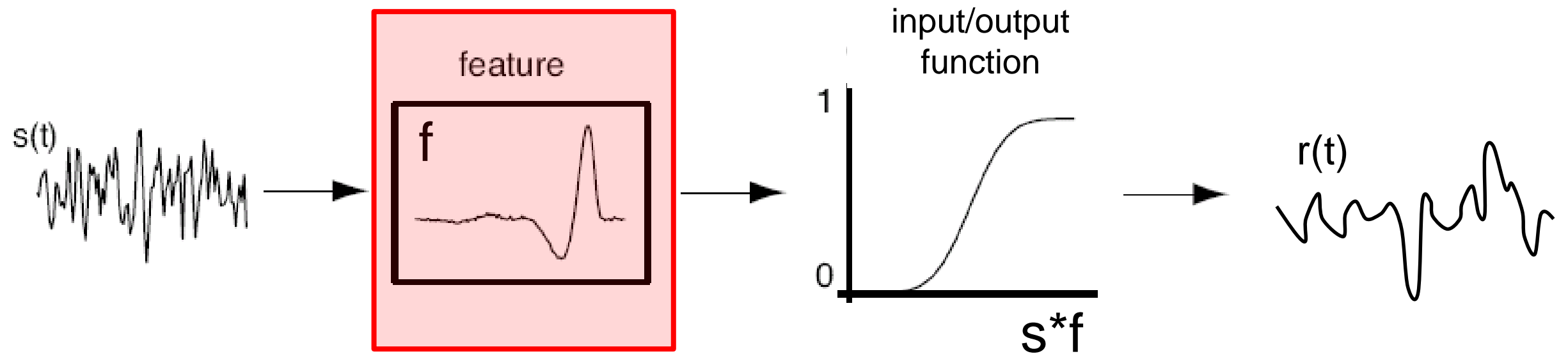


How to find the components of this model



How to proceed?

$P(\text{response} \mid \text{stimulus})$

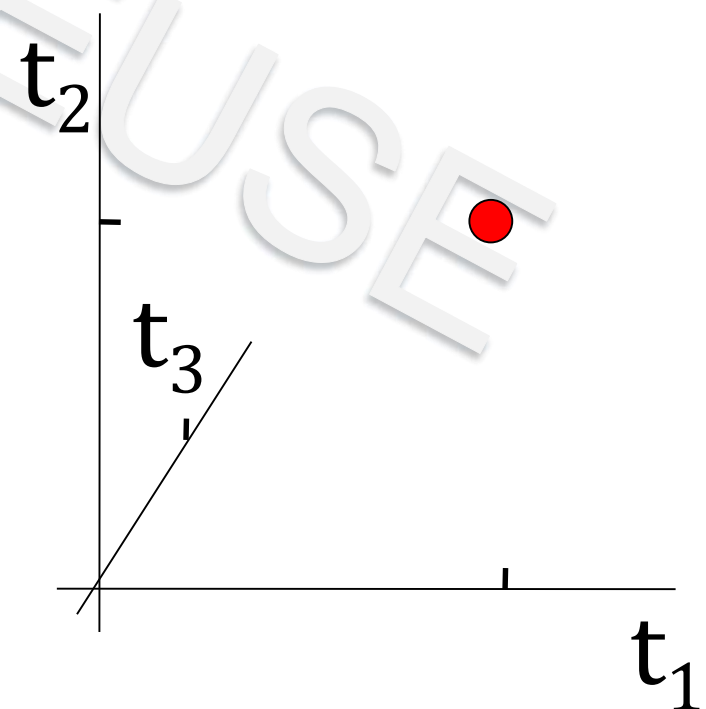
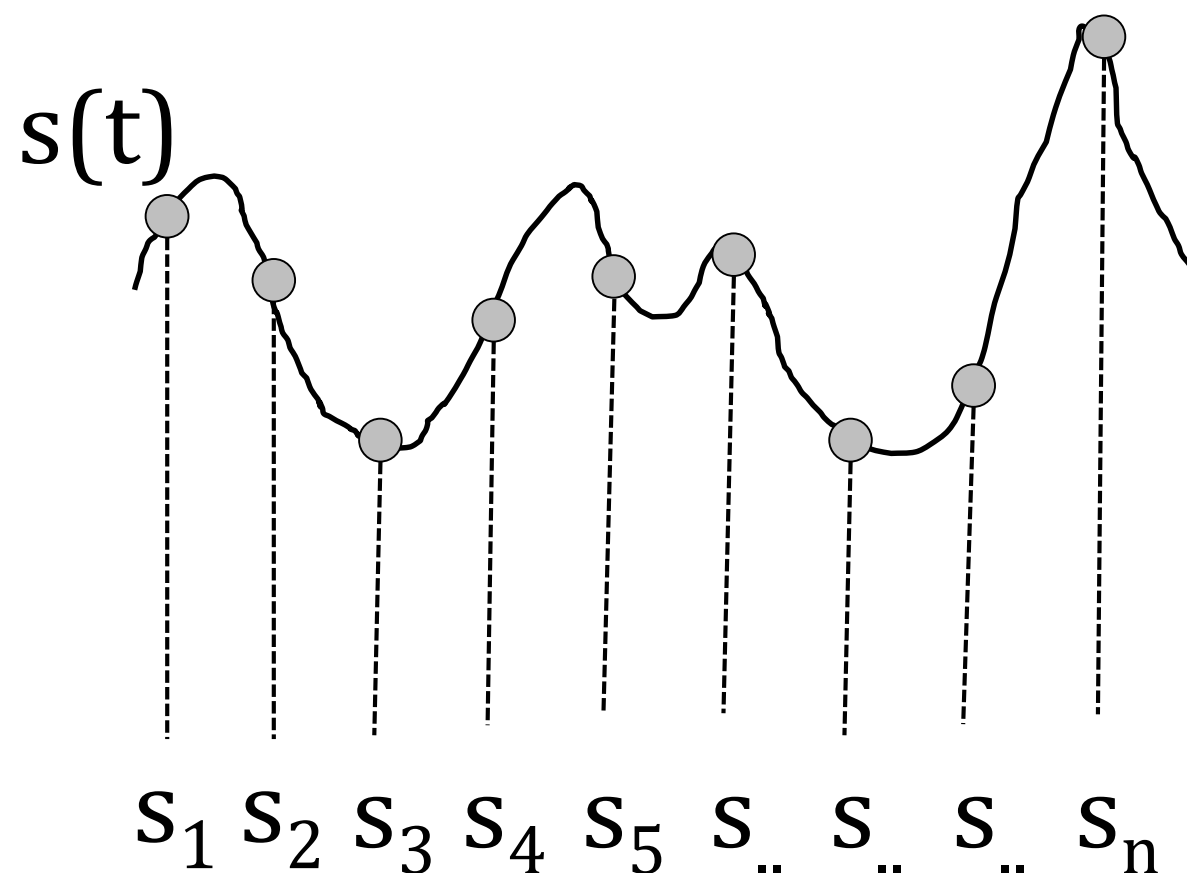
Our problem is one of dimensionality!

We want to sample the responses of the system to many stimuli so we can characterize what it is about the input that triggers responses.

$P(\text{response} \mid \text{stimulus}) \rightarrow P(\text{response} \mid s_1)$

Dimensionality reduction

Start with a very high dimensional description
(eg. an image or a time-varying waveform)
and pick out a small set of relevant dimensions.



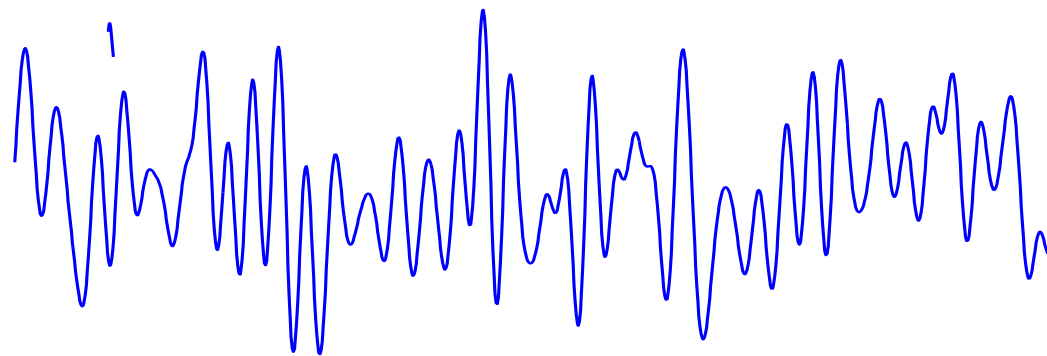
$$s(t) = (s_{t1}, s_{t2}, s_{t3}, \dots, s_{tn})$$

What is the right stimulus to use?

