Behavior Research Methods & Instrumentation
1977, Vol. 9 (2), 162-163

SESSION VIII SYMPOSIUM: HARDWARE AND SOFTWARE

PETER G. POLSON, *University of Colorado, Presider*

Symposium: Hardware and software

PETER G. POLSON
University of Colorado, Boulder, Colorado 80309

The five papers presented in this session covered a very wide range of topics from EMG biofeedback training to the timing of events under the control of multiprogrammed real-time systems.

The first paper by Pope and Gersten describes a computer-based system for response-contingent EMG biofeedback-assisted relaxation training. The paper describes the basic shaping procedure for the relaxation response, the hardware (a 24K Nova 2/10), and the operation of the shaping program. I feel that the primary audience for this paper will be individuals who are working in the field of biofeedback and are interested in developing computer based systems for their own research and clinical work.

The next two papers, plus others given at a previous meeting (e.g., Cohen & Massaro, 1976; Poltrock & Mathews, 1976), should provide the reader with a reasonably complete introduction to computer-based systems for the generation and presentation of auditory stimuli. The paper by Knight is a very nice tutorial presentation of the logic and basic hardware and software requirements for the manipulation of digitized speech. Knight focuses on the problems of using a small computer (4K of memory) to perform such experiments, but I feel that his discussion is applicable to any size system. The presentation by Gillman, Wilson, Morse, and Kent[1] describes a complete system for the synthesis of speech and nonspeech stimuli, the recording of digitized waveforms, and the preparation of stimulus sequences for experimental use. The system uses Klatt's (1977) digital speech synthesizer for the by-art generation of speech stimuli. The system is written in FORTRAN IV, and its authors claim that it is portable. However, the hardware requirements are nontrivial. The system requires a fast 32K machine with a large amount of disk shortage and analog-to-digital and digital-to-analog converters. I have some reservations about the claim of portability, but this system represents an important contribution even if this claim is not true. Study of the write-ups, user manuals, and code (available from the authors) would be an excellent starting point for the development of a more modest system.

In summary, I feel that these papers, plus Klatt's (1977) invited address and the papers by Cohen and Massaro (1976) and Poltrock and Mathews (1976), give a reader a complete overview of computer-based systems for the generation and presentation of auditory stimuli of all types. Careful review of the systems described in these papers would enable a researcher who was developing a new laboratory or upgrading an established laboratory to incorporate the best elements of these systems.

The paper by Scholz describes a timesharing system that permits program preparation and execution for up to eight users. The system has its own simplified command language and editor. It runs under an unmodified version of the RT-11 operating system as a foreground job. This paper should be of great interest to individuals currently running RT-11 systems.

The final presentation, by Kaplan, is a very important contribution to our understanding of the problems of controlling event duration with a multiprogrammed real-time computer system. Kaplan's example involves selecting one of the L lights, turning the light on for exactly 500 msec, timing a 500-msec intertrial interval, selecting the next stimulus during this interval, and so on. The computation required to select the next stimulus takes between 100 and 200 msec, and the system is concurrently controlling n such experiments.

Kaplan uses a series of seven FORTRAN programs in this analysis of the problems involved in accurately controlling the two time intervals. His results are very general; the problems he describes and solves only get worse with more complex sequences of events. What he has shown is that, without taking some rather elaborate precautions, computer-controlled event durations and computer-recorded latencies can have large random errors. Kaplan's solution is very similar to that worked out by Christian and Polson (1975) for the special case of recording latencies of responses to stimuli presented

on TV-like displays. I feel that Kaplan's paper is required reading for any investigator who is using a real-time system that controls the executions of two or more concurrent tasks, for example, several experiments, interrupt-driven asynchronous input/output system, background execution of non-real-time progams, etc.

In summary, the papers presented in this session can be roughly partitioned into two categories: those dealing with research applications and those that deal with various technical aspects of real-time computer systems. The Knight and the Gilman et al. papers address themselves to what I feel is one of the most important applications of computers in psychological research, that is, stimulus generation. In both vision and hearing, computer-generated stimuli are an important tool for the analysis of perceptual processes. The Kaplan paper is a fundamental contribution to our understanding of the limitation of multiprogrammed real-time computer systems. My own feeling about the ultimate solution to the problems outlined by Kaplan are that very precise control of time intervals and multiprogramming are antithetical activities and that computer networks with small machines running single experiments are the answer.

REFERENCES

CHRISTIAN, T. W., & POLSON, P. G. The precision of latency measures on real-time computer systems. *Behavior Research Methods & Instrumentation*, 1975, **7**, 173-178.

COHEN, M. M., & MASSARO, D. V. Real-time speech synthesis. *Behavior Research Methods & Instrumentation*, 1976, **8**, 189-196.

KLATT, D. H. The use of computer-generated synthetic speech in the study of speech production and perception. *Behavior Research Methods & Instrumentation*, 1977, **9**, 66. (Abstract)

POLTROCK, S. E., & MATHEWS, N. N. A system for computer control of auditory stimuli. *Behavior Research Methods & Instrumentation*, 1976, **8**, 197-199.

NOTE

1. The paper by Gillman, C. B., Wilson, D. L., Morse, P. A., and Kent, R. D., entitled "Speech synthesis: A unified system for presenting acoustic stimuli," was not submitted for publication.