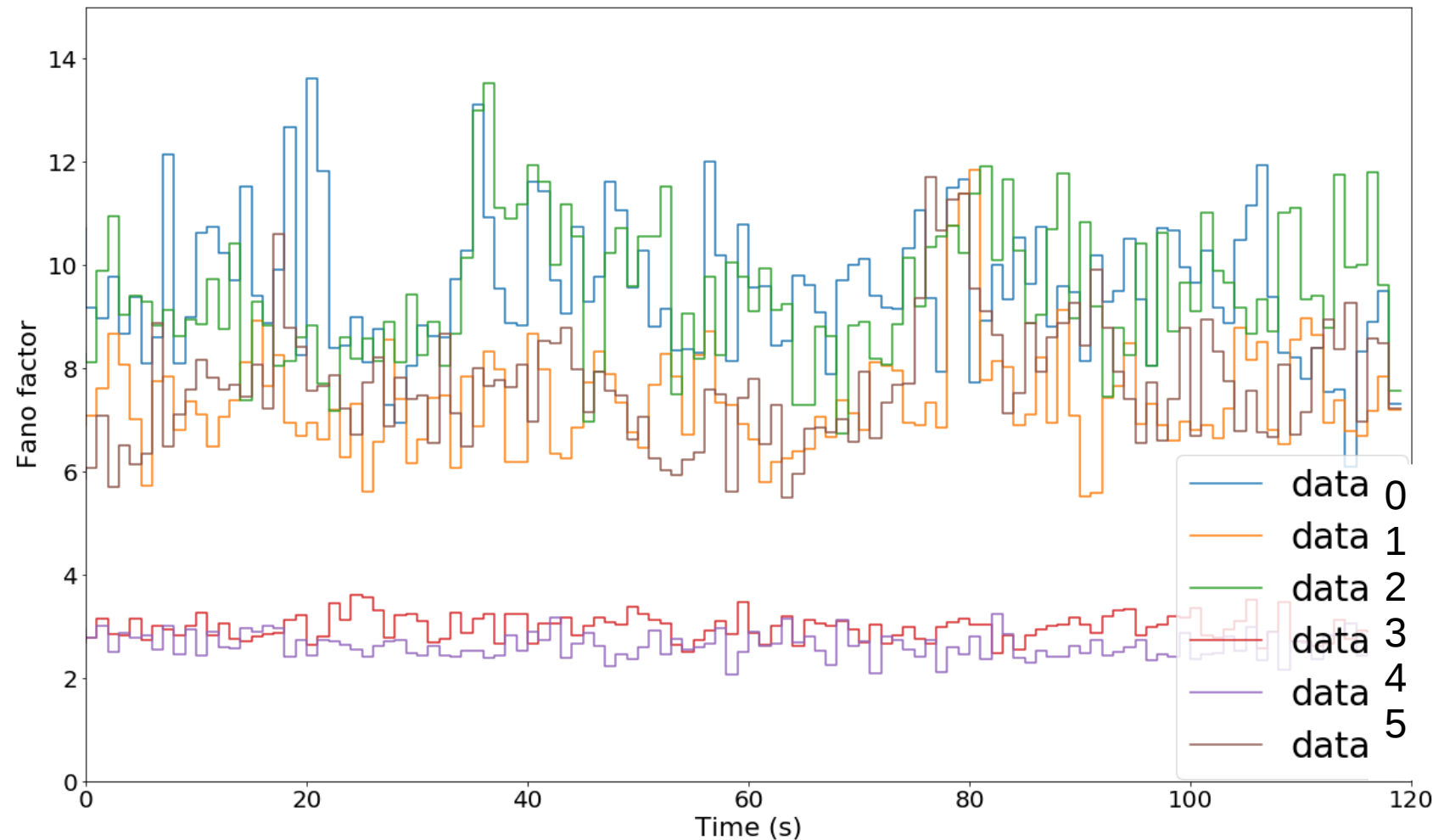
- T-Student Test

- Pearson

- Kruskal

Exploring the Data:
Fano-Factors (time binned)