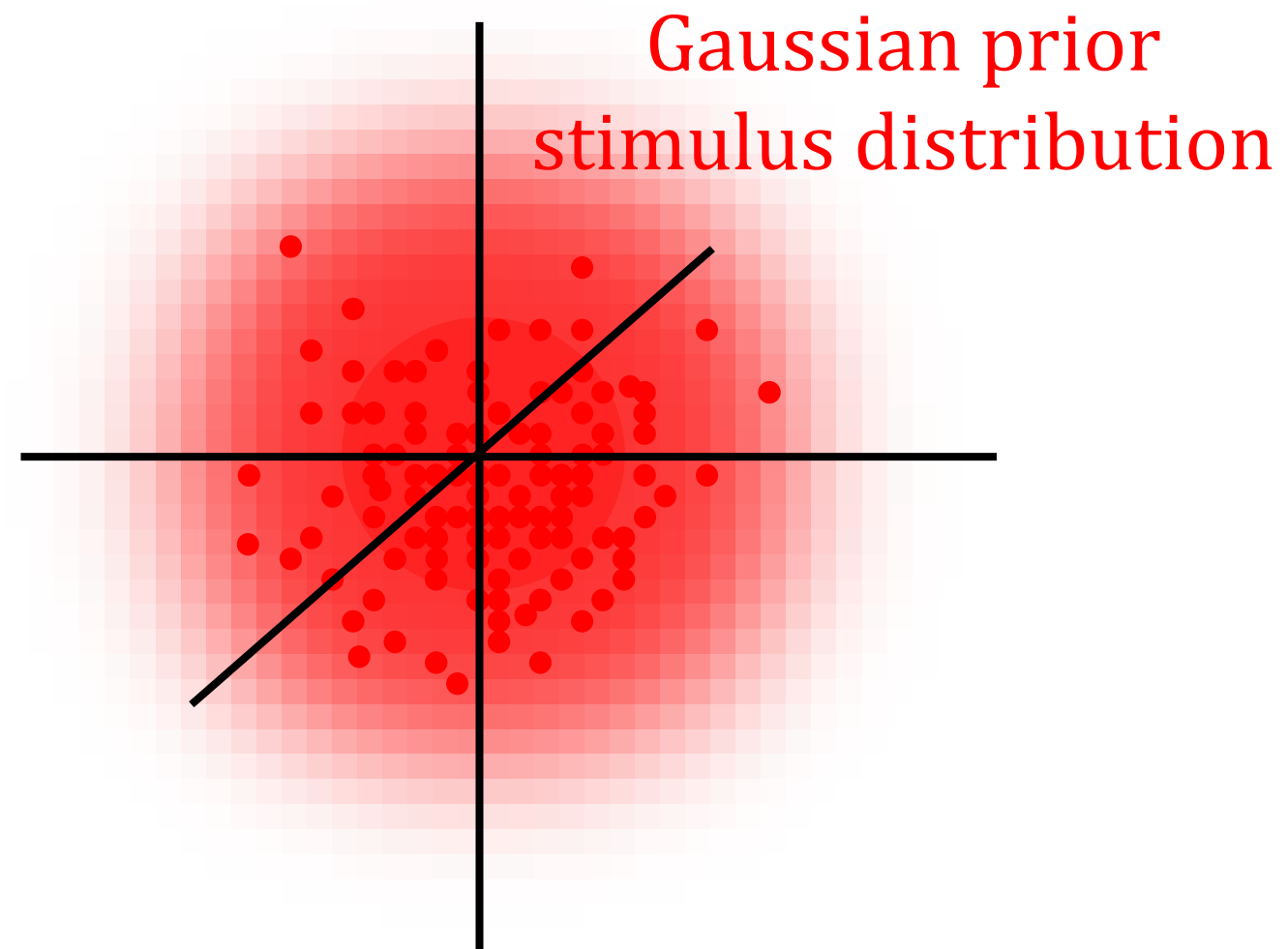
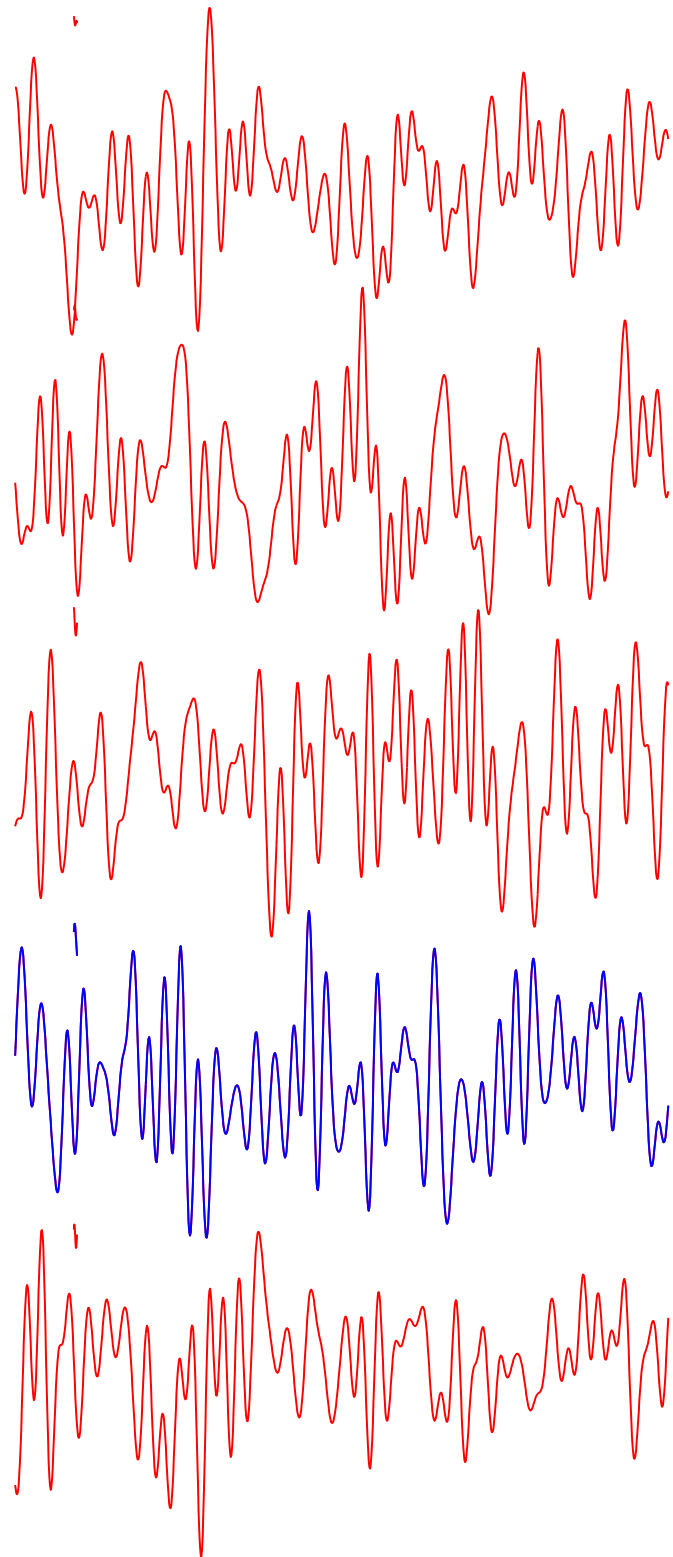
We want to sample the responses of the system to a variety of stimuli so we can characterize what it is about the input that triggers responses.

$$P(\text{response} \mid \text{stimulus}) \rightarrow P(\text{response} \mid s_1, s_2, \dots, s_n)$$

