

Readings in Neuroinformatics

Slaven Cvijetic, 30.11.2018

Self-Organization of Orientation Sensitive Cells in the Striate Cortex, Chr. von der Malsburg, Kybernetik 14, 85--100 (1973).

Abstract

The visual cortex has several layers of organization for information processing. Orientation sensitive cells organized in functional columns reside in the striate cortex, which respond optimally to specific orientations of bars. Its organization is determined by genetics to some extent. However, genetics alone cannot account for the totality of all afferent axons terminating on cortical neurons nor for the plasticity of the system. In this paper, we address the questions to what end the striate cortex is organized and what its underlying mechanisms of the circuitry are. We show that a self-organizing system based on synaptic plasticity can resolve the issue of genetics and we introduce a computational model to simulate the circuitry of the striate cortex. The model consists of excitatory and inhibitory cells that are wired in a 2-dimensional manner forming a cortical plane. The connections of these cells are weighted, which are modified during a learning process, thus changing synaptic strengths across the network. An excitatory cell will excite its neighbours and the inhibitory cells, which in turn, inhibit its immediate neighbouring excitatory cells. This results into clusters of cells firing together that respond optimally to a stimulus even if it appears to be non-structured or random. The system is also stable to arbitrary changes of some connections since it can readapt to an optimal state. Thus, it is enough to make a few simple assumptions to explain some very important functional properties of the striate cortex.

(words: 240)

(Is it okay, to introduce the problem with: "in this paper, we address the question/problem...")