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Multidimensional patterns of neuronal activity: how do we see them?

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Introduction

The brain is a highly interconnected network of constantly interacting units. Understanding the collective behavior of these units requires a multi-dimensional approach. The results of such analyses are hard to visualize and interpret. Hence tools capable of dealing with such tasks become imperative.

Methods

We present a method that offers means of visualizing and interpreting the complex dynamics of a set of parallelly recorded units, in an intuitive manner. First, the activity of all simultaneously recorded neurons is represented in a multidimensional space. Second, the multidimensional space is projected on a lower dimensional (3D) space of colors, using 3D Kohonen Maps. The projection algo-

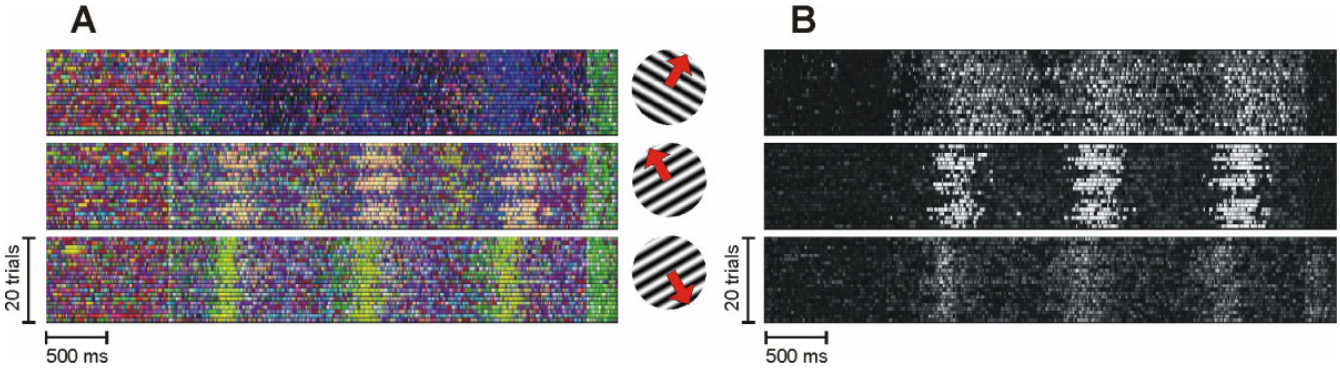

Figure 1

A) Activity of 26 simultaneously recorded single units from cat area 17, stimulated with drifting sinusoidal gratings (3 direction of drift shown). Lines represent individual trials and are grouped by stimulation condition (20 trials per condition); B) Same dataset as in A but only stimulus-specific patterns are shown (white = most specific pattern).

rithm assigns each multidimensional pattern a color in such a way that similar patterns receive similar colors. This color-coding helps our own visual system to detect patterns of activity that would be otherwise difficult to detect. Additionally, we used a simple algorithm to identify multidimensional patterns that are stimulus-specific.

Results

The method is applied to data recorded from cat area 17 under different stimulation conditions (sinusoidal gratings of different orientations). Fig. 1A shows how different gratings evoke different patterns of activity, each depicted with another color. In Fig. 1B one can observe the identified stimulus-specific patterns (light gray), that are either spread across the whole stimulus presentation period or are localized in a more narrow time window. We conclude that this visualization technique opens the way for efficient multi-dimensional exploration of neuronal data.

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