Spike Extraction and Stimulus Decoding in the Primary Visual Cortex

Anatoly Buchin and Reza Eghbali

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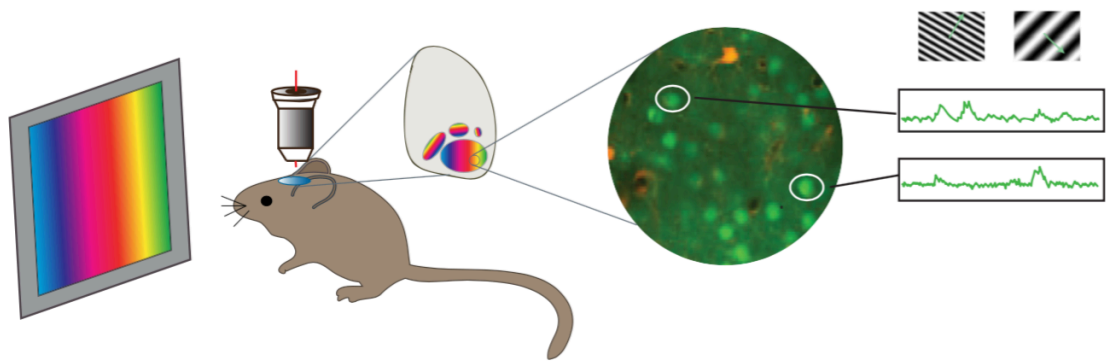
Introduction

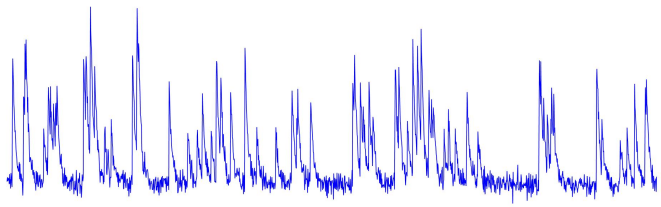
- The Brain is noisy, so are the measurements
- What is the noise? What is the signal?



[Neil et al. 2011]

Outline

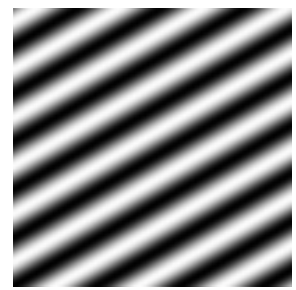
- Spike extraction from the Ca signal in mice V1



