Report from 2015 OHBM Hackathon (HI)

Self-Organization and Brain Function

Project URL: https://github.com/SOBF

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1 Introduction

To investigate self-organizing properties of the ocular dominance columns in the primary visual cortex computationally, using the Swift-Hohenberg equation [1].

Self-organization is a fundamental property of complex systems, describing the order spontaneously arising by the local interactions of the system components not mediated by top-down inputs. Though self-organizing systems typically possess a large number of components and exhibit complex dynamics, their evolution is deterministic and governed by a small number of order parameters. This property is used here to model the self-organization of the ocular dominance columns of the striate cortex in patterns of neighboring stripes, which respond preferentially to inputs from the left or the right eye.

2 Approach

The Swift-Hohenberg equation was used to model the self-organization of the ocular dominance columns. There are two order parameters in this equation, the first one determines the spatial wavelength λ of the stripes and the second one the branchiness ϵ of the pattern. The algorithm used to generate the results has been modified from an open source script.

3 Results

Figures (a), (b) and (c) show the temporal evolution of the solution to the Swift-Hohenberg equation for random initial conditions (a), constant ϵ and time increasing from (a) to (c). In (c), (d) and (e) three solutions with different ϵ are shown. The branchiness increases with ϵ from (c) to (e). The wavelength λ was set to

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the same value in all figures and the pattern in (d) is similar to the ocular dominance layers found in the visual cortex.

4 Conclusions

A simple model suffices to study basic properties of ocular dominance self-organization. Possibly, a combination with models for self-organization in neighboring cortical layers would allow to investigate higher organizational principles of the cortex [2], e.g. the coordination between ocular dominance, orientation, and cytochrome oxidase.

Availability of Supporting Data

More information about this project can be found at: https://github.com/SOBF. Further data and files supporting this project are hosted in the *GigaScience* repository REFXXX.

Competing interests

None

Author's contributions

JPP, RM, LCTH, and DD performed the project and wrote the report.

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Pfannmoller et al. Page 2 of 2

