Supplementum to Vol. 23 · 1975

Experimental Brain Research

First European
Neurosciences Meeting
Munich 1975

Abstract Collection

Springer-Verlag Berlin Heidelberg New York
Exp. Brain Res. EXBRAP 23 (1975) August, 1975

A THEORY OF NONLINEAR INTERACTIONS IN MULTI-INPUTS (NERVOUS) SYSTEMS. Poggio, T.

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Nonlinear Interactions/Fly's/Visual System.

An approximative description of a class of many inputs, nonlinear, interactive networks is introduced through the Volterra series formalism. In this way a kind of canonical classification of nonlinear interactions provides a conceptualization of the relevant information processing performed by a network. The "computational" properties of "Volterra networks" can be further characterized through an interesting connection with a theory of Analog Perceptrons.

The Volterra formalism is applied to behavioural studies of the part of the nervous system of the fly which underlies visual orientation and pattern discrimination. Antisymmetric, second order interactions between pairs of inputs are responsible for direction sensitive movement detection. Excitatory, single channels (weighted according to their location in the eye) probably provide the position dependent information responsible for the fly's orientation towards small objects. Surrounding nonlinear, fourth order inhibitory interactions affect selectively the "attractiveness" of more structured patterns. The interplay between nonlinear excitation and inhibition in this nervous network underlies simple cases of figure-ground extraction and is probably critically important for spontaneous pattern discrimination.