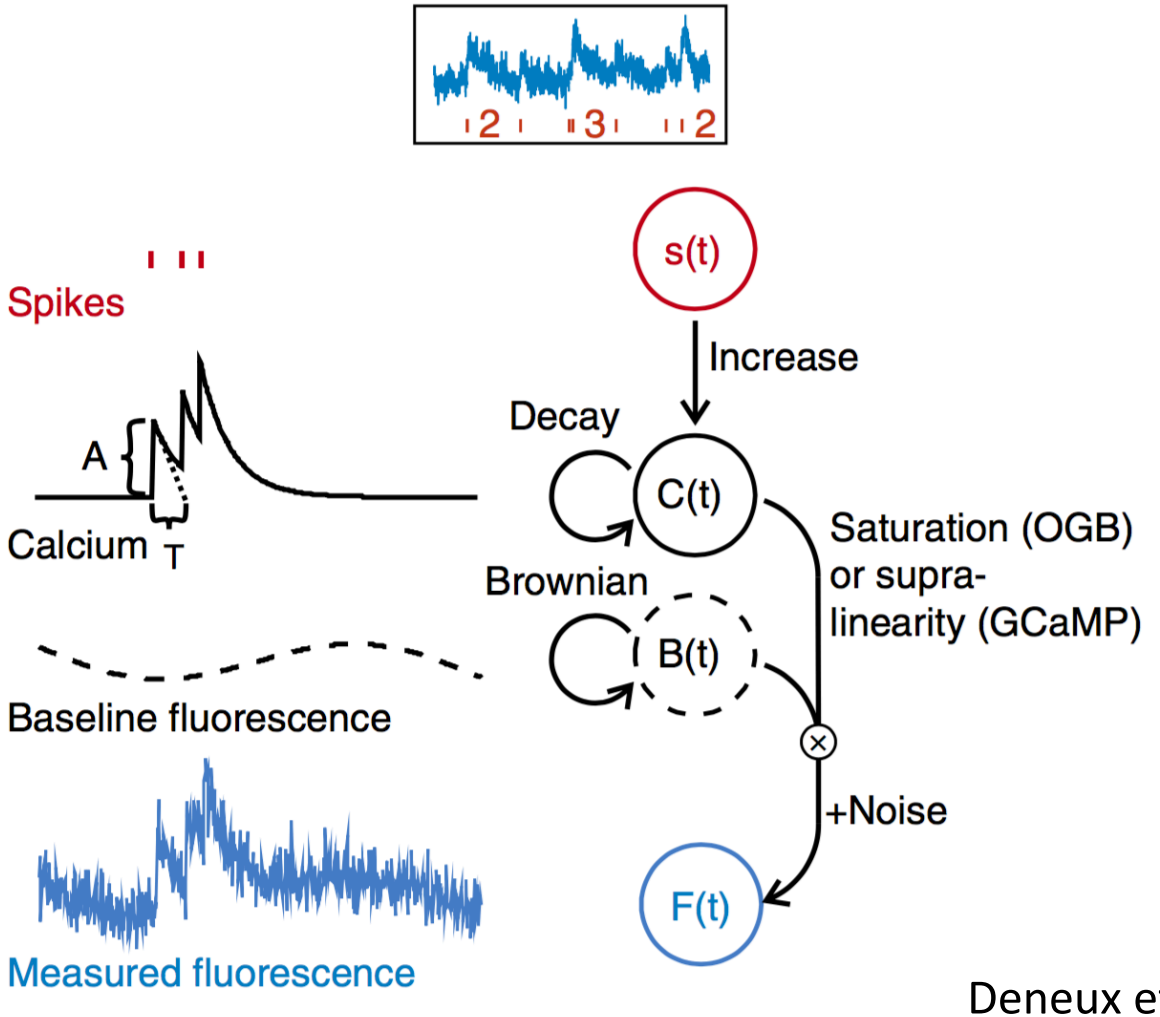
00100101110110100101O

- Decoding of drifting grating orientation

00100101110110100101O

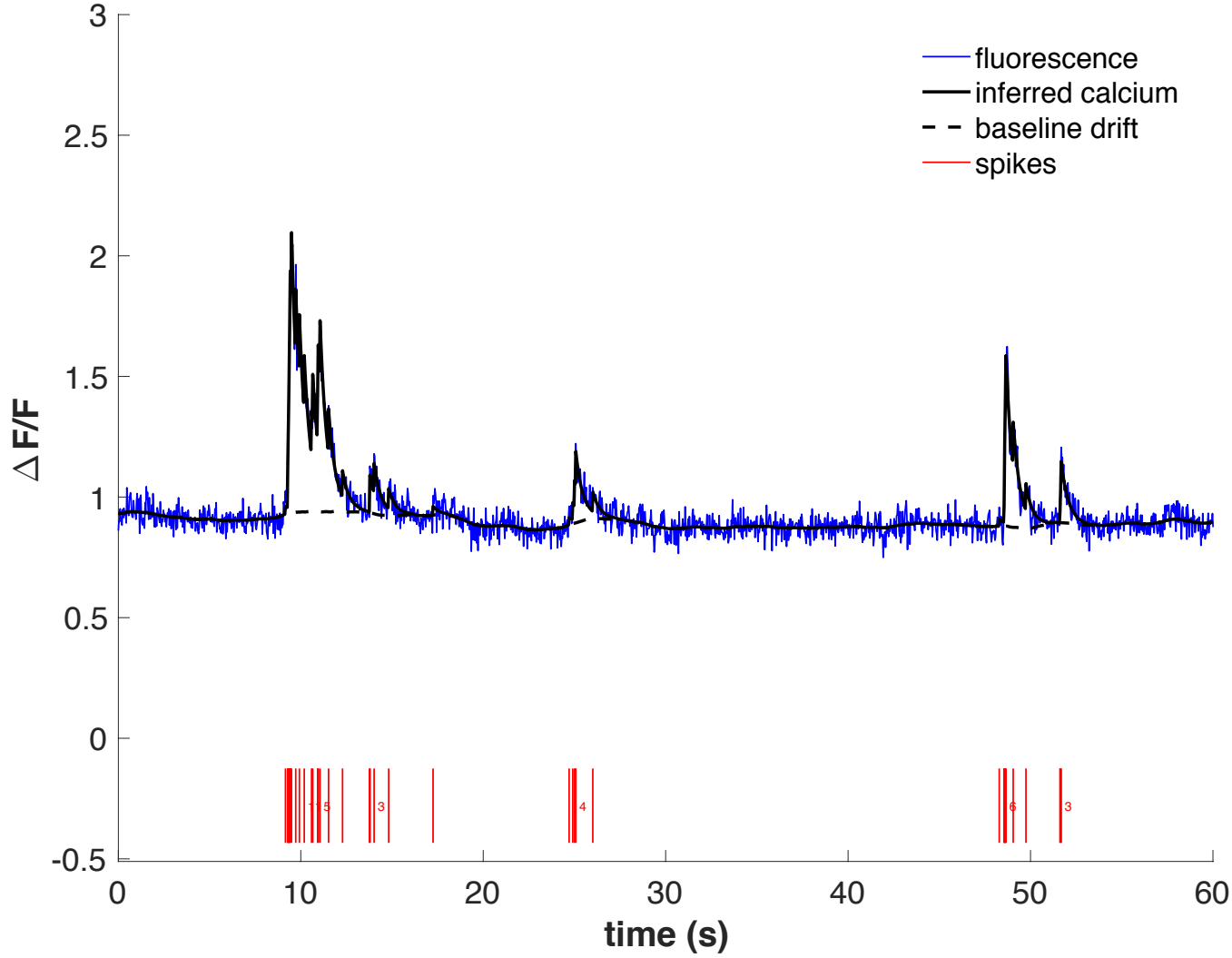


Spike inference algorithm: ML spike



