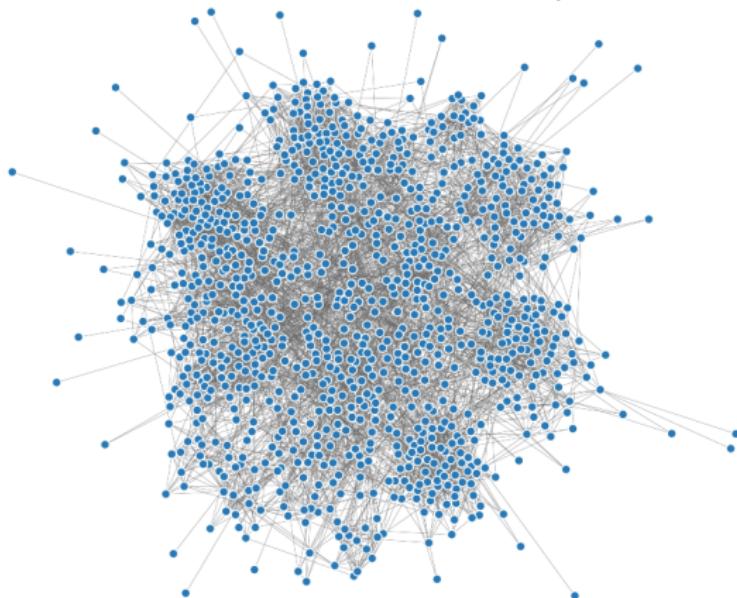


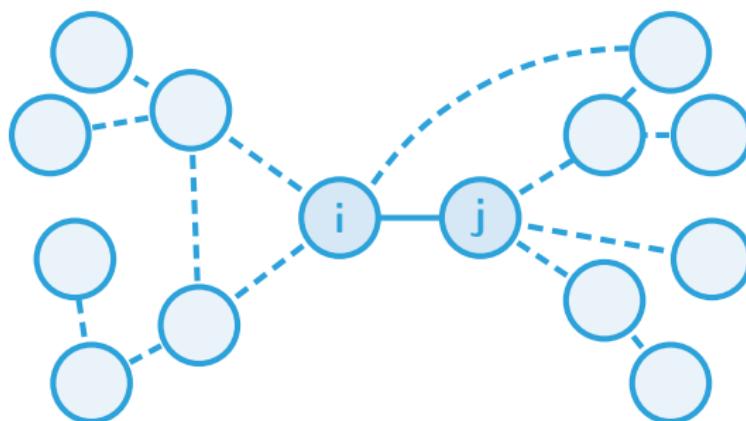
# Simple connectome inference from partial correlation statistics in calcium imaging

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Gilles Louppe, Damien Ernst and Pierre Geurts (aka The AAAGV Team).



# Introduction

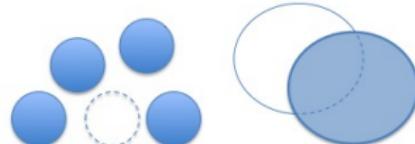
From time-series of the neuron activity, the **goal** is to **infer** the directed connections between neurons.



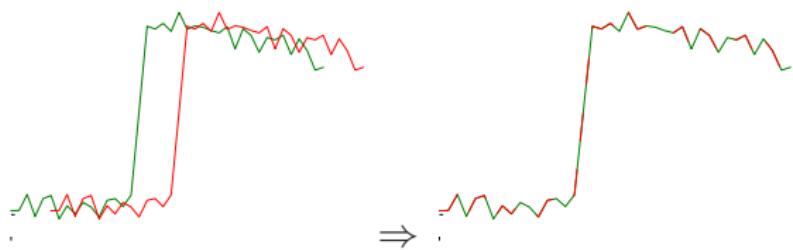
# Introduction

But this problem is **difficult** because...

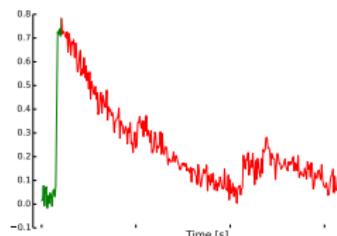
- ▶ **masking** effects



- ▶ **low** sampling rate



- ▶ **slow** decay of fluorescence.



## How-to :

1. **Deal** with calcium fluorescence signals : [signal processing](#).
2. **Find** the network : the [inference method](#).
3. **Improve** the method : [averaging](#) and [tuning](#).