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

Differentiating Data Sets

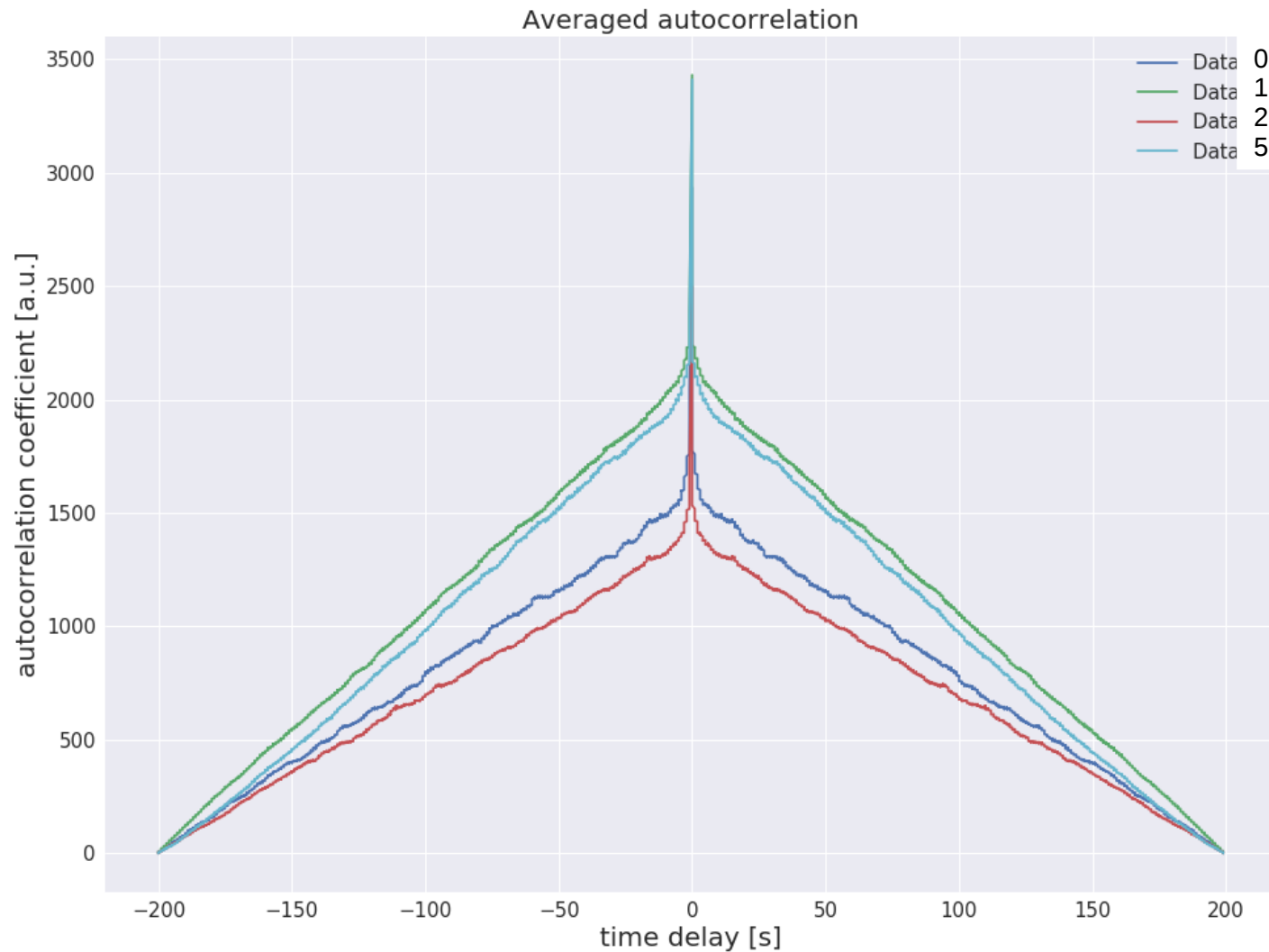■ Comparing Fano-Factors

Fano factor of binned spike trains

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
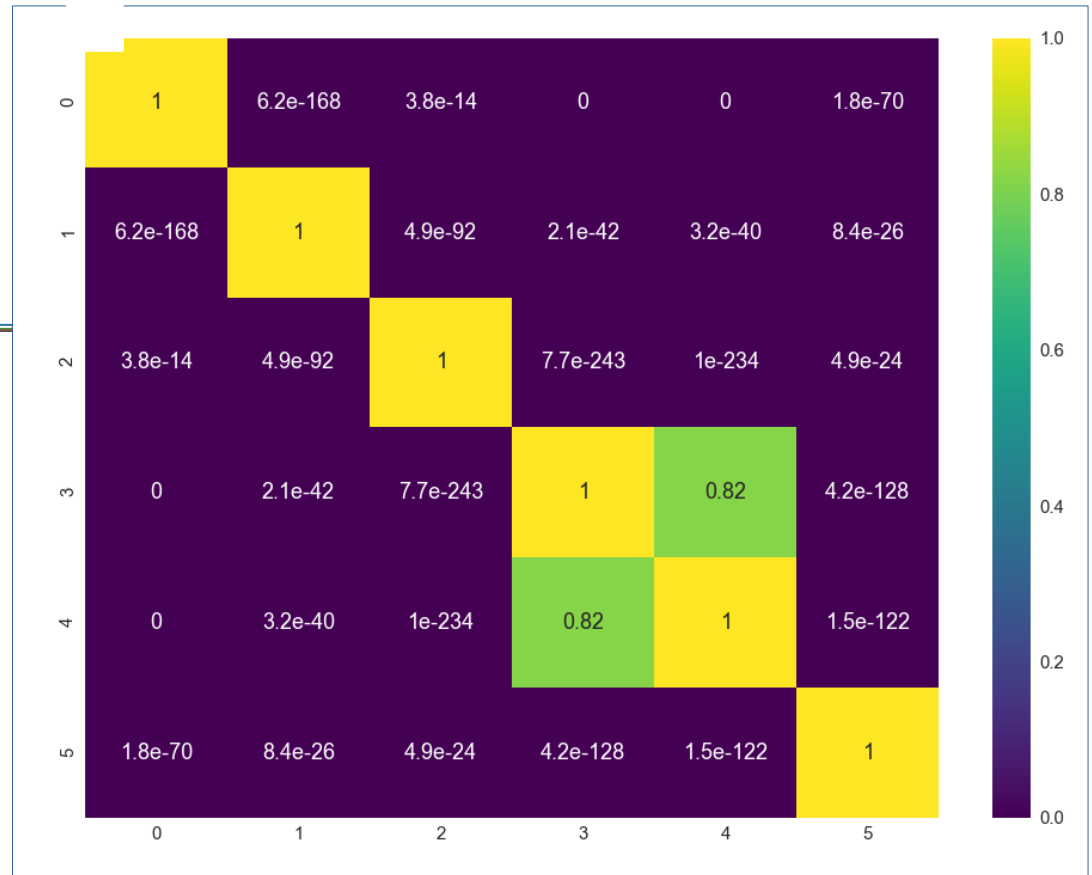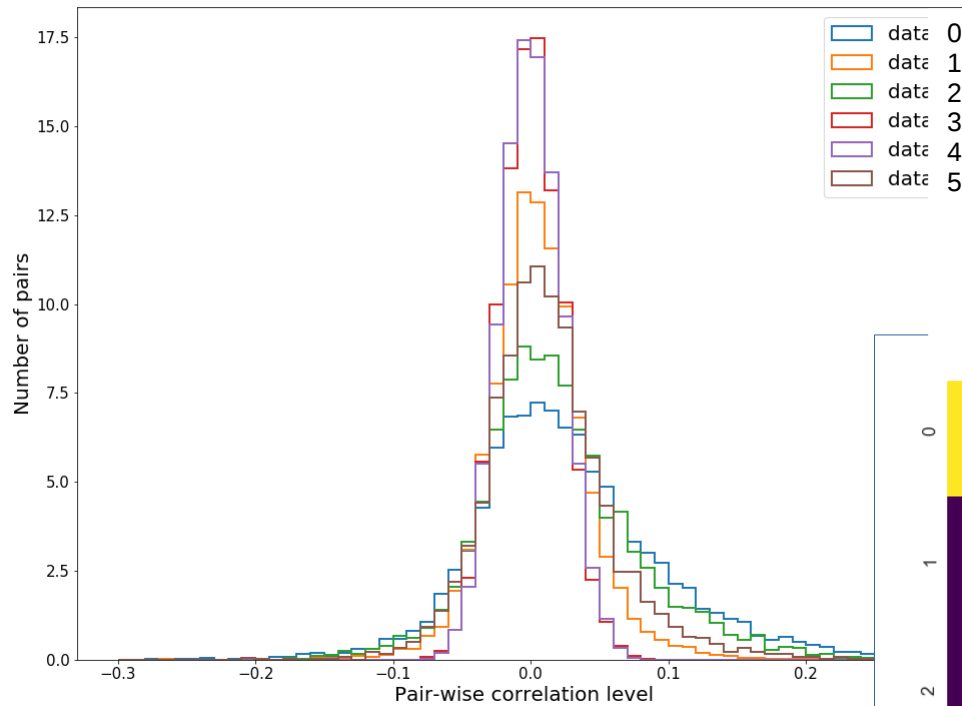 - → Kolmogorov-Smirnov test not robust enough