Deneux et al. 2016

Spike inference results



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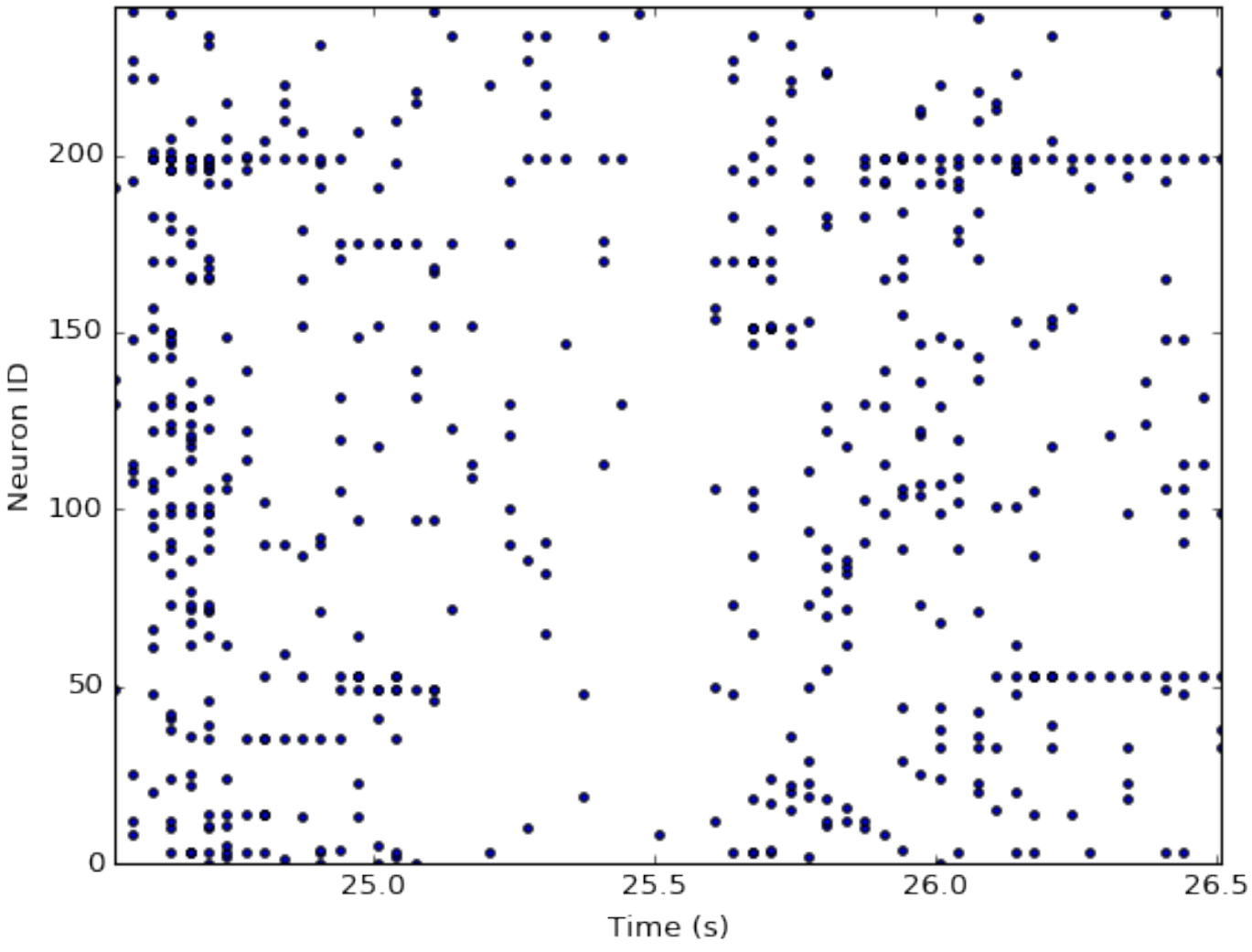

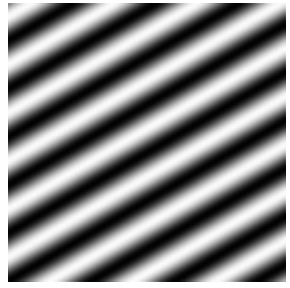

stimulus

Decoding the Direction

- SVM classifier for decoding direction of drifting gratings
- Shuffled over different repeats of the stimulus.

stimuli			
direction	tf (Hz)	cell_1	cell_2
90°	2	4	2
90°	2	3	0
90°	2	0	1
90°	2	2	2

