

Poster presentation

Open Access

## Estimation of spectro-temporal receptive fields based on linear support vector machine classification

Arne F Meyer\*<sup>1</sup>, Max FK Happel<sup>2</sup>, Frank W Ohl<sup>2</sup> and Jörn Anemüller<sup>1</sup>

Address: <sup>1</sup>Department of Physics, Carl-von-Ossietzky University, Oldenburg, DE, Germany and <sup>2</sup>Leibniz Institute for Neurobiology and Institute of Biology, Otto-von-Guericke University, Magdeburg, DE, Germany

Email: Arne F Meyer\* - arne.f.meyer@uni-oldenburg.de

\* Corresponding author

from Eighteenth Annual Computational Neuroscience Meeting: CNS\*2009  
Berlin, Germany. 18–23 July 2009

Published: 13 July 2009

BMC Neuroscience 2009, **10**(Suppl 1):P147 doi:10.1186/1471-2202-10-S1-P147

This abstract is available from: <http://www.biomedcentral.com/1471-2202/10/S1/P147>

© 2009 Meyer et al; licensee BioMed Central Ltd.

### Introduction

The spectro-temporal receptive field (STRF) of a neuron is defined as the linear filter that, when convolved with the spectro-temporal representation of an arbitrary stimulus, gives a linear estimate of the evoked firing rate [1]. A common method for STRF estimation uses the spike-triggered average (STA) to compute the mean stimulus pattern preceding every spike.

Here, we present a method that not only considers stimulus patterns that evoke spikes but also those after which no spikes occur. This results in a binary classification problem. We show that the STRF model is equivalent to the structure of a linear support vector machine (SVM) and propose the use of SVMs for the estimation of the STRF. Based on this approach, we demonstrate that the obtained STRFs are a better predictor for spiking and non-spiking behavior of a neuron.

### Methods and results

The SVM is trained using real spike data from anesthetized gerbils [2] and zebra finches [3]. The parts of the stimulus spectrogram preceding a spike are labeled as class 1, whereas the remaining (non spike-evoking) parts are labeled as class 0. We used 80% of the data for training and 20% for prediction. See figure 1

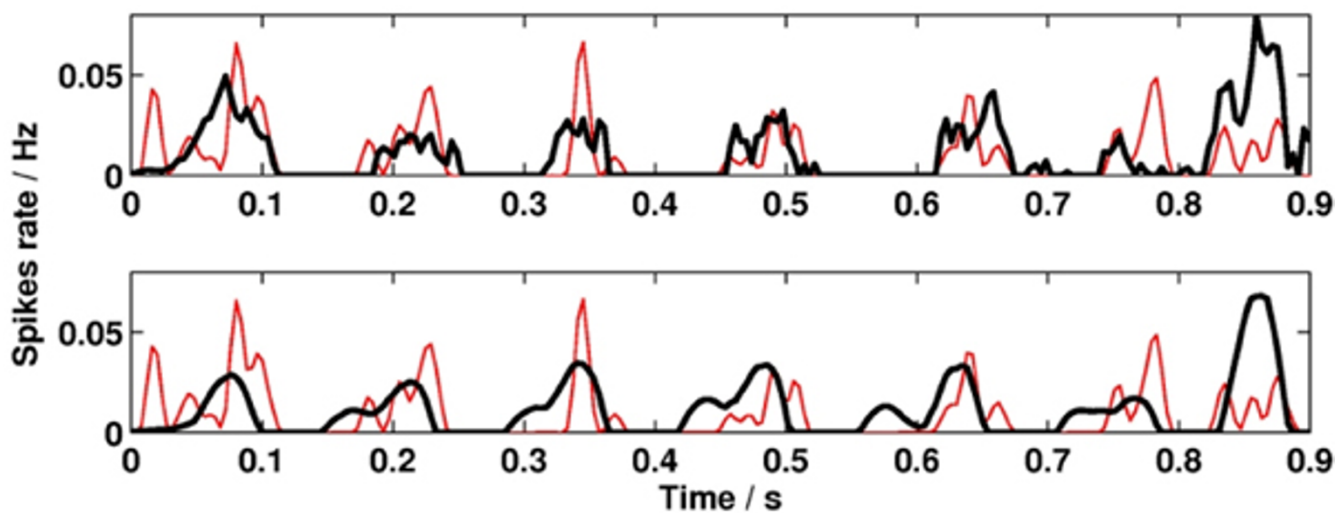
### Discussion

In comparison to classic STA estimation, the method proposed here is characterized by a notably finer structure in

the temporal evolution of spike rate prediction. In particular the non spike-eliciting time intervals are better captured by the novel approach. This behavior is likely a result of the learning procedure employed that is based on a binary classification paradigm with a linear classifier. The averaging approach of the STA results in smoother estimates for the neuronal receptive field (due to the temporal low-pass envelope characteristics of natural stimuli), consequently producing less-detailed spike rate predictions.

### References

1. Theunissen FE, Sen K, Doupe AJ: **Spectral-temporal receptive fields of nonlinear auditory neurons obtained using natural sounds.** *J Neurosci* 2000, **20**:2315-2331.
2. Happel MFK, Müller SG, Anemüller J, Ohl FW: **Predictability of STRFs in auditory cortex neurons depends on stimulus class.** *Interspeech* 2008:670.
3. **STRFPAK Matlab Toolbox** [<http://strfpak.berkeley.edu/>]



**Figure 1**  
The predicted spike rate (bold black line) compared to the actual response smoothed with a Gaussian window of 20 ms (thin red line). The upper panel shows the result for the SVM-based method, the lower panel for the STA method. The mean coherence between actual and predicted rate is 0.23 for both methods.

Publish with **BioMed Central** and every scientist can read your work free of charge

*"BioMed Central will be the most significant development for disseminating the results of biomedical research in our lifetime."*

Sir Paul Nurse, Cancer Research UK

Your research papers will be:

- available free of charge to the entire biomedical community
- peer reviewed and published immediately upon acceptance
- cited in PubMed and archived on PubMed Central
- yours — you keep the copyright

Submit your manuscript here:  
[http://www.biomedcentral.com/info/publishing\\_adv.asp](http://www.biomedcentral.com/info/publishing_adv.asp)