Averaged autocorrelation

Statistical tests:
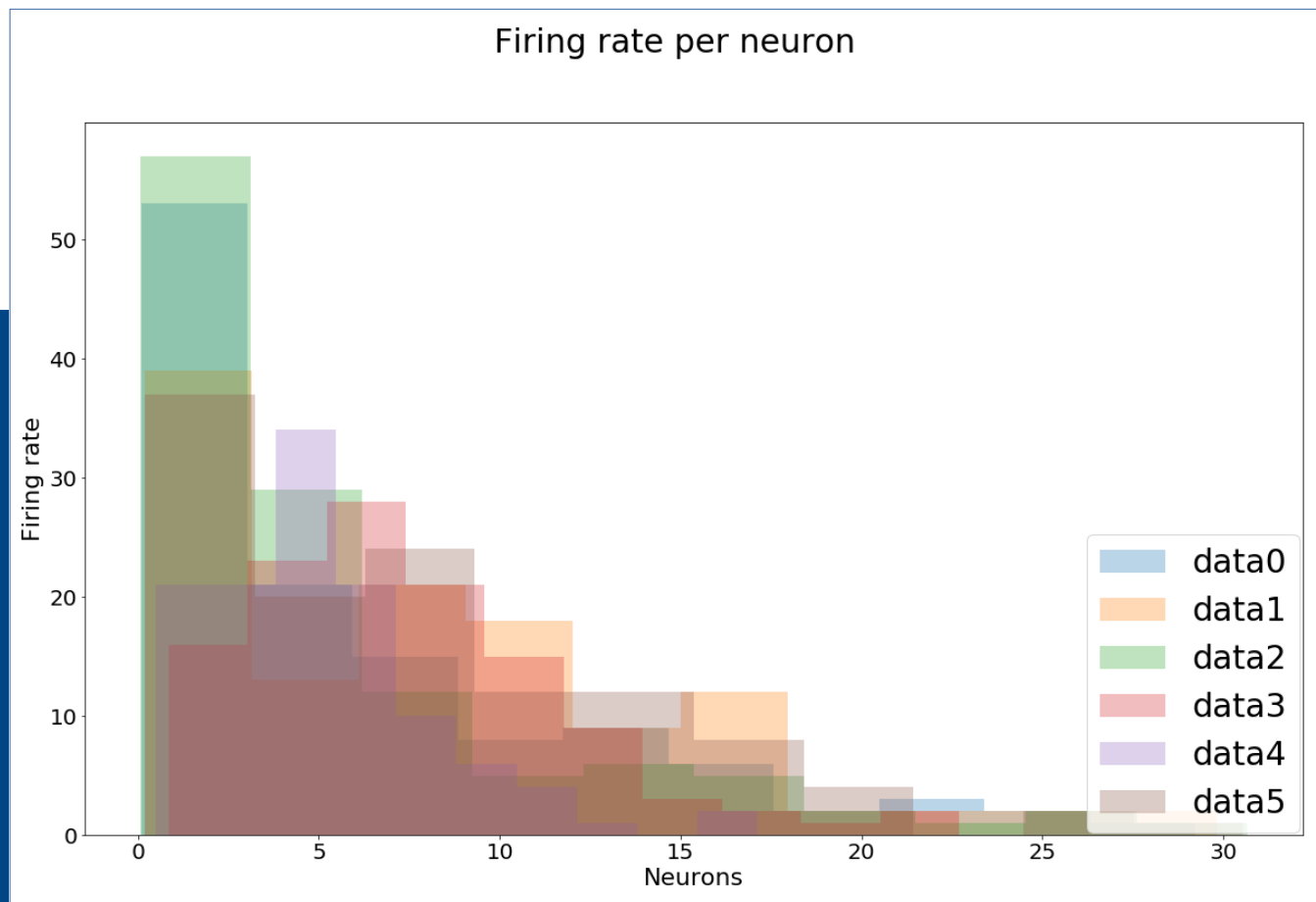# Cross-Correlations Comparisons