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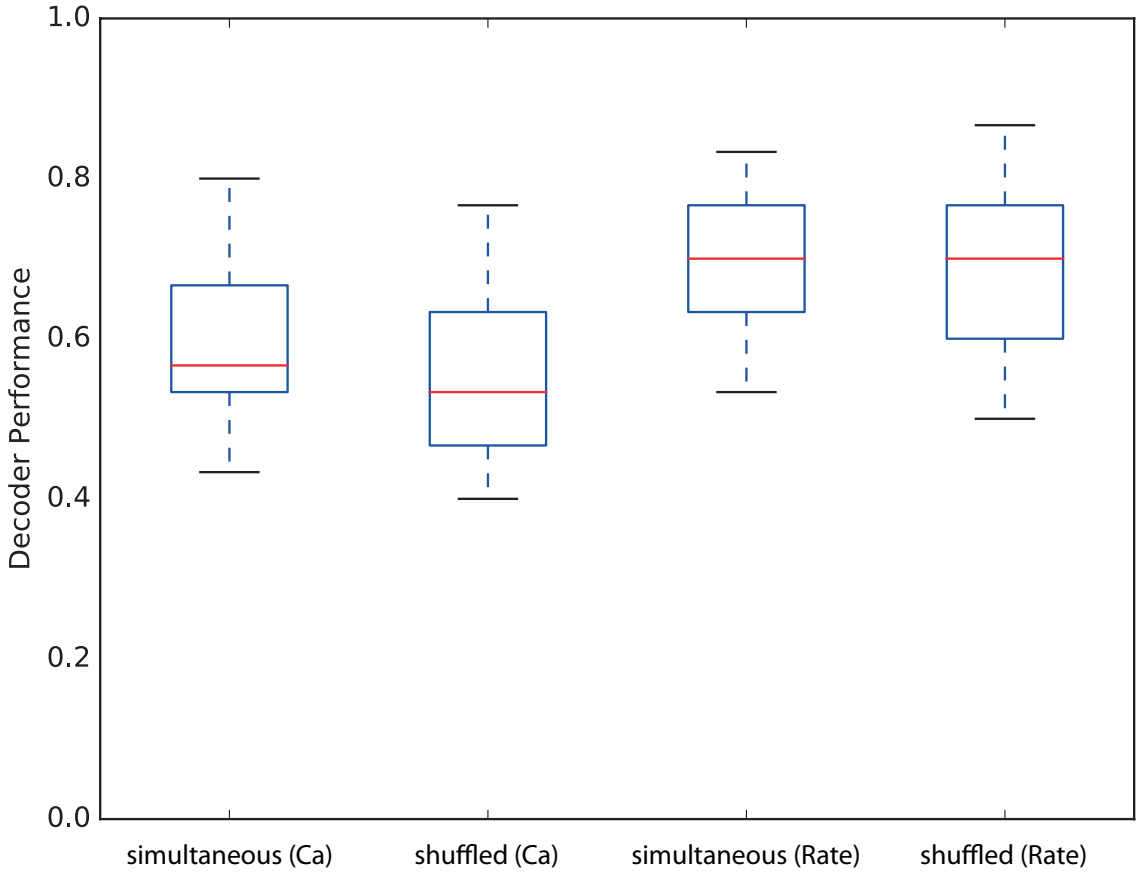