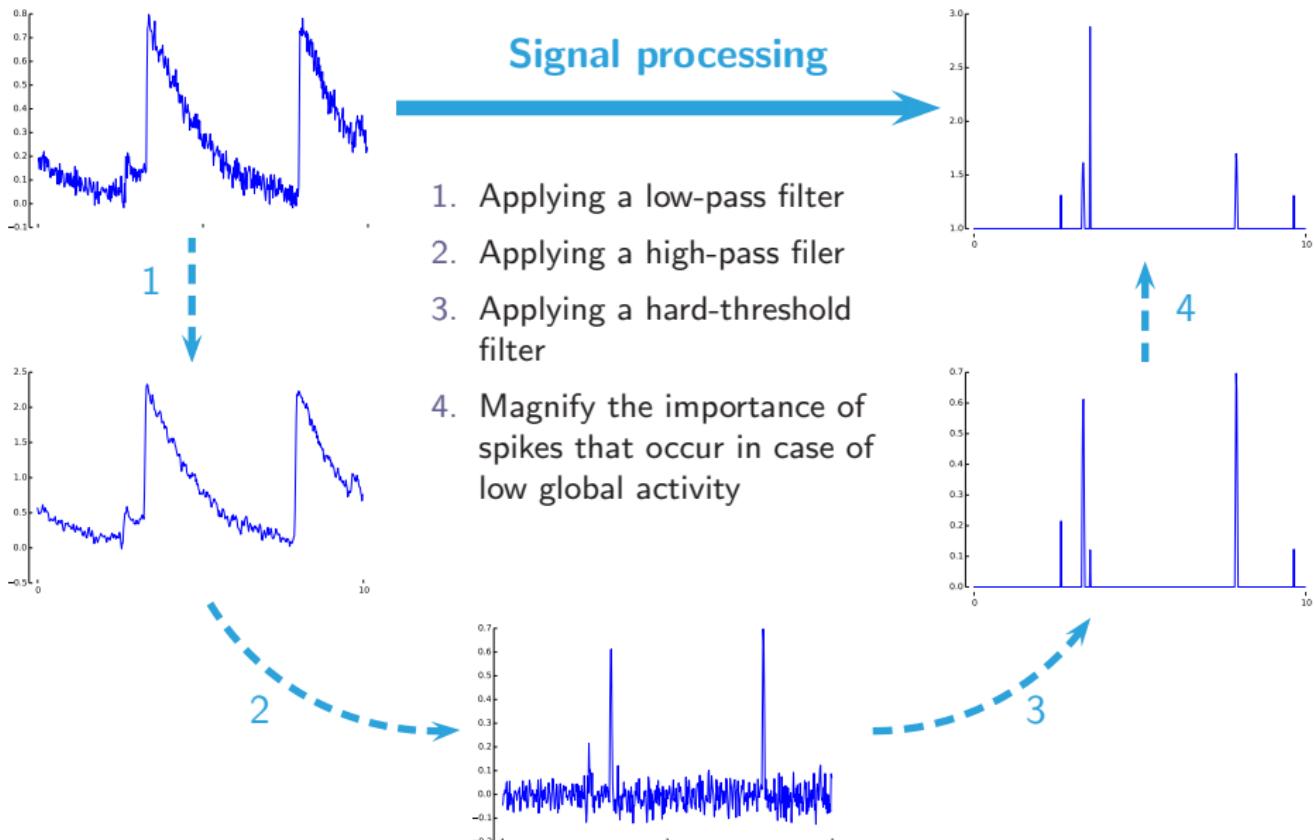
## One step further :

- ▶ Improvement of each stage of our solution.
- ▶ Comparison with other methods.

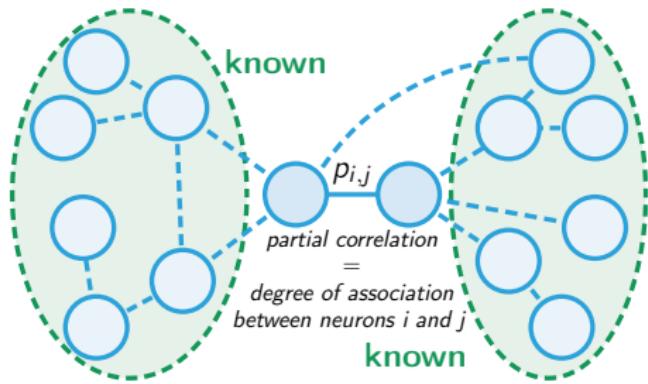
## Even further :

- ▶ The “full method” in a nutshell.

