National Aeronautics and Space Administration

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QUARTERLY STATUS REPORT

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QUARTERLY STATUS REPORT ON NASA GRANT NGL 22-009-304

JUNE 1, 1969 - AUGUST 31, 1969

I. Physics of Signal Transmission & Transduction in the inner ear

A. Research progress. Work has continued on the projects described in the progress report of June 6, 1969

1. Velocity measurements.

We have developed surgical techniques for placing two radioactive sources (Co^{57}) in the middle ear and have made preliminary measurements of transfer functions from sound pressure at the drum membrane to stapes velocity and round window velocity. On the basis of theoretical arguments, it has generally been assumed that the volume displacements of the stapes and round window are equal. Our measurements show significant differences at frequencies above 1 kHz. We are making further measurements to determine whether these differences are real or artefactual.

In order to improve our measurements, we have planned changes in our experimental apparatus which will allow us to measure two velocity signals simultaneously, and also increase the high-frequency limit of our measurements from 10 kHz to 40 kHz. Since previous data on this high-frequency region are not very reliable, these changes are extremely important to our future measurements.

2. Pressure measurements

Two piezoelectric transducers coupled to small (.005") probe tubes that were developed for our application have been delivered. We have performed some initial free-field calibration measurements, in a large anechoic chamber, and we are now constructing a small calibration chamber for these transducers.

3. Techniques for analysis of signals and stimulus control.

The computer program for controlling the acoustic stimulus and plotting results has been modified considerably to make it more useful in experiments. Among the modifications is a new subroutine that allows the experimenter to sweep stimulus level at constant stimulus frequency. We are now using this system in measurements of electric responses from microelectrodes inserted into an auditory receptor organ.

B. Publications

1. W.T. Peake, H.S. Sohmer & T.F. Weiss, Microelectrode recordings of intracochlear potentials, RLE Quarterly Progress Report #94, pp. 293-305, July 15, 1969.

2. T.F. Weiss, W.T. Peake & H.S. Sohmer, "Intracochlear responses to tones", RLE Quarterly Progress report #94, pp. 305-316, July 15, 1969.

C. Personnel actively working on this project.

Professor W. T. Peake
Professor T. F. Weiss
D. W. Altmann
D. R. Wolfe
V. Nedzelnitsky

W. T. Peake

II. Communications Biophysics - The Temporal Structure of Electrophysiological Data.

A. Research Progress. Most of our effort has been focused on the electrical characterization and display of ectopic heartbeats appearing in the electrocardiogram. Recently the bulk of this effort has been spent in developing data acquisition instruments.

1. Magnetic tape recording system.

A data recording-reproduction system capable of multiplexing three low-frequency data channels on a single voice bandwidth magnetic tape channel has been designed and constructed. The basic algorithm involves time-multiplexing the three signals in the form of relative pulse positions. While not producing truly periodic sampling, the code developed by the device does have a perfectly periodic frame-rate and thus allows correction for variations caused by irregularities in tape speed. The preliminary version does not incorporate this feature; however, it may readily be added. The system is presently being evaluated by Dr. Gordon Myers.

2. Ectopic beat detection

An ectopic beat detector based on a simple pulse-duration criterion has been built. This device

estimates the duration of the widest component in the EKG complex, compares it with a stored reference based on an observably normal beat and declares abnormal morphology on the basis of exceeding a specified fraction of this reference. Preliminary evaluations suggest that this sytem works as well as an earlier system which compares the duration of the individual beat with a running average of the previous four normal beats.

3. Analog interface

The design of an analog input-output interface for our digital data processor has been completed. This interface can accomodate 16 analog input channels and includes three analog output channels; two of the output channels will be used as horizontal and vertical signals to a display and the remaining will be used for waveform simulation. The interface includes multiple buffering and a timing system which allows period sampling irrespective of the activity of the central processor. It is presently being implemented in terms of medium-scale integrated (MSI) circuitry.

B. Publications. A master's thesis entitled, "Regulation of Digitalis Administration by Testing for Repetitive Ventricular Response" by D. L. Sulman was presented in September, 1969, to the Department of Electrical Engineering, M.I.T.

S. K. Burns