December 1970

Brief 70-10447

NASA TECH BRIEF

Biomedical Sensing and Display Concept Improves Brain Wave Monitoring

This concept for increasing the effectiveness of biomedical sensing and display promises greater monitoring capability while lessening high skill requirements in operating personnel. Present techniques, based on commercially available instrumentation, monitor passive brain waves from a number of discrete probe contacts (usually 10 for each hemisphere of the brain) applied externally with a conductive attachment paste. The waves, after amplification, are printed out in strip chart form, requiring interpretation by skilled medical personnel. Because of the limited number of probes, the fact that only passive signals are recorded, and the method of data presentation, only massive tumors or lesions, extensive in masking effects and affecting large areas of the cortex, are detectable.

The new concept overcomes these deficiencies by employing the following techniques: 1) The number of probe points is increased from 10 to 25 or 50 per hemisphere in order to locate lesions or tumors more precisely. The preamplifier gain attainable with usable signal-to-noise ratios determines the optimum number of probe points. 2) Microelectronic preamplifiers are used so that each stage permanently mounts adjacent to its probe contact point. Power supply voltages can be maintained at relatively low levels with low current drain. A successful design could operate at levels of 10 to 20 volts with total power dissipation of 3 to 5 milliwatts per preamplifier. Thus, the ability to attain required signal-to-noise ratios is appreciably enhanced.

A major feature in this concept is the deployment of an increased number of probe locations in a fixed array within a semiflexible plastic housing for each hemisphere. The housing incorporates a shielding ground plane (Faraday shield) to prevent radio frequency interference. This permits greater gain factors in the individual amplifiers, improving sensitivity and signal-to-noise margins.

The display system organization samples each channel input from the monitoring array at a rate at least twice as great as that of the frequency-time wave-forms under consideration, in accordance with the Nyquist sampling theorem. However, since detailed comparison of waveform characteristics is a necessity, the sampling rate per channel may be greater than the characteristic waveform frequency-time relationship by a factor of ten or more.

The information sampled on a per-channel basis is converted into binary digit form and stored in a computer memory bank.

At some later time, after the introduction of a perturbing input, such as are used to produce "evoked" potentials, the sampling and storage operations are repeated. The computer system operates to compare the original signal with the new one, while the signals are still in binary form. Differences are displayed on a cathode ray tube (CRT), together with the signal waveforms themselves. Alternatively, the differences may be augmented by the use of "Z" modulation on the face of the CRT.

Notes:

1. This development is in conceptual stage only, and, as of date of publication of this Tech Brief, neither a model nor prototype has been constructed.

(continued overleaf)

2. Requests for further information may be directed to:

   Technology Utilization Officer
   Headquarters
   National Aeronautics
   and Space Administration
   Washington, D.C. 20546
   Reference: TSP70-10447

Patent status:

This is the invention of a NASA employee and a patent application has been filed. Inquiries concerning license rights may be made to the inventor, Mr. Robert L. Trent, through NASA Headquarters.

Source: R. L. Trent
Electronics Research Center
(ERC-10233)