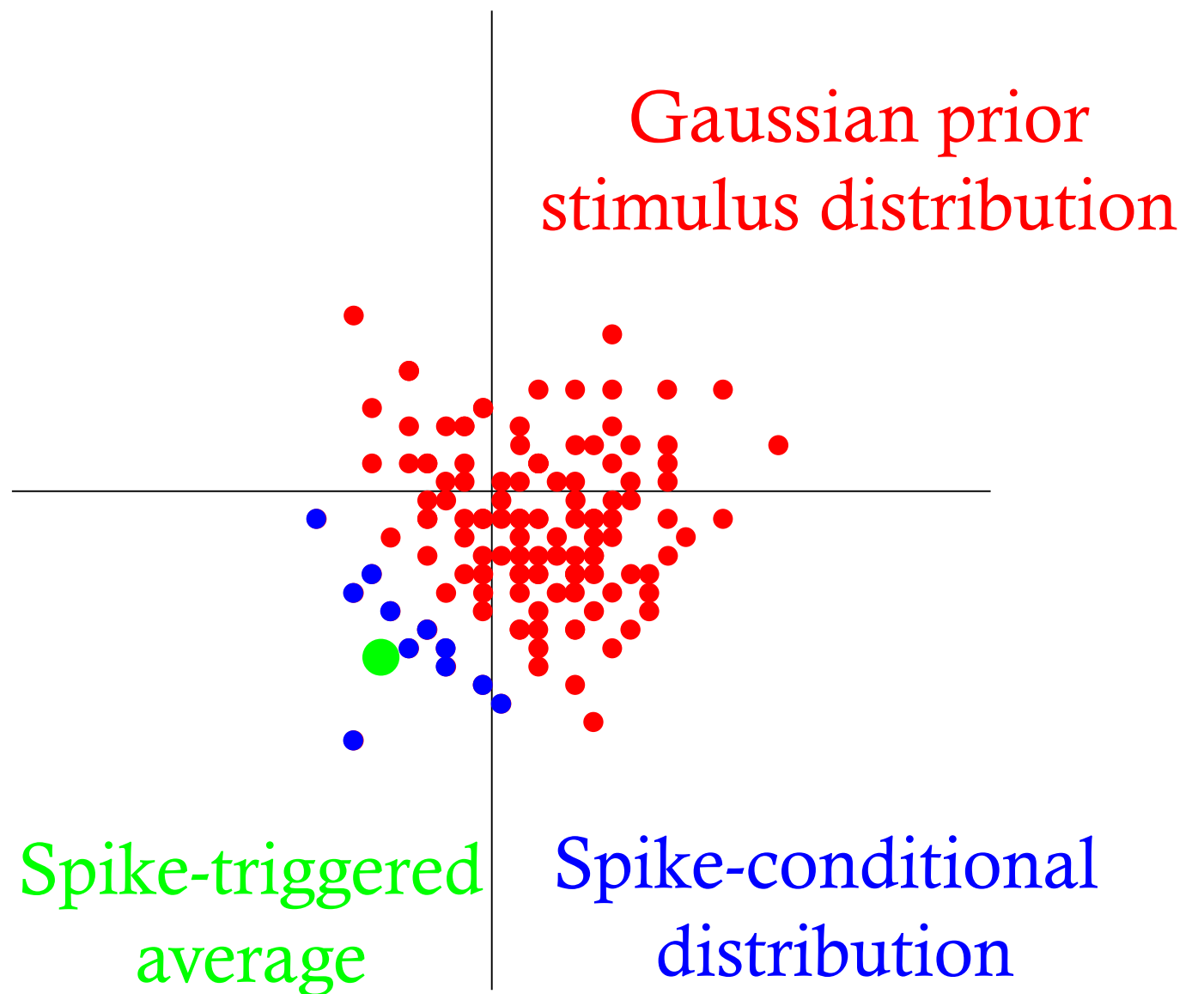
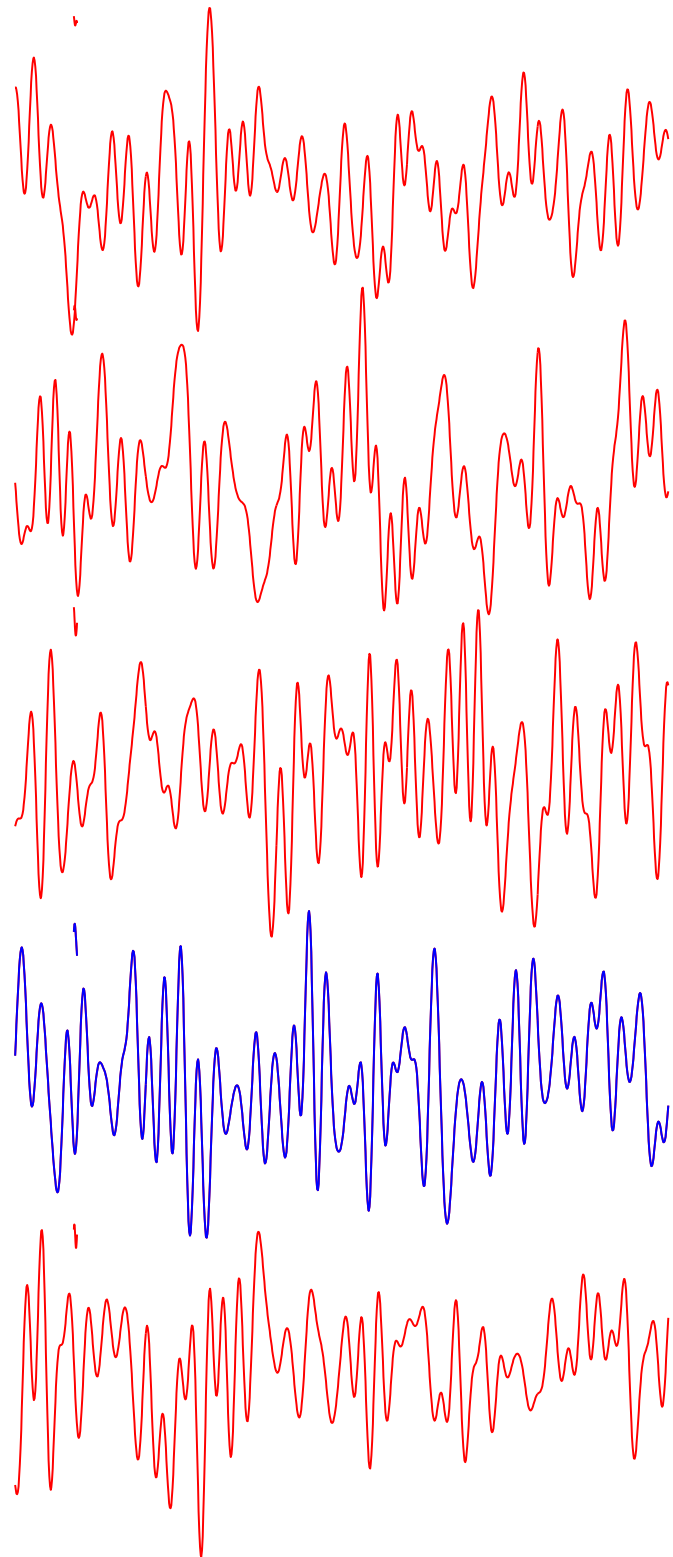
One common and useful method is to use
white noise



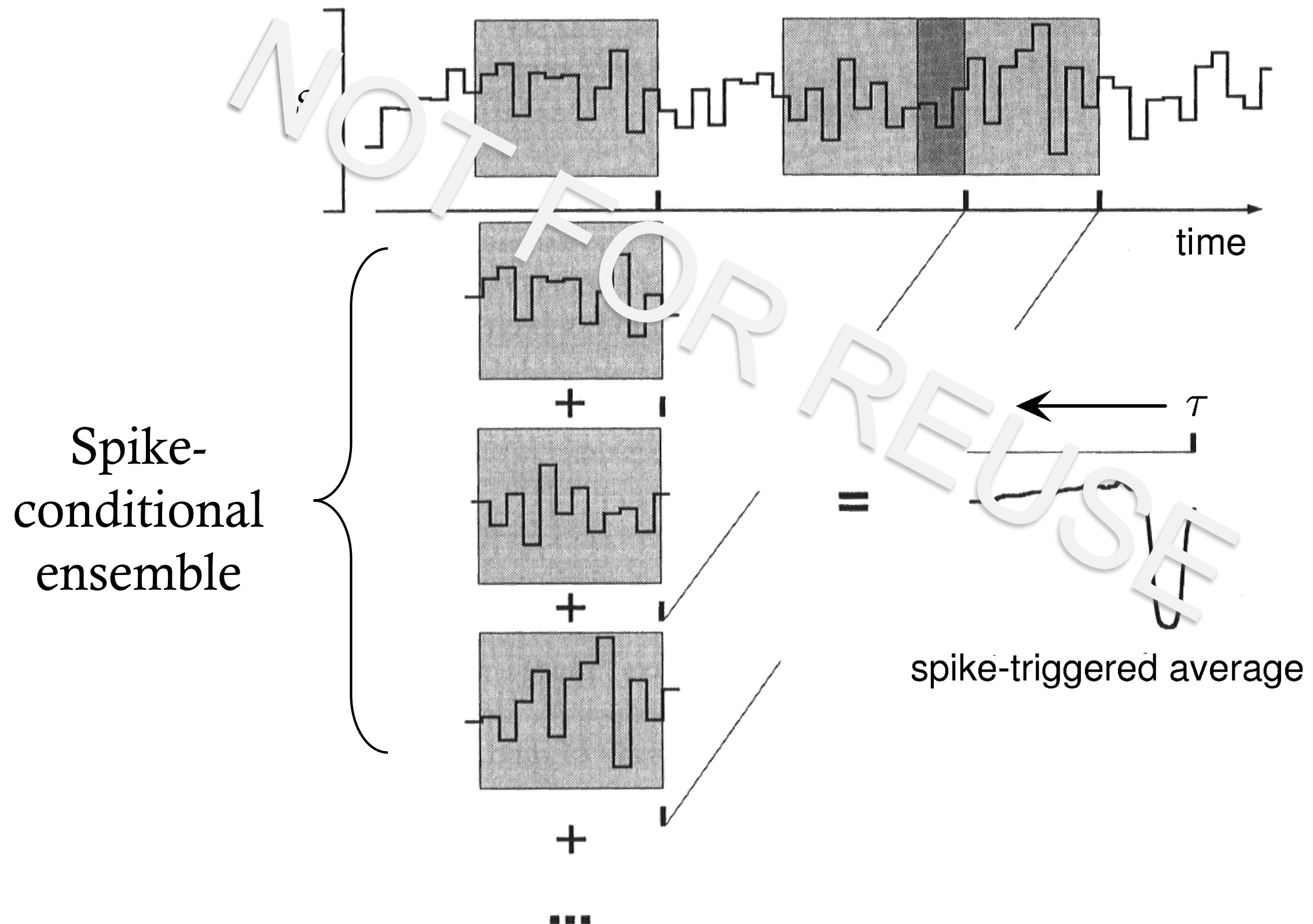
Determining multiple features from white noise