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

Differentiating between Simulated and Non-Simulated Data

- Using Pairs-wise Correlations and the Kolmogorov-Smirnov test
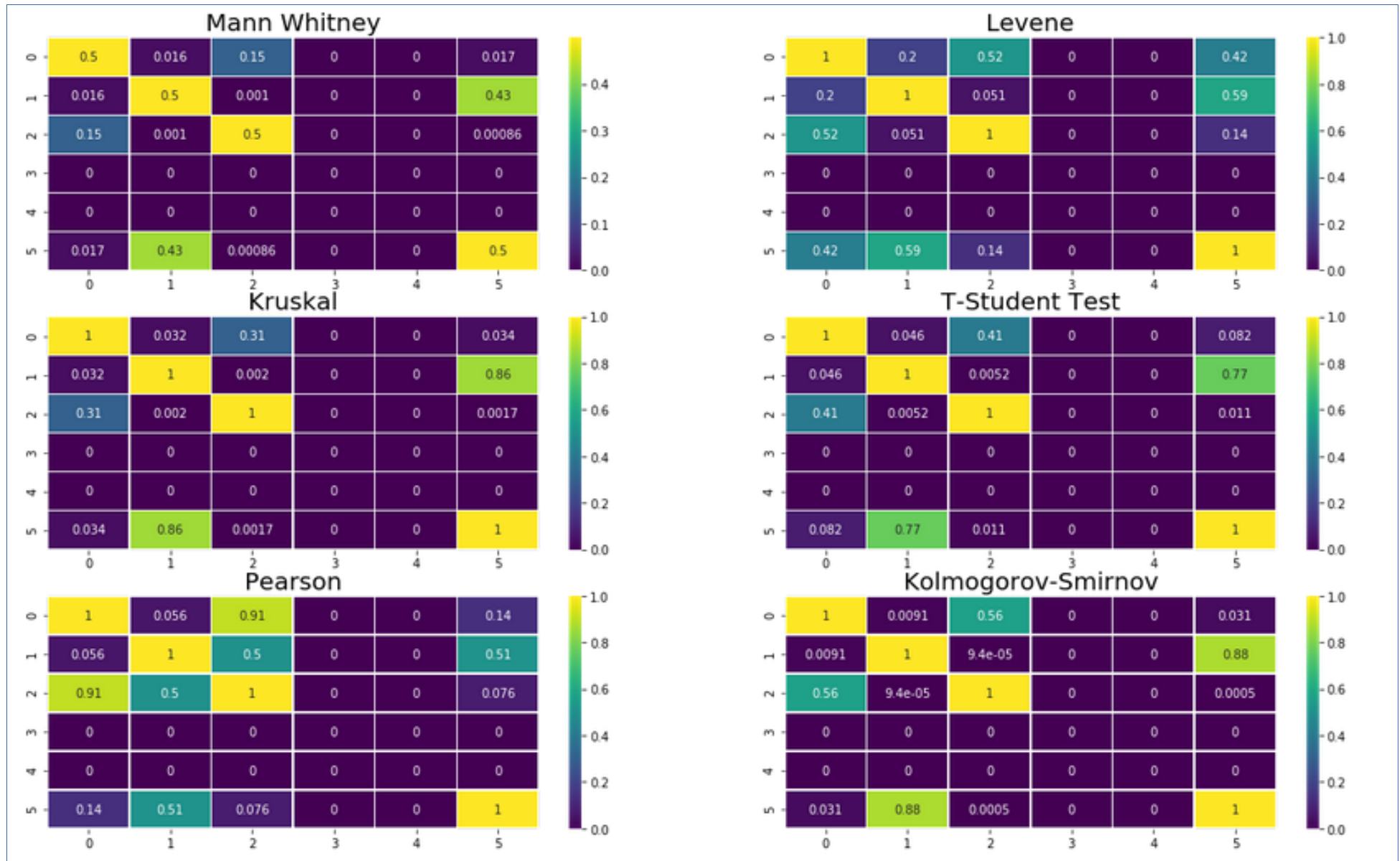
Statistical tests:
Comparing Firing Rate per Neuron

