

AN AUDIO-DIGITAL HYBRID MAGNETIC TAPE TRANSPORT

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The computer-controlled recording and playing of speech samples or other audio signals will play an increasingly important role in speech and hearing research and in such applications as teaching machines, etc. Quick access to selected items on the tape is required, and the selection must be made in real-time according to a logic prescribed by a computer program. One way of implementing these functions by a relatively simple device is to provide a magnetic tape recorder with two speeds, high and low, and two kinds of tracks, analog and digital. An audio sample can be searched via its digital label at a high speed, from many blocks pre-recorded in series, and when it is located, it can be reproduced at the slow tape speed.

For this purpose, a new two-speed hybrid tape transport has been constructed. The tape is 0.5-inch-wide and 1,200-feet long, i. e. , the standard size for a computer tape unit. The tape width is divided into 7 tracks, one is used for speech recording/reproduction (record/play), the next is reserved for shielding purposes and the rest are used for five digital recording/reproduction (read/write) in a density of 200 BPI. The normal read/write speed is 30 inches/sec in both forward and reverse directions. But read/write can be done also at 6 inches/sec concurrently with audio recording/reproduction (in the forward direction only). Erasing the audio track is performed by means of a separate erase head. Equipped with three capstans for forward-high, forward-slow and reverse-high speeds, this hybrid transport when it is used properly provides a versatile digital backup memory with a storage provision for analog materials such as speech.

The transport is controlled by our PDP-9 computer, which stands alone for on-line use and whose attention can be dedicated to the transport, thus making its control circuitry quite simple. Since the transfer rate of 6 kcps gives 167 microsec as an interval between samples in the "high speed", data of 5 bits at a time can be moved in and out of the accumulator

at this rate under a program control. The control information such as tape direction, speed, read/write, play/record is also transferred through the accumulator.

Read/write timing, parity check, IRG recording and marking (begin/end of a block/word/speech) are all done by software. Owing to the speed of the PDP-9, this software approach has offered such advantages as simplification of the interface logic and ease of changes in operation modes. At present, 3 out of 5 digital tracks are used to store data, 1 track is devoted for the parity bit and another is used as a mark track. An 18-bit computer word is thus written over 9 lines (6 data lines each 3 bits, a check sum, a word-begin mark and a word-end mark).

Unlike conventional magnetic tape units for computer use, the way the hybrid tape is used requires frequent start/stops and changes in the direction and speed of the tape movement. A number of subroutines have been written to facilitate these operations.

Recording a number of speech samples in proper order is a rather time-consuming job. Based on the experience gained from its preliminary use, various subroutines such as PUT, RECORD, FETCH, PLAY, REPLAY, BACK have been prepared to speed up recording of speech and moreover corrections of mistakes. For example, in RECORD, the tape starts moving in the recording mode at the moment a toggle switch (any one of the accumulator switches) is pushed up, and it stops when the switch is pushed down.

The hybrid tape transport is now being used as an audio-response unit of a one-terminal teaching machine for English test-training sessions¹⁾ as well as for some other purposes. Although there is still much to be desired in the present unit in that the start/stop time (of the order of 0.5 sec) is not short enough, the high speed is not high enough, the low speed is not low enough and direct transitions between states (speed and direction) are limited. In spite of its simplicity and limitations in the mechanical performance characteristics, the hybrid tape transport has proved to be very useful for these kinds of applications.

1) See the paper by Fujimura in this issue.