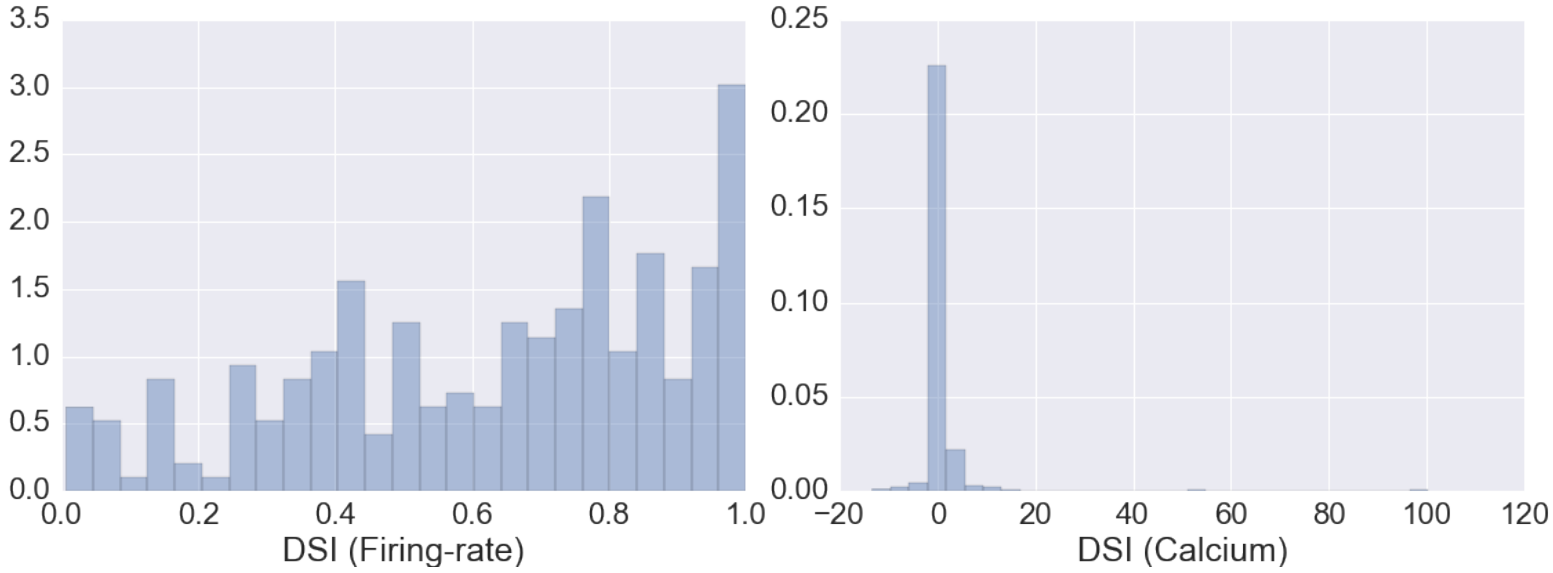
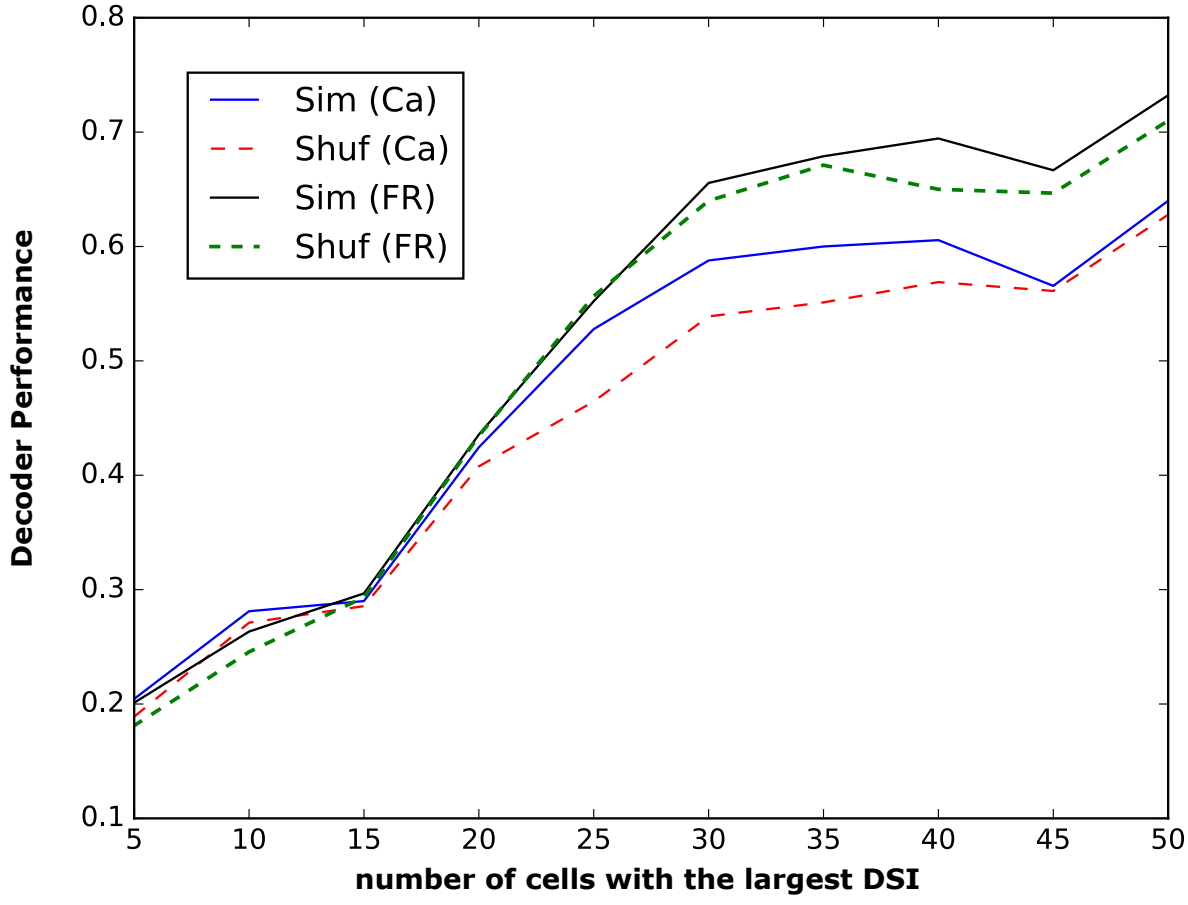