Differentiating Data between the 2 Monkeys

■ Using Frequency per Neuron Distribution and the different statistical tests
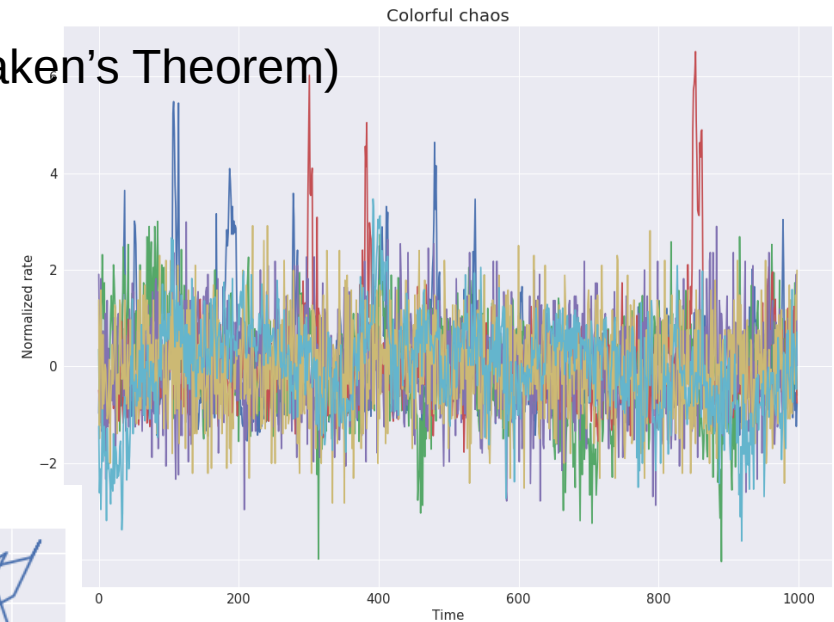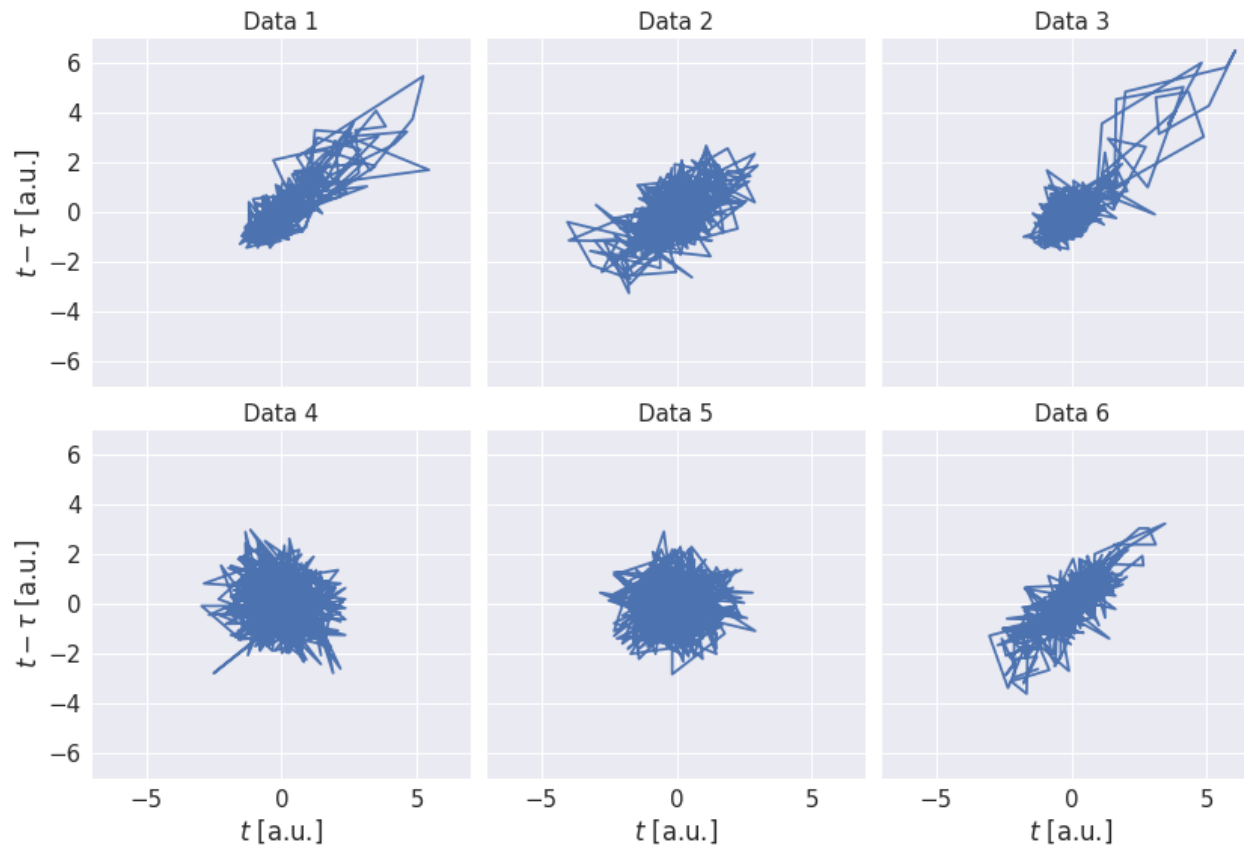
Statistical tests: Attractor Reconstruction