# Signal processing



# Connectome **inference** from partial correlation statistics



**Partial correlation** coefficient  $p_{i,j}$  between neurons  $i$  and  $j$  defined by :

$$p_{i,j} = -\frac{\Sigma_{ij}^{-1}}{\sqrt{\Sigma_{ii}^{-1}\Sigma_{jj}^{-1}}},$$

## Advantages and drawbacks :

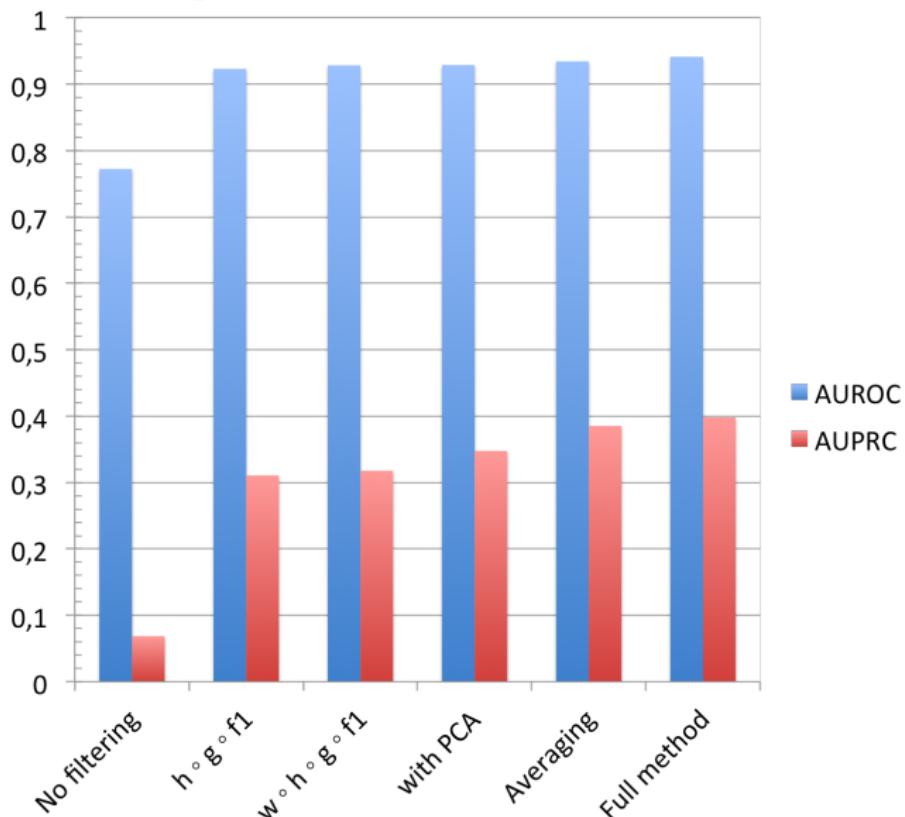
- ✓ Only direct associations
- ✓ Filter out spurious indirect effects
- ✓ Easy to compute (with lots of data)
- ✗ Edge orientation
- ✗ Sensitive to the value of parameters in the filtering process

# Improvements

- ▶ **Approximation** for partial correlation statistics using only the 800 first principal components.
- ▶ **Averaged** partial correlation statistics over various values of the parameters
  - ✓ Improve robustness (over all networks)
  - ✓ Reduce variance of its prediction
  - ✓ Decrease the sensitivity to the filtering process

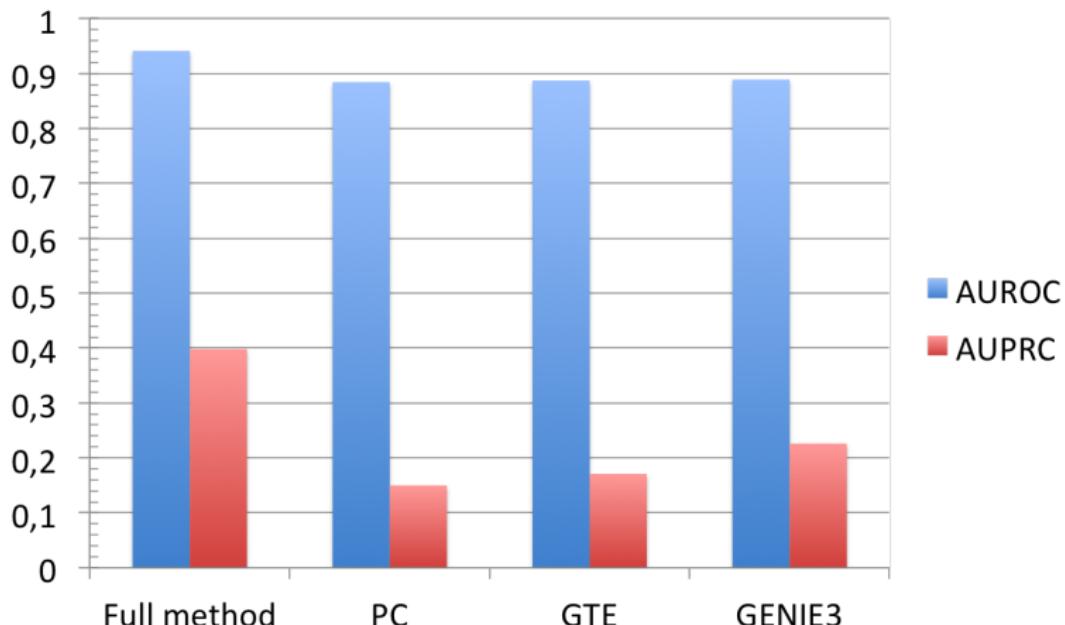
# Each stage of our solution brings some improvement

*Average scores on normal-1,2,3,4 datasets.*



## Comparison with other methods

*Average scores on normal-1,2,3,4 datasets.*



## An optimized version to win the challenge : “Full method”

- ▶ A **tuned** signal processing,
- ▶ **Weighted** average of partial correlation statistics,
- ▶ **Prediction** of edge orientation.

For every details of our method...

**The description of the method :**

Sutera, A., Joly, A., François-Lavet, V., Qiu, Z. A., Louppe, G., Ernst, D., & Geurts, P. (2014). Simple connectome inference from partial correlation statistics in calcium imaging.

**Code available at :**

<https://github.com/asutera/kaggle-connectomics>