

REAL-TIME MICROCOMPUTER SYSTEM FOR NEUROPHYSIOLOGICAL RESEARCH
MEASUREMENT OF INTER-NEURONAL AND STIMULUS-RESPONSE COUPLINGS
IN THE CAT'S VISUAL CORTEX

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We are investigating the spatio-temporal aspects of the processing and coding of visual information via simultaneous recordings from several neurons within a neural ensemble. For such experiments it is desirable to have an online method for the determination of the stimulus-response and the inter-neuronal couplings, in order to drive functionally connected neurons by a 'matched stimulus pattern'.

Two microprocessor systems were developed, each based on a Z80 CPU, supported by 32 kByte RAM and a graphic interface with a resolution of 512 x 256 points. Times of occurrences are recorded relativ to the stimulus using an interrupt technique.

The inter-neuronal- and stimulus-response relations for pairs of simultaneously recorded spike trains are examined via the so called Joint Peri-Stimulus-Time Scatterdiagram (JPSTS) (Gerstein, 1969). The Cross-Correlation Function (CCF) can be derived easily from this diagram. JPSTS, CCF, and post-stimulus-time histograms are calculated and displayed online.

With an extremely fast arithmetic processor, programmed for the Fast Fourier-Transform (256 sample points in 17 ms) the stimulus-response transfer characteristics are obtained in the frequency domain. An actual as well as an averaged aliasing- and leakage-free frequency spectrum of the spike trains are simultaneously displayed on a TV-monitor. With this system even an estimate of the nonlinear system properties can be obtained by using a set of discrete (incommensurable) frequencies as spatial and (or) temporal components of the visual stimulus (Victor & Shapley, 1980).

With the aid of these real-time informations the neurophysiologist is able to compose a 'matched stimulus pattern', which is capable of driving the particular ensemble of visual cortical neurons.

- 1) Gerstein, G.L. and Perkel, D.H. (Science, 164, p. 828-830 (1969))
- 2) Victor, J. and Shapley, R. (Biophys. J., 29, p. 459-483 (1980))

(This work was supported by Stiftung Volkswagenwerk)