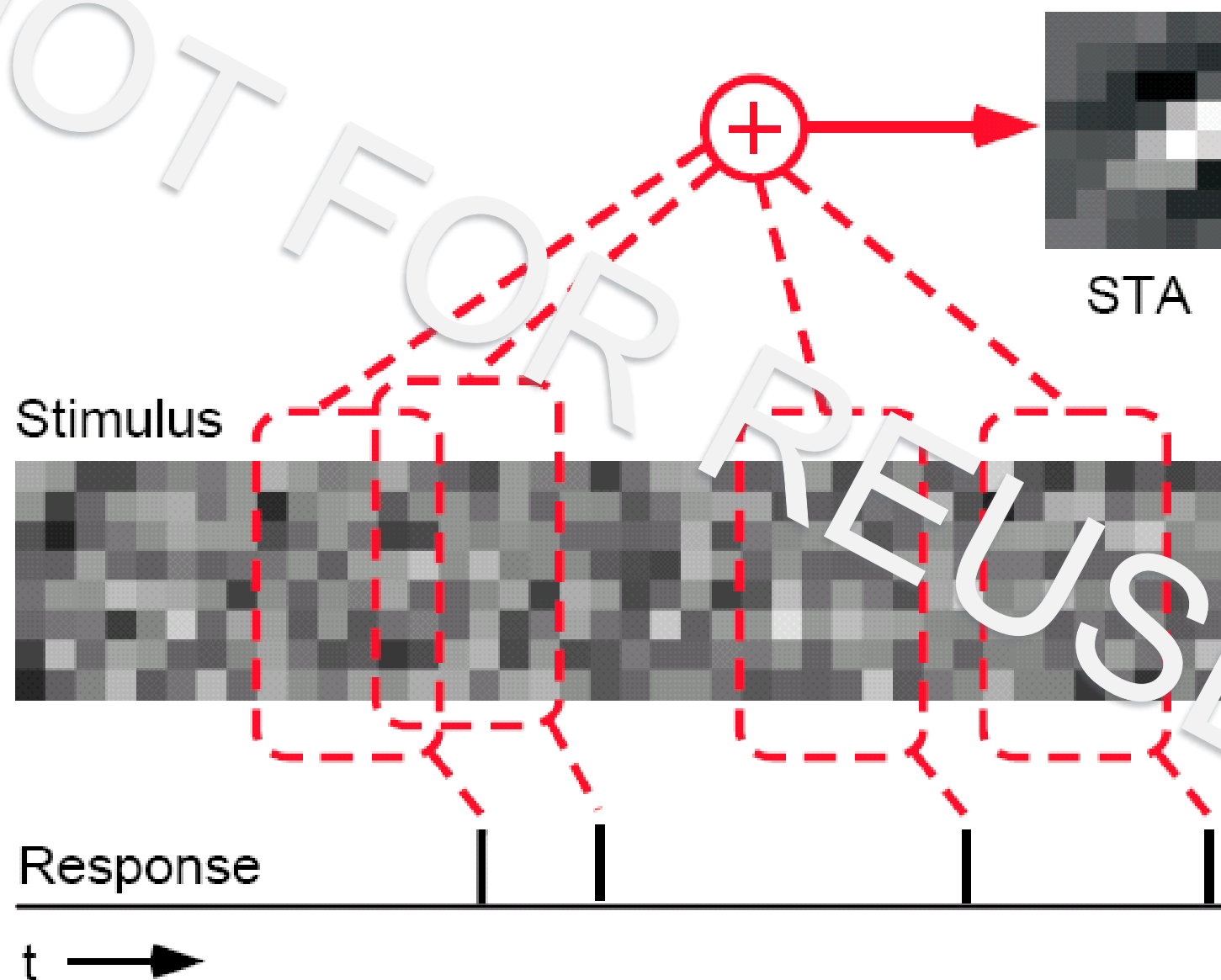
Determining linear features from white noise



Reverse correlation: the spike-triggered average

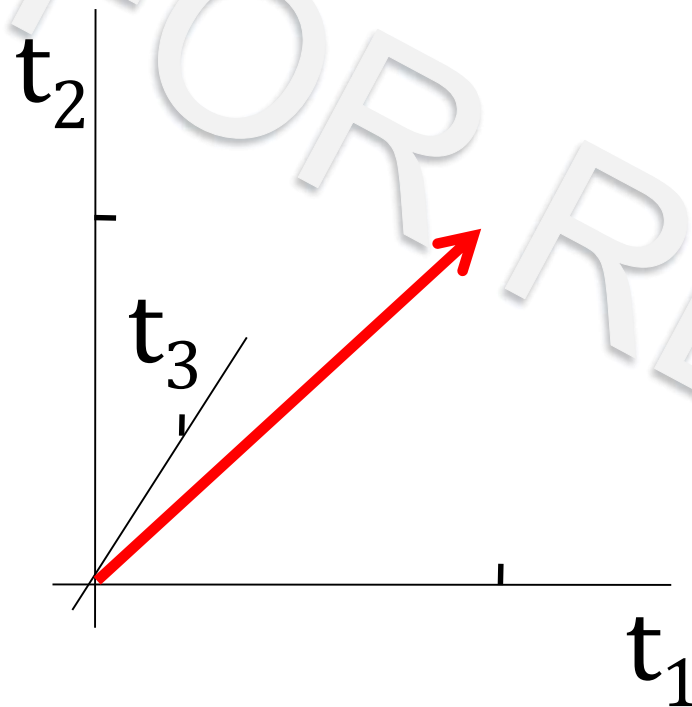


The spike-triggered average



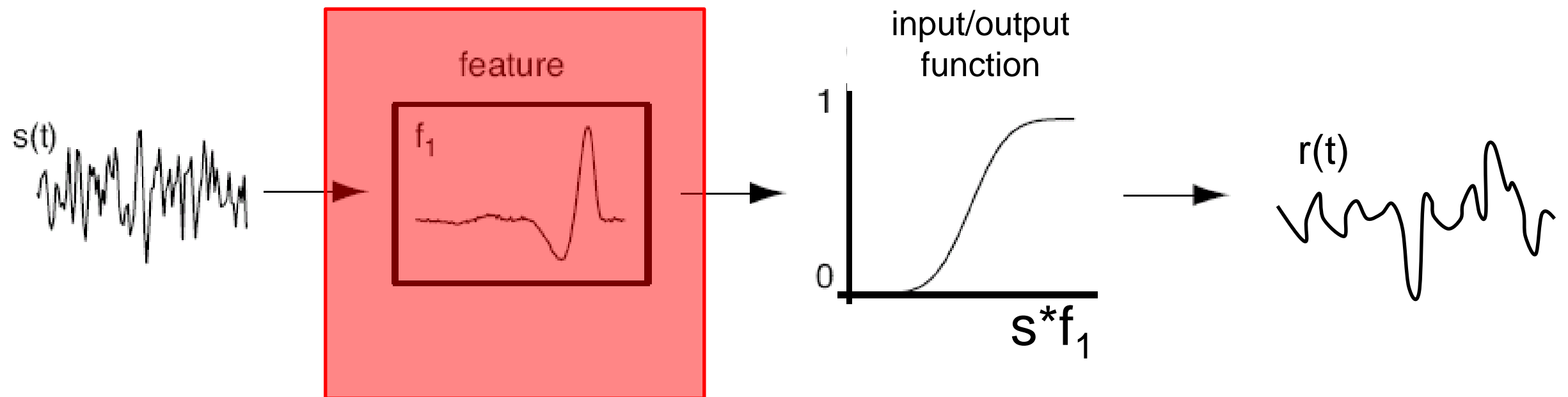
Linear filtering

Stimulus feature f is a vector in a high-dimensional stimulus space



Linear filtering = convolution = projection

How to find the components of this model



Determining the nonlinear input/output function

The input/output function is:

