Presentation Abstract

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Presentation Title: Imaging neuronal network activity with 2D electrode arrays

Location: Hall A

Presentation time: Sunday, Oct 18, 2015, 8:00 AM -12:00 PM

Presenter at Poster: Sun, Oct. 18, 2015, 10:00 AM - 11:00 AM

Topic: ++B.09.a. Signal propagation

Authors: *N. KODAMA*¹, P. PUZEREY³, R. FERNANDEZ GALAN²;
¹Dept. of Neurosciences, ²Case Western Reserve Univ., Cleveland, OH;
³Cornell Univ., Ithaca, NY

Abstract: Current approaches to visualizing and analyzing neuronal activity at the circuit and microcircuit levels are mostly based on optical imaging techniques, using calcium and voltage-sensitive dyes. The former offers good spatial resolution to identify cell clusters and microcircuits but relatively poor temporal resolution, which is limited by the dissociation time constant of the dyes. In contrast, voltage-sensitive dyes offer high temporal resolution, comparable to that of electrophysiological recordings, but poor visualization of neuronal circuits, since the dyes mostly localize in dendritic arbors. For both techniques, the multiplexing of data acquisition hardware also imposes a trade-off between spatial and temporal resolutions. We present an alternative approach to imaging neuronal activity, not with optical signals but electric ones, which has both high temporal and spatial resolutions. To this end we use high-density, two-dimensional electrode arrays (120 electrodes; 1.2 sq. mm). Simultaneous recordings from all the electrodes over a patch of brain tissue are plotted as dynamic maps of the electric potential across neuronal networks, from which we can quantify the emergence, propagation speed and direction of neuronal activity, either evoked or spontaneous. Also, a current source density analysis allows us to track over time the current sources and sinks in the network, and determine their co-localization with different cell groups and types. We demonstrate how this approach to investigating neuronal network
activity allows us for the first time to detect abnormalities of cortical circuits in animal models of disease in an accurate and highly efficient manner.

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