Readings in Neuroinformatics

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Amari, Shun-ichi. 1977. Dynamics of pattern formation in lateral-inhibition type neural fields. *Biological cybernetics* 27(2). 77–87.

Abstract

Brain structures and their dynamics can be described with mathematical models. In particular, nerve cells in tissue of the cortex can be represented by statistical field equations. The way in which interacting patterns of excitation are formed and propagated between the nerve cells in a given tissue then determines the properties of these fields. So far, various neural field models have been published, without treating multi-stable dynamics in cortical neural tissue. We have now rigorously proved the stability of five types of dynamics. Two of them are monostable fields with simple dynamics, one with a local excitation pattern and the other with excitation of the entire field. Two are bistable, with one excitation patterns moving in an explosion-like manner and the other moving to the location of the input stimuli maximum. The fifth type maintains a spatially periodic excitation pattern. In addition to these dynamics occurring in single-layer homogeneous neural fields with lateral inhibitory connections, we demonstrate the simple mechanism of neural oscillation and active transients, which occur in a field consisting of two layers, one excitatory and one inhibitory. We achieve this by reducing the field dynamics to the dynamics of the boundaries of excited regions. We show that in such a field, traveling waves occur, too. Our field theory can serve as a theoretical basis for further study of competition and cooperation in brain theory.

227 words.