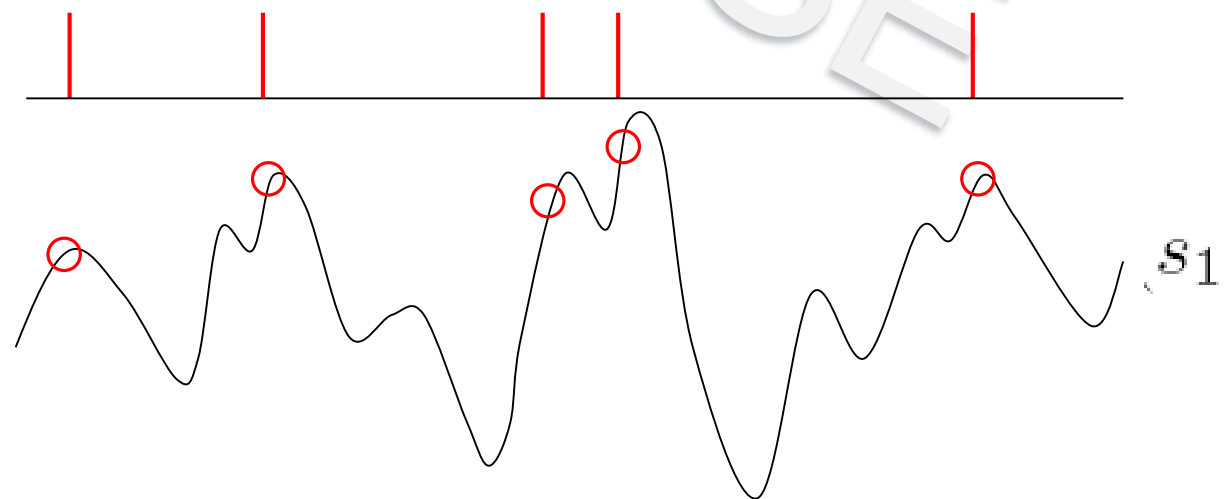
$$P(\text{spike}|\text{stimulus}) \quad \longrightarrow \quad P(\text{spike}|s_1)$$

This can be found from data using Bayes' rule:

$$P(\text{spike}|s_1) = \frac{P(s_1|\text{spike})P(\text{spike})}{P(s_1)}$$

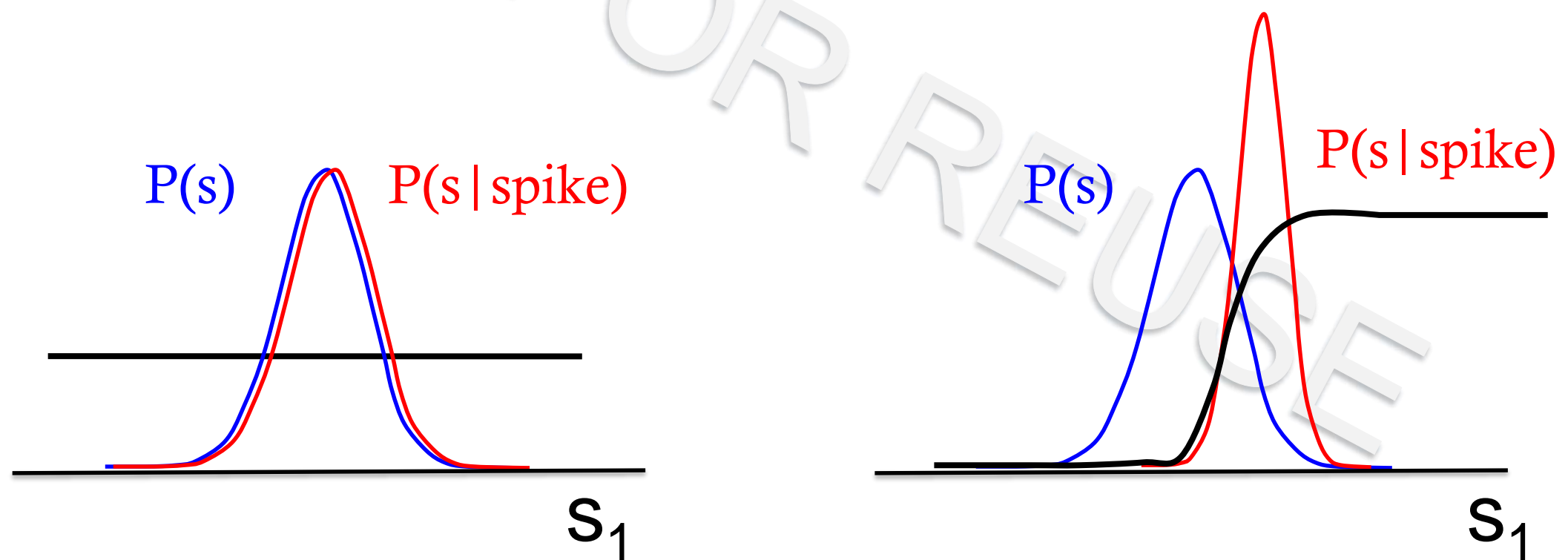
$P(s_1)$

$P(s_1|\text{spike})$

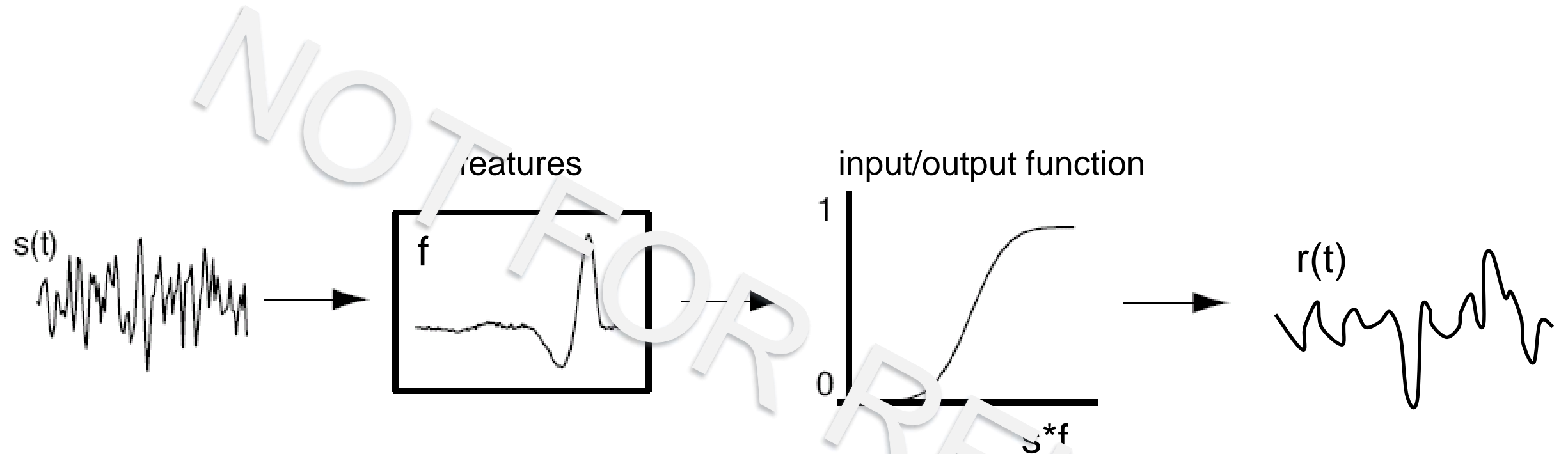


Nonlinear input/output function

$$P(\text{spike} | s_1) = P(s_1 | \text{spike}) P(\text{spike}) / P(s_1)$$



Linear/nonlinear models



Linear filter & nonlinearity: $r(t) = g(\int f(t-\tau) s(\tau) dt)$

High-dimensional feature selection



Featured Members

Auntie_Sassy



Age: 35
Location: Greenwood

Woman seeking

- Man for Dating
- Man for Friendship

Worst Haiku Ever

This is my first dip into the online dating pool and quite frankly, I have no idea what I'm doing.... [learn more about me »](#)