Direction Selectivity Index

$$\mathrm{DSI} = \frac{R_{\mathrm{pref}} - R_{\mathrm{null}}}{R_{\mathrm{pref}} + R_{\mathrm{null}}}$$

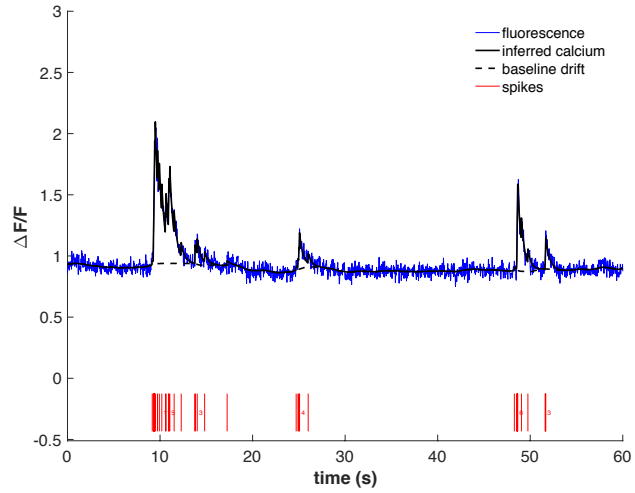


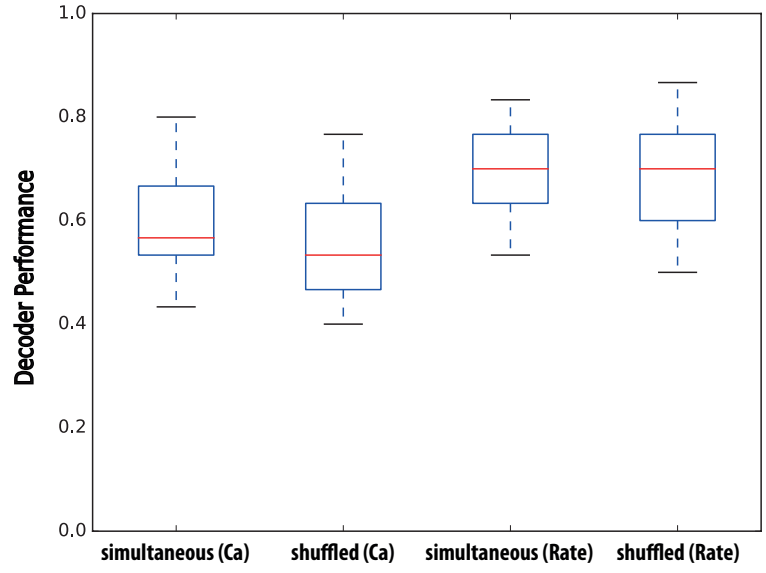
- Use the k cells with the largest DSI to decode direction.