$$\vec{r}(t) = (x(t), x(t - \tau), x(t - 2\tau), \ldots, x(t - m\tau))^T$$

$$\approx (x_i, x_{i-1}, x_{i-2}, \ldots, x_{i-m})^T$$

Differentiating between Simulated and Non-Simulated Data

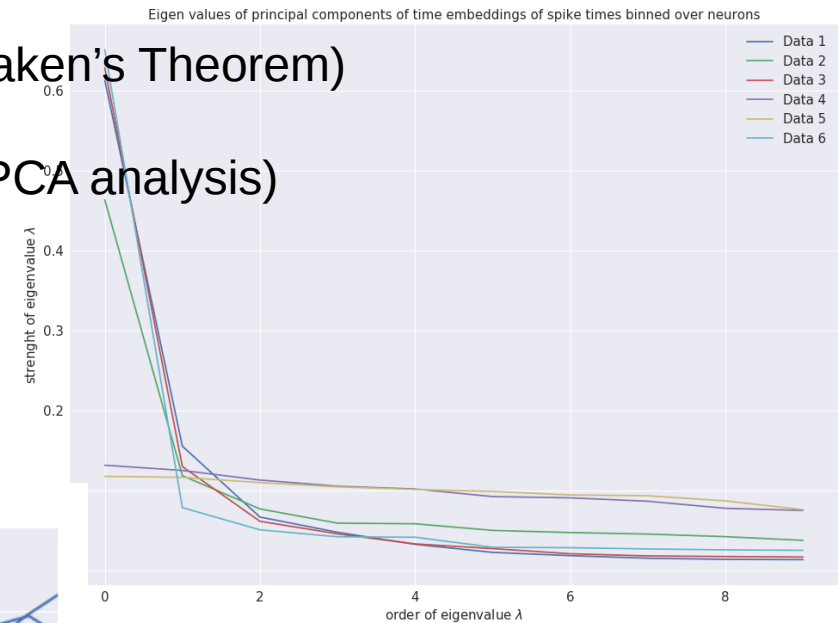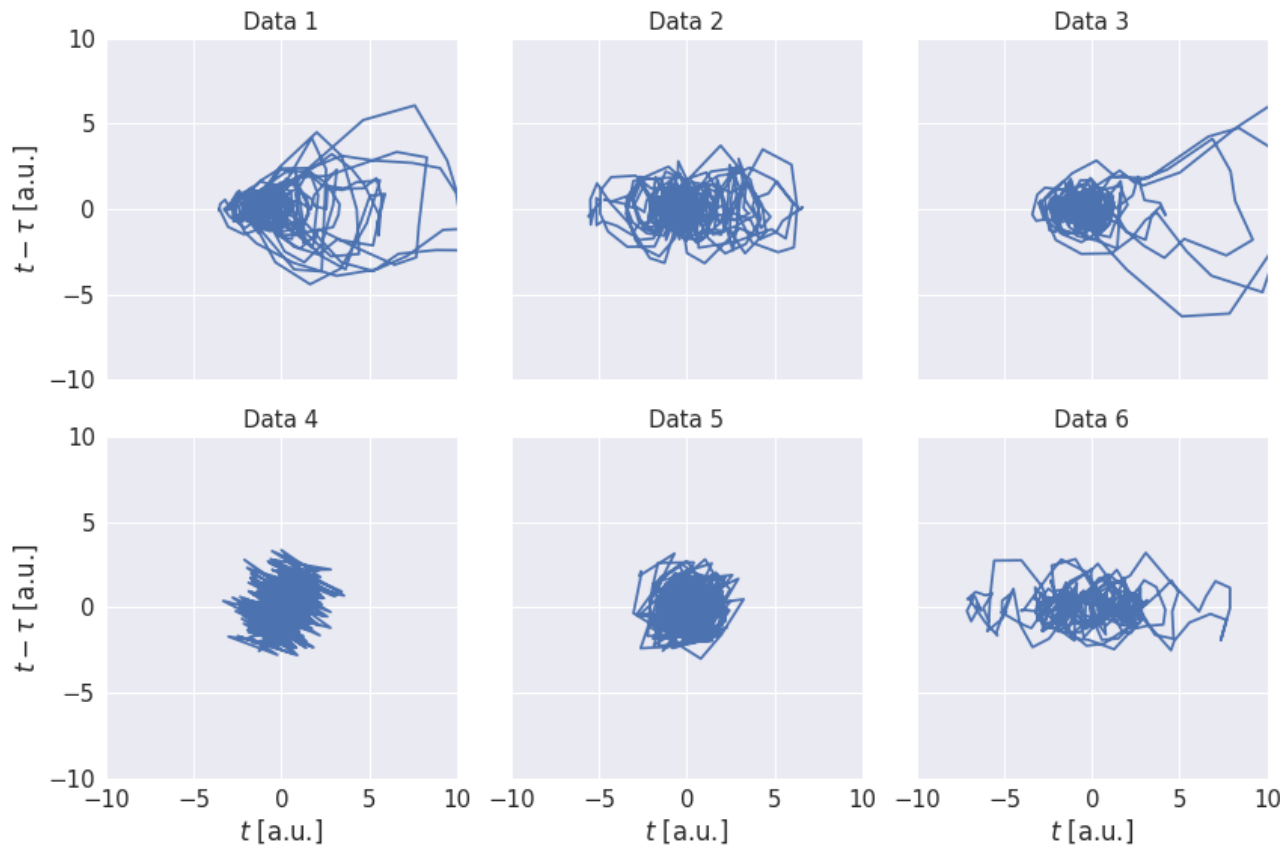- Using Time embedding for attractor reconstruction (Taken's Theorem)