JohnnyX



Age: 47
Location: Capitol Hill

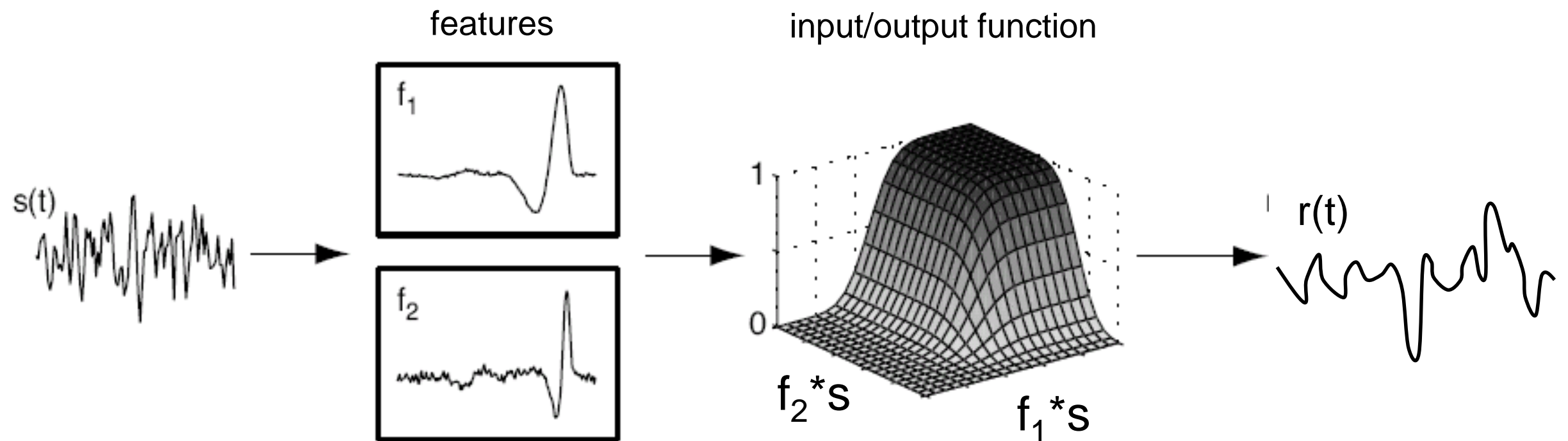
Man seeking

- Woman for Dating
- Woman for Friendship

Sex, Love and Rock-n-Roll

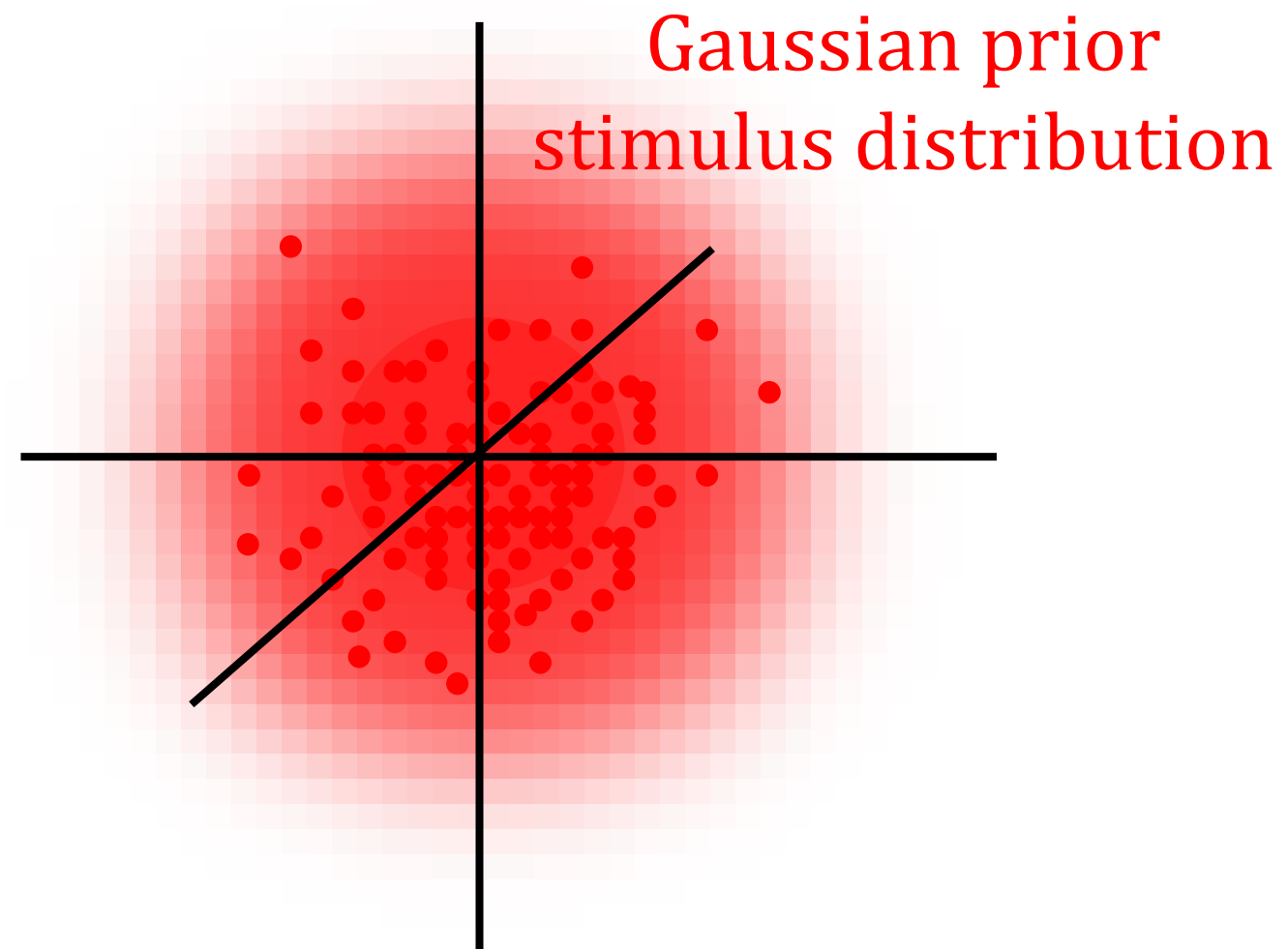
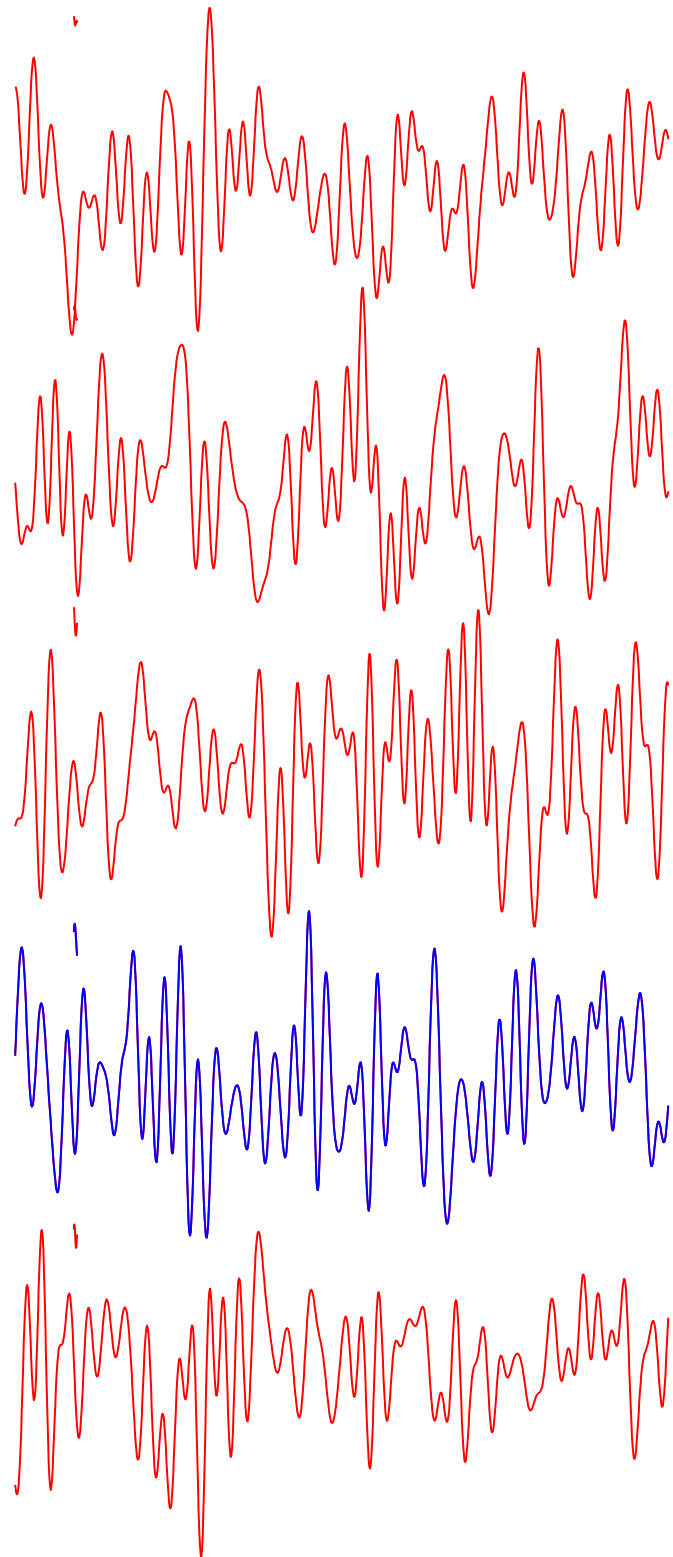
If you don't see how it possible for an older guy to be sexy and exciting, stop reading now because... [learn more about me »](#)

