A COMPUTERISED SYSTEM FOR ELECTROCOCHLEOGRAPHIC (ECOG) MEASUREMENT

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To study the influence of vitamin A on hearing we choose to examine ECoGs induced by an audible stimulus. The basis of this project is a suitable experimental equipment for inducing and recording inner ear electrical responses in guinea pigs.

The problem to be studied asks for a high number of animals and measurements within one animal; furthermore the ECoGs of each animal have to be examined over a long period of time. This calls for a simple and automated measurement and evaluation procedure. In contrast to most ECoG experiments we do not study the influence of special ototoxic agents (noise, drugs etc.) but examine the variation of ECoG signals as caused by different metabolic states of vitamin A. Consequently only slight variations in the electrophysiological signals are expected. This demands for an exact and highly reliable measurement apparatus. To fulfill these requirements we choose to design a highly computerised equipment.

The experimental setup designed by us yields the following advantages:
1. It offers all the features of a commercial system as a subset of its features.
2. The following tasks are software defined and therefore easily alterable:
   a. Audible stimulus generation
   b. Signal acquisition and conditioning (e.g. sampling rate, digital filtering)
   c. Averaging
   d. Pattern recognition
   e. Pattern evaluation
   f. Filing of signals and results
3. Audible stimulus generation and signal acquisition are both under supervision of the main computer. This allows for the establishment of a feedback loop in order to optimize an experimental run.
4. Less discrete devices than in commercial systems.
5. Easy handling; the operator is guarded by messages from the program.
6. Quality checking can be incorporated as a standard program task thus inhibiting experiments which would yield erroneous data.
7. A data base for results can be incorporated.

A HARDWARE

Picture 1 shows the main components of the electronic equipment. The main computer is a PRIME P 300 with 112 k bytes of memory, two disk drives, two tape drives and a digital I/O system, ten asynchronous by directional serial interfaces (with control lines) and an analogue-digital conversion system.

At the experimental site the second computer system is installed. This system is composed of two single-board computers based on the Z 80 processor. The system is compatible to INTELS MULTIBUS. It is equipped with several V.24 interfaces and an ADC and DAC-system. The microcomputer is connected to the prime computer via a V.24 communication link operating at 9600 baud.

The mentioned loudspeaker, the animal, the intracochlear electrodes and the pre-amplifier are contained in a special isolated chamber.
B SOFTWARE DESIGN

The software is grouped into three divisions:

1. Communication software for the connection of the microcomputer to the PRIME computer.
2. Special software - organized in three levels - to be run on the PRIME computer.
   2.1 First level software
      a. Data acquisition
      b. Stimulus generation
   2.2 Second level software
      This software performs the following tasks:
      - Non real time signal conditioning
      - Averaging
      - Pattern recognition
      - Pattern evaluation
      - Filing of results of a single experiment
      - Display of results on the graphical display
   These programs are organized as subroutines which are called by third level software.
   2.3 Third level software
      This software resembles the experimental design. The flow of an experiment is governed by the sequence of calls of second level software, of messages to the operator and responses of the operator.
      At this level the modularity of the program system allows for an easy redesign of the experimental procedure.