AB062. Cortical state contribution to neuronal response variability

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Background: Visual cortex neurons often respond to stimuli very differently on repeated trials. This trial-by-trial variability is known to be correlated among nearby neurons. Our long-term goal is to quantitatively estimate neuronal response variability, using multi-channel local field potential (LFP) data from single trials.

Methods: Acute experiments were performed with anesthetized (Remifentanil, Propofol, nitrous oxide) and paralyzed (Gallamine Triethiodide) cats. Computer-controlled visual stimuli were displayed on a gamma-corrected CRT monitor. For the principal experiment, two kinds of visual stimuli were used: drifting sine-wave gratings, and a uniform mean-luminance gray screen. These two stimuli were each delivered monocularly for 100 sec in a random order, for 10 trials. Multi-unit activity (MUA) and LFP signals were extracted from broadband raw data acquired from Area 17 and 18 using A1X32 linear arrays (NeuroNexus) and the OpenEphys recording system. LFP signal processing was performed using Chronux, an open-source MATLAB toolbox. Current source density (CSD) analysis was performed on responses to briefly flashed full-field stimuli using the MATLAB toolbox, CSDplotter. The common response variability (global noise) of MUA was estimated using the model proposed by Scholvinck *et al.* [2015].

Results: On different trials, a given neuron responded with different firing to the same visual stimuli. Within one trial, a neuron's firing rate also fluctuated across successive cycles of a drifting grating. When the animal was given extra anesthesia, neurons fired in a desynchronized pattern; with lighter levels of anesthesia, neuronal firing because more synchronized. By examining the cross-correlations of LFP signals recorded from different cortical layers, we found LFP signals could be divided to two groups: those recorded in layer IV and above, and those from layers V and VI. Within each group, LFP signals recorded by different channels are highly correlated. These two groups were observed in lighter and deeper anesthetized animals, also in sine-wave and uniform gray stimulus conditions. We also investigated correlations between LFP signals and global noise. Power in the LFP beta band was highly correlated with global noise, when animals were in deeper anesthesia.

Conclusions: Brain states contribute to variations in neuronal responses. Raw LFP correlation results suggest that we should analyze LFP data according to their laminar organization. Correlation of low-frequency LFP under deeper anesthesia with global noise gives us some insight to predict noise from single-trial data, and we hope to extend this analysis to lighter anesthesia in the future.

Keywords: Cortical state; response variability; local field potential (LFP); multi-unit activity (MUA); visual cortex

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