Less basic coding models

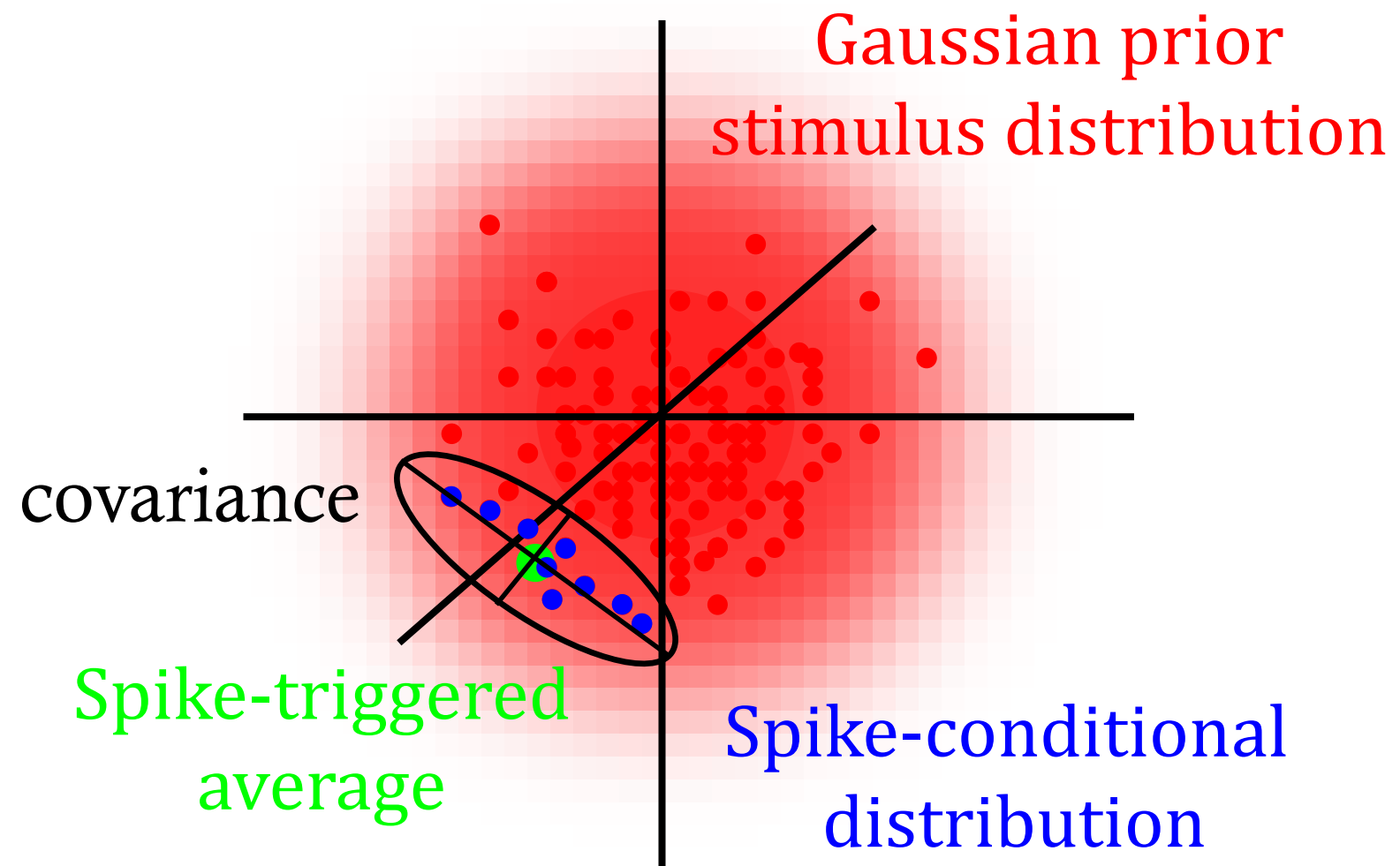
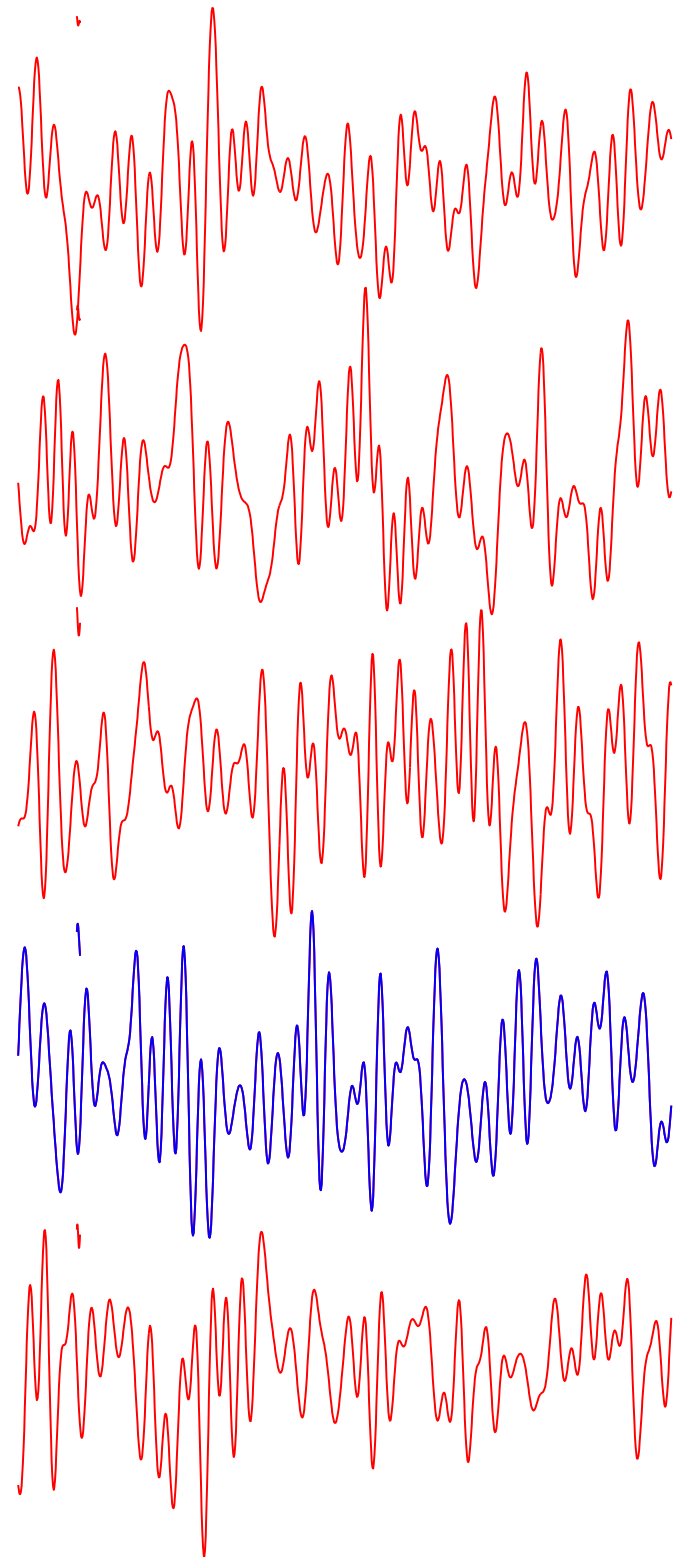


Linear filters & nonlinearity: $r(t) = g(f_1 * s, f_2 * s, \dots, f_n * s)$

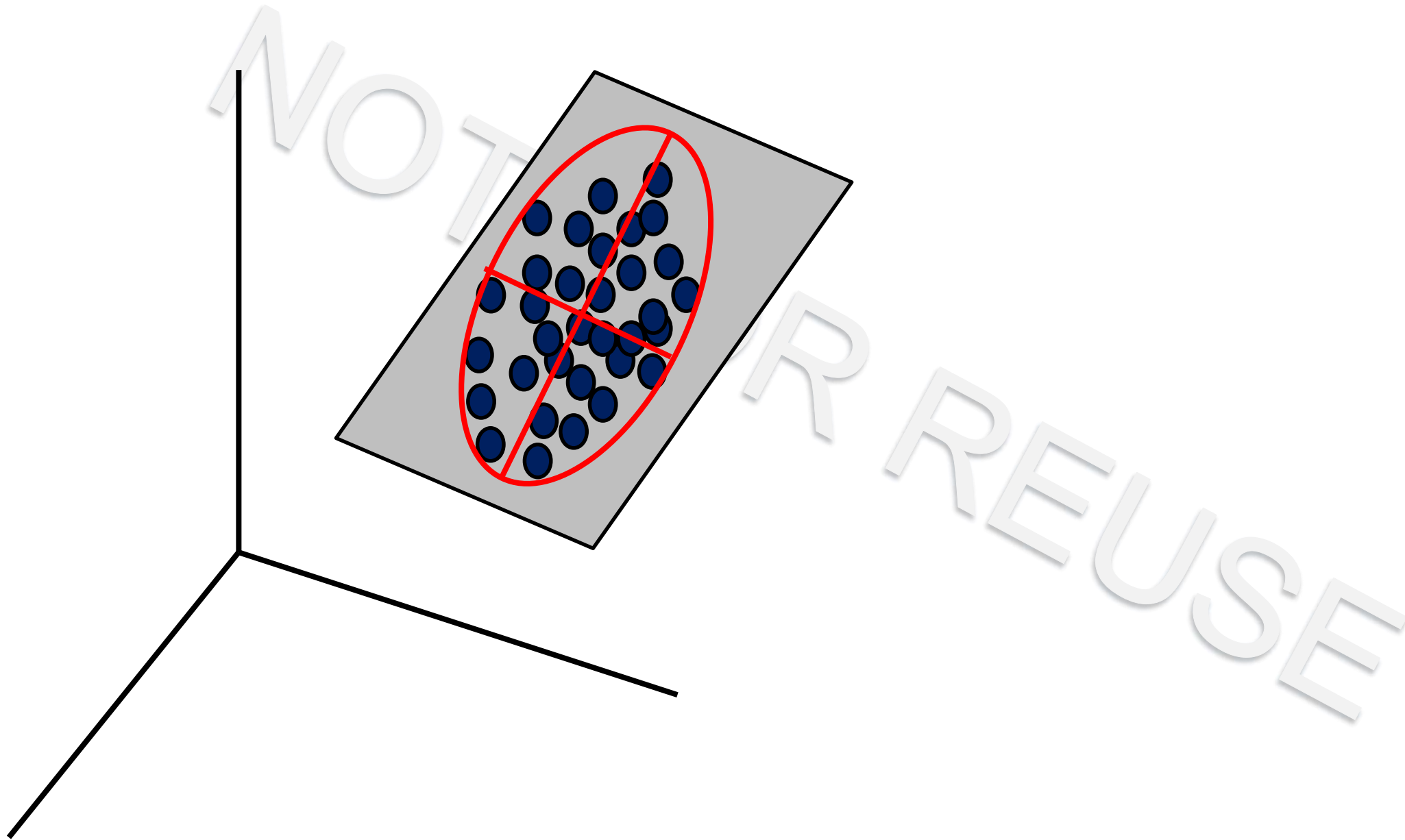
Determining multiple features from white noise