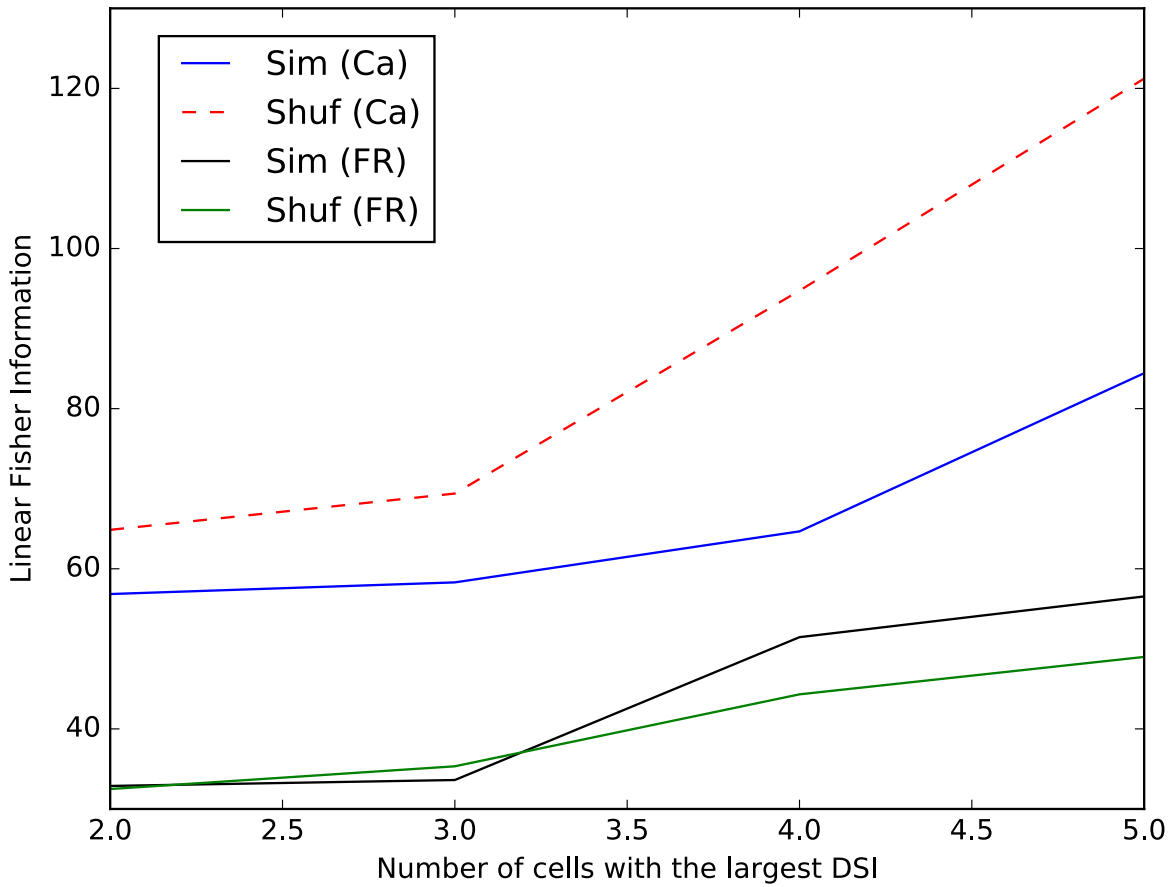
Conclusions

- Spike trains could be efficiently inferred from noisy Ca-imaging
- Rate-based decoding is ~10% more accurate than Ca-based
- Trial-shuffling does not significantly change the decoder performance





Linear Fisher Information



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