  - Parameter used: Intantaneous Firing Frequency

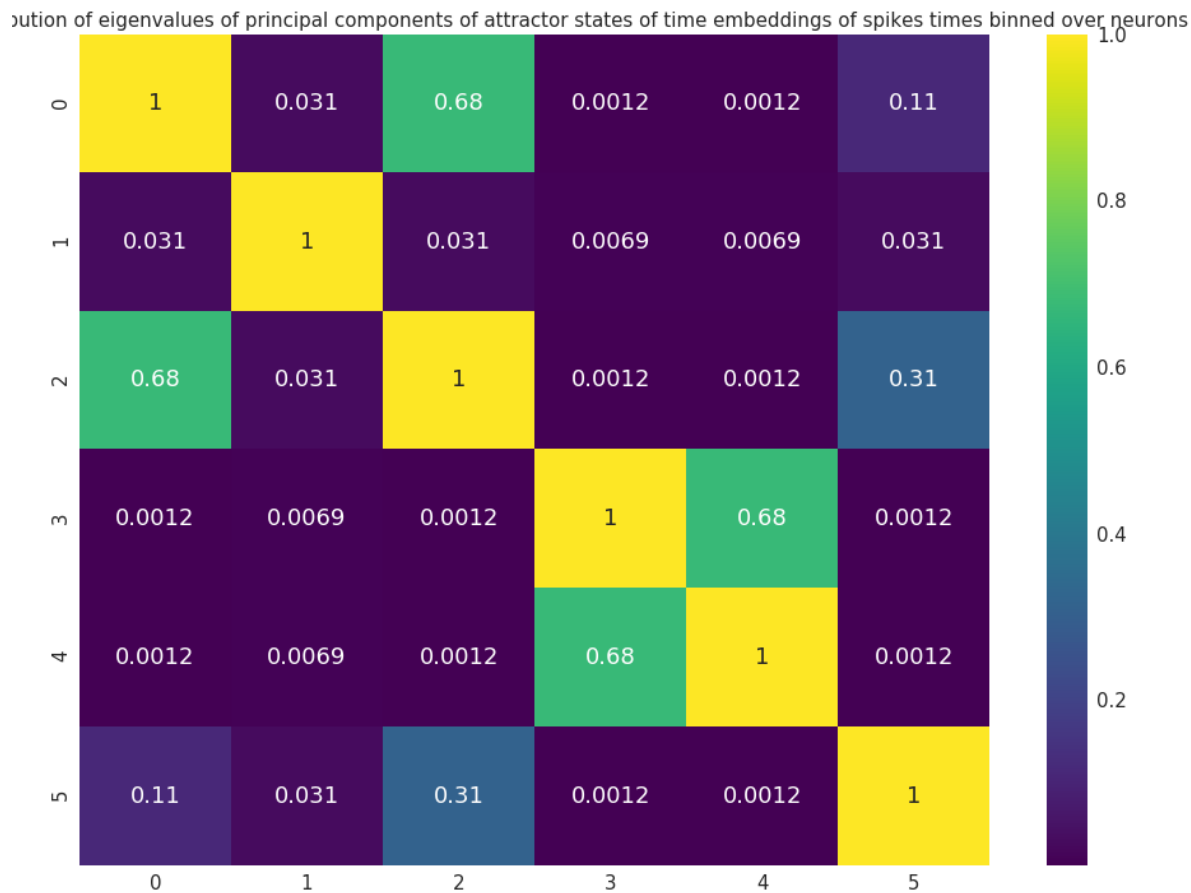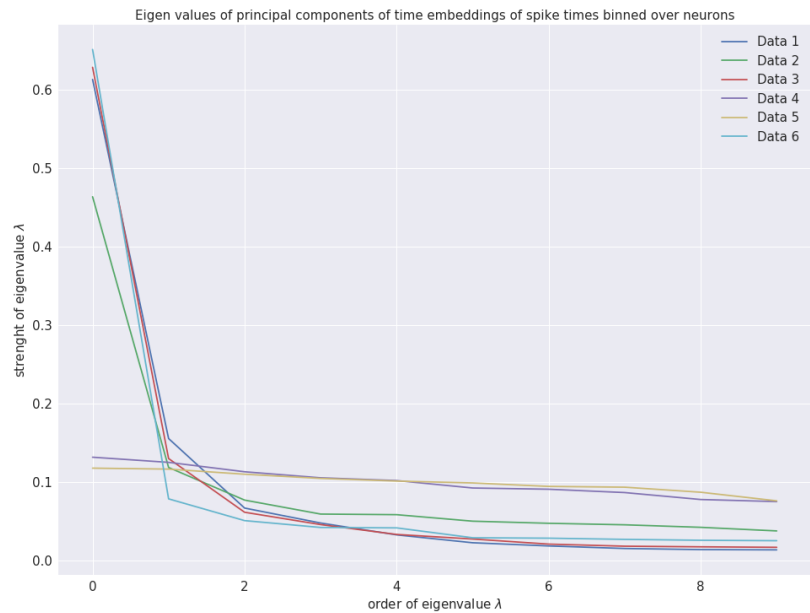# Differentiating between Simulated and Non-Simulated Data

■ Using Time embedding for attractor reconstruction (Taken's Theorem)

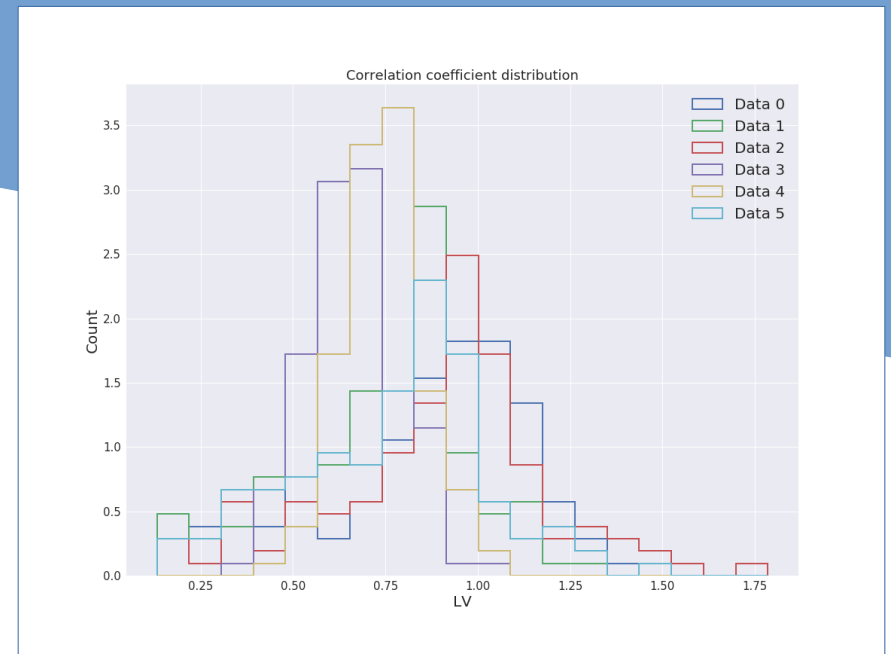■ Parameter used: Eigenvalues (calculated through PCA analysis)

Differentiating between Simulated and Non-Simulated Data

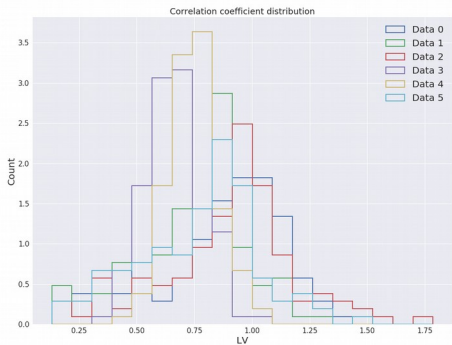■ Using Eigenvalues and the Kolmogorov-Smirnov test