Determining multiple features from white noise



Principal component analysis



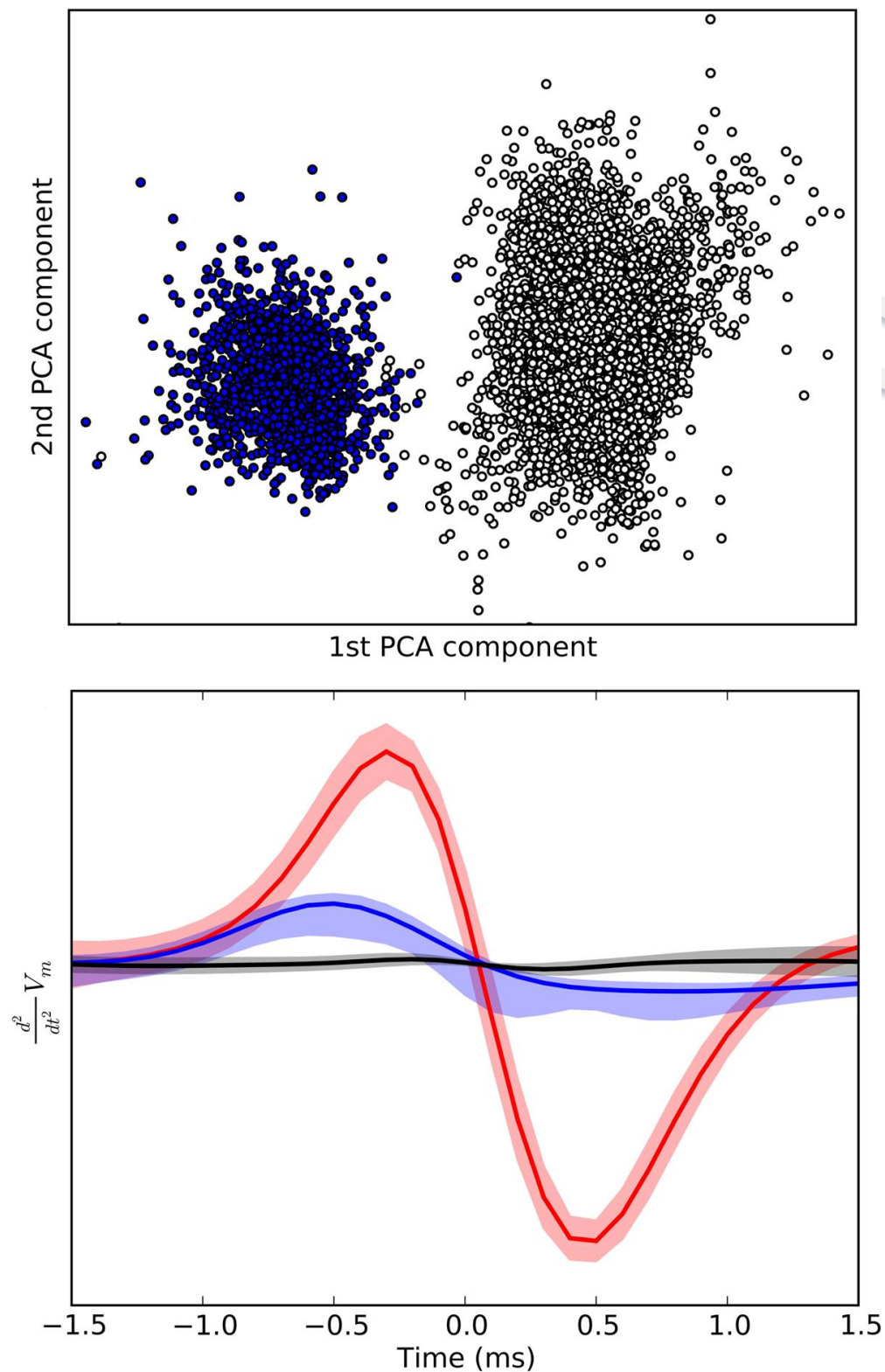
Principal component analysis: eigenfaces

NC

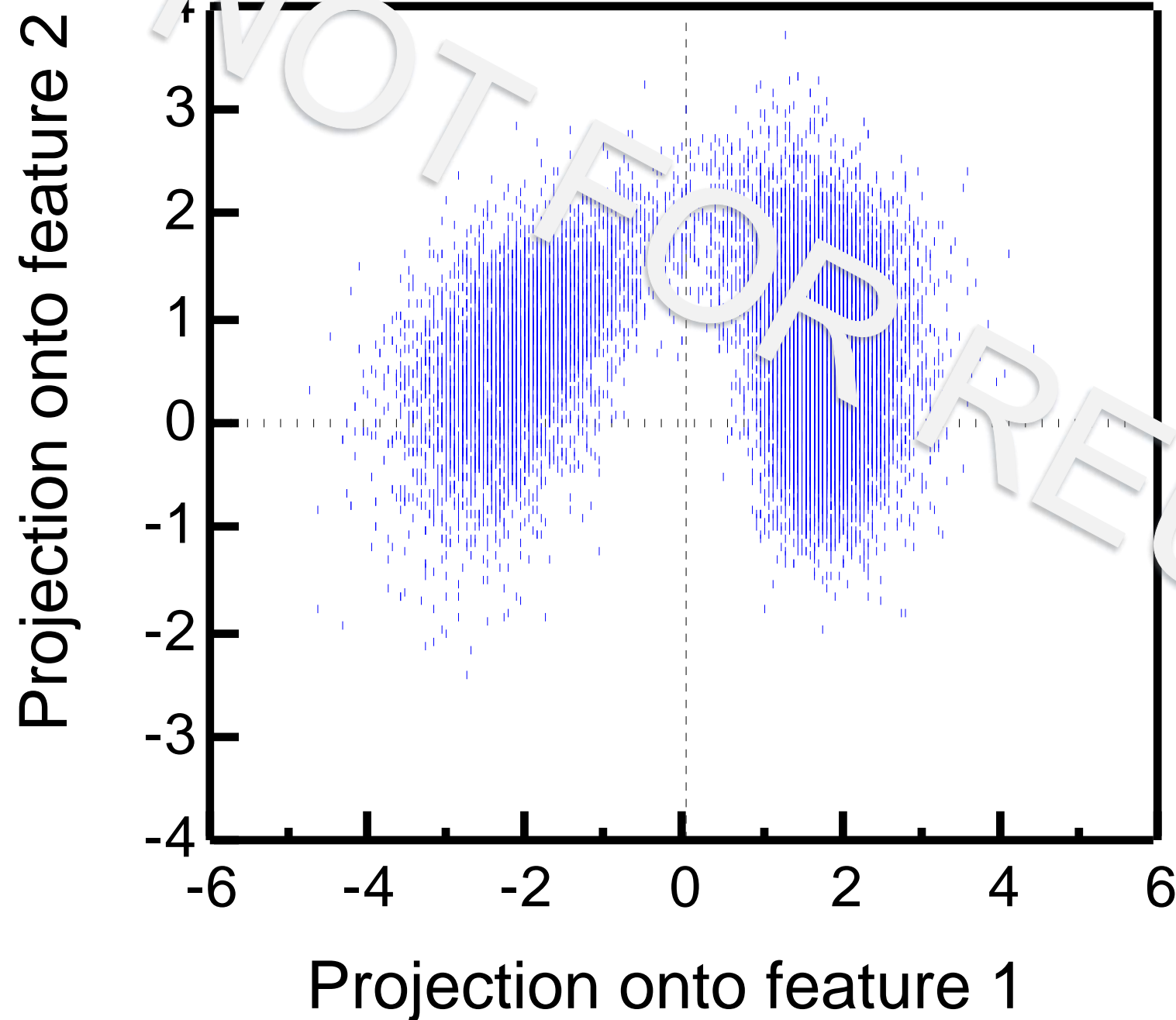


SE

Principal component analysis: spike sorting



Finding interesting features in the retina



NOT FOR REUSE