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 2

Data: Monkey 1

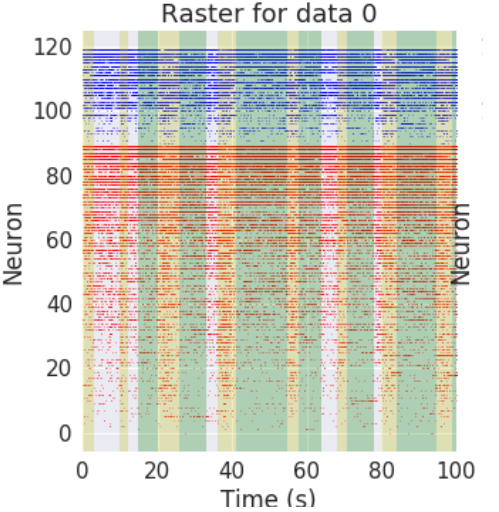Data: Simulations

nest::
simulated()

Data Set 3

Data Set 4

Data Set 0

Data Set 2
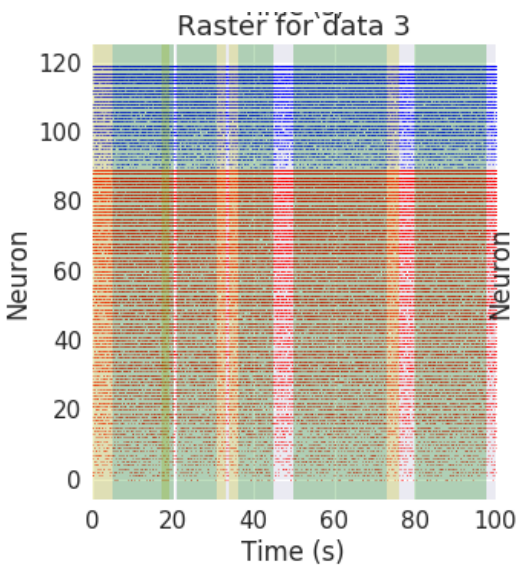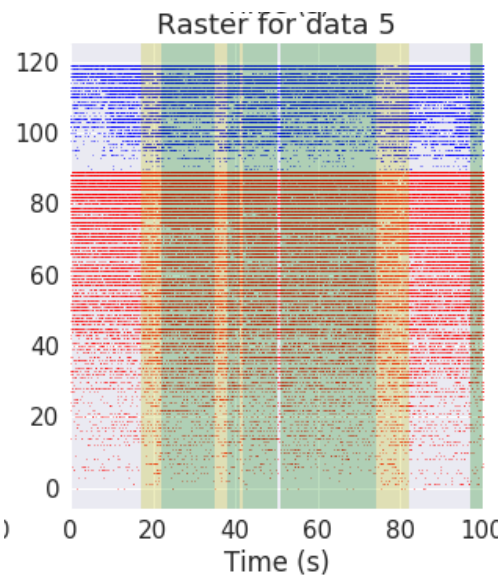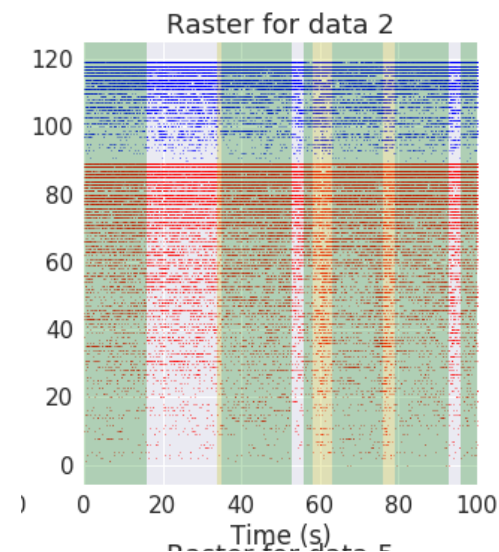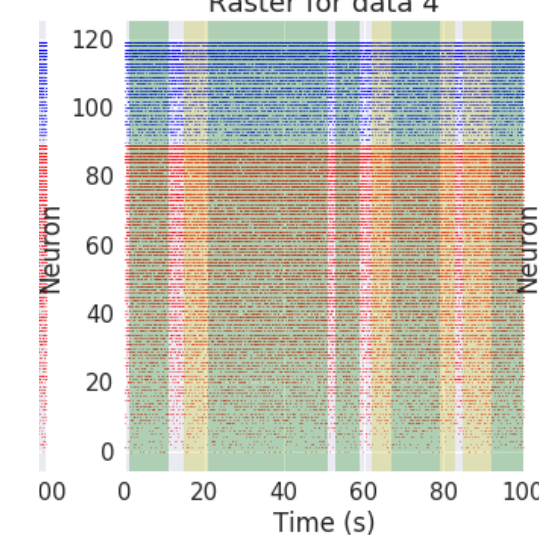
Data Set 1

Data Set 5

Conclusions

Data: Monkey 1

Data: Monkey 2
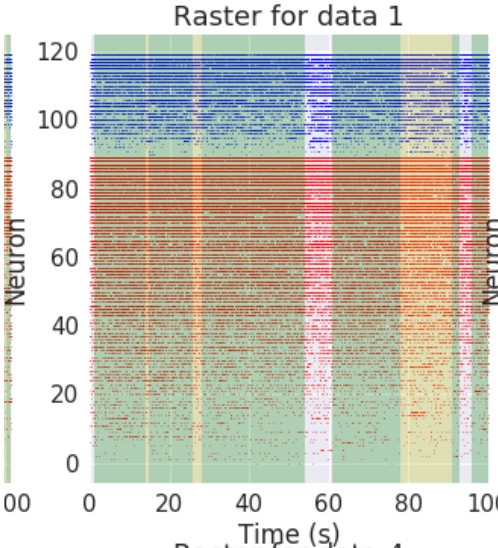
Data: Simulations

Data Set 0
Data Set 2

Data Set 1
Data Set 5

Data Set 3
Data Set 